Dynamics in the Management of Honey Production in the Forest Environment of Southwest Ethiopia:

Interactions between Forests and Bee Management

Tefera Belay Endalamaw

June 2005

MSc. Thesis

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June 2005
AV 2005-34

Acknowledgement

First and foremost I would like to thank my families who expend a lot on my way to college. My Mother, Kebeb Shiferaw, whose sprit have been with me since childhood deserves my acknowledgement. My father has handled the guardianship both as a father and mother; thank you! I would like also to thank Wondo Genet College of forestry, my mentor institution, which shaped me to be a forester.

I also would like to acknowledge Wageningen University that deepens my understanding of forestry. My esteemed gratitude goes to my supervisor Dr. Freerk Wiersum, who has put his time and interest all the way to develop my thesis to this form.

I am grateful to the Netherlands development cooperation which generously funded my study. I am also indebted to NTFP-DR Project Southwest Ethiopia that helped me with logistics during data collection period. I would like to thank Ato Anteneh Addisu and his families who hosted me during my stay in Mizan Teferi. Dr. Mulugeta Limenh has brought “honey” to my attention as researchable area and hence I take this opportunity to acknowledge him. I would like also to extend my gratitude to Dr. Amsalu Bezabih, for his sincere encouragement and assistance.

My friends in Wondo Genet: Bezash, Birhanu, Gebreyesu, and Haimanot shall recieve my heartfelt gratitude for their hospitality to host me and their moral advice. My data would have been incomplete had Yosef bridged the gap even after I returned back to Wageningen; please receive my special thank! Asmamaw, Alaye, Genet, Mengistie, and Atsmachew have also made my stay in Addis warmer than I expected. I also would like to thank all my friends here in Wageningen; I will run out of paper to mention you all.

Last, I inspired to mention one whose deeds can not be expressed in words, Oh Lord thank you!

Abstract

Non timber forest product extraction is an ancient form of forest exploitation still with ample potential. Due to the heterogeneity of nature of NTFPs, ecology, uses, users, and users rights single management options for all NTFPs are not possible. Most studies on options for NTFPs management have focused on plant products and less attention has been given to animal-based products like honey. Honey is one of the leading NTFPs in south west Ethiopia. Although several studies have been made on the ecology and management of the bees and the forest of the region, little study has been made about the interactions in tree and bee management and their dynamics. The aim of this study is to investigate the nature of tree-honey bee management interactions in different land use zones. The study was based on the theory that evolutionary processes in the exploitation of vegetation and animal resources in general follow similar patterns. Forest exploitation has evolved from open access procurement of wild products to the commercialized cultivation of domesticated trees on private lands. Similarly, exploitation of honey evolved from feral honey hunting from tree cavities growing in freely accessible forest to the use traditional hive based technologies in forests under different types of access regimes and finally use of modern movable frame hive located on private lands. Human interventions in the management of both resources also gradually intensified with indigenous rules and regulations governing resource use changing to communal ownership and private ownership. The study was carried out in southwest Ethiopia in three districts with variable socioeconomic and land-use conditions; these are reflected in a variety of beekeeping management conditions and interactions between forest and bee resources. Both primary and secondary data were collected for the study. Primary data was collected through household interview, group discussions, expert interviews and observations. The collected data were analyzed through SPSS, spreadsheet and logical explanation.

Within the research area three types of beekeeping technologies exist at different levels of intensity: the ancient practice of feral honey hunting which is at the verge of extinction; traditional hives-based technology which is currently the dominant form of honey production in all land use zones; and the recently introduced modern (Kenyan top-bar type) hive-based technology. The traditional technology can be further differentiated on basis of type of hives. Three types of traditional hives were identified: hardwood hives, bamboo hives and soft wood hives. Hardwood hives and bamboo hives are durable and used for several harvest years, while softwood hives are less durable and are used mainly for single year's service. In the traditional technology there is no colony management except baiting of hives to attract new colonies and protection against vermin. Trees play an important role for bee management; they serve for making hives, for hanging hives and for providing forage. Trees used for beekeeping are actively managed and the intensity of management increases from forest towards home gardens. Traditional hives and bees are private property but they can be placed in trees and lands under varying tenure arrangements. Four types of tenure for hive-hanging trees identified; free access, temporary tree tenure, transferable tree tenure and private land tenures. With the exception of the so-called kobo-forests natural forests are mainly free access lands, while homegardens are mainly privately owned land. Private land ownership promotes tree planting, but does not necessarily involve use of improved hive technologies. However, several socio-economic factors such as increased population pressure and market access stimulate a gradual evolution in bee-keeping technology from free hunting to modern hive use. The study concludes that beekeeping requires management of bee colony, hives and trees, and that for all of these attributes of beekeeping gradual changes are taking place. The intensity of management practices and technological developments are not uniformly spread over the study area, nor are they evolving in a similar manner. Only few efforts at intensification of beekeeping practices are taking place. In the uplands an extensification of traditional beekeeping practices from forests to other land-use zones is occurring, while in the lower regions a deintensification in honey production is taking place due to the development of commercial land-use systems.

Keywords: ***dynamics in resource exploitation, tenure regime, beekeeping, southwest Ethiopia, hive technology and tree-bee interaction***

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1 Introduction

1.1 Background

1.1.1 Non Timber Forest Products

For most of the evolutionary history of human, timber has had little or no value. Instead forests have been valued for the myriad of non timber forest products (NTFPs) they produced for humans. It is ironic that the value of these NTFPs are recognized at the same time that the forest themselves are rapidly disappearing (Redford, 1996).

With increase in the importance of NTFPs for livelihood and conservation, the need for elaborate explanation of the options for management and the driving factors that influence its sustainable utilization become an evolving research agenda (Wiersum, 1999). But the ecological, economic and use heterogeneity of NTFPs make single management option less effective, efficient and equitable (Tedder et al., 2002).

NTFPs production and use are affected by complex multiple overlapping rights which arise also due to the heterogeneity of products, uses and users (Tedder et al., 2002). The diversity of rights is likely to have been shaped by the historical evolution of their cultural and institutional environments (Perez and et al, 1996). However, in many instances management evolution is a process without a clear dichotomy between gathering and agriculture; rather, a continuum of resource use and management has been proved to exist (Wiersum, 1997).

Management practice of NTFPs, among other things, involves understanding of the relationship of people and forest in terms of market force and opportunities, the availability and allocation of land and labour, the shift in balance from forest based activity to agricultural employment and income (Perez and etal, 1996). NTFP management is also affected by disappearance of cultural and religious values that once played a significant role in the management of NTFPs (SCBD, 2001). Tenure arrangement for forest land and trees has also affect the type of management taking place (Paudel and Wiersum, 2002). These sets of factors could also shape the dynamics in the management and use of NTFPs over time and/or across landscape.

1.1.2 Beekeeping as NTFP Production

NTFPs can be defined as all the biological materials (other than industrial round wood and derived sawn timber, woodchips, wood-based panels and pulp) that may be extracted from natural ecosystems, managed plantations, etc.., and utilized within the household, be marketed or have social, cultural or religious significance (Ros-Tonen, 1999; 2001). According to this definition, NTFPs can consist of products both from fauna and flora (Ros-Tonen, 1999).

Most NTFP studies focus on vegetation products and much less attention has been given to the various forest animal products including honey. However, forest animal products should be included in NTFP studies for several reasons, the high values people place on them, the considerable size of the trade, the significant changes in the consumption

patterns and in the resource base, and due to their significant role in perpetuation of the forest community at large (Redford, 1996).

One of the important faunal NTFPs is honey produced by honey bees (*Apis mellifera*). As livelihood source, honey contributes income, household consumption, medicinal and social values (Hill and Webster, 1995). Honey can be collected from feral source, or from managed bee colonies foraging in forests or among cultivated plants. Beekeeping practices, especially with intermediate technology, have a profound importance in securing two competing objectives: local development and conservation. Beekeeping as a livelihood practice connects the farmers' economies with the preservation of the trees used for beekeeping, and therefore this system can contribute to the preservation of wide forest areas (Svensson 1992; Hartmann, 2004).

Similar to other NTFPs management, but with its own peculiarities, beekeeping requires an affinity with the land and the implementation of specific management practices; these require a detailed knowledge of the complicated behaviour of the honey bee itself, the plants which provide the resource, nature conservation and agricultural production (Gibbs and Muirhead 1998).

The peculiarities with beekeeping are that while hives require a minimal amount of land, bees foraging from a hive range over several square kilometers. But the bees food resources-nectar, pollen and honey dew has little or no economic use except honey bees themselves collect it. While they consume this plant parts they bring a very important economic benefits to agriculture, in the form of pollination, higher than the benefits beekeeper got from them and their products (Crane, 1990). Beekeeping, therefore, enhances the perceived value of trees, encourage beekeepers to protect trees and improve regeneration of trees (Svensson, 1991).

1.2 Problem defined

As NTFPs, management of honey production practices has evolved along evolutionary path in use and management of resources from free hunting of honey from wild to the very modern use of movable frame hives (Crane, 1992). Honey collection from wild nests is an old age activity, and honey harvesting from traditional hives has been practiced for at least the last 4500 years (Crane, 1990). Evolution in management of honey production may be caused by changes in management of several sets of interacting elements, which include managing the hives and bee (colony), the land and honey trees and the various socioeconomic issues associated with them. It is, therefore, a complex art and science that requires comprehensive skills and knowledge of the mentioned aspects and their interaction effects (Crane, 1990). However, most beekeeping studies have focused on the management of bee colonies and hives, and much less attention has been given to bee-tree management interactions. Moreover, there is little insight on how the tree use and management change with other beekeeping practices.

In the process of honey production, forests and trees provide nectar, pollen and other useful raw materials for bees. Bees also serve the forests through pollination and by increasing vested interest of beekeepers in forest conservation (Svensson, 1991; Kerns et

al, 1998; Hill and Webster, 1995). Any damage occurring to either of these resources not only endangers plant and bees, but also several land use practices, like beekeeping, that depend on their mutual interaction (Crane, 1990; Hartman, 2004). In the study area, several trees and other plant forms provide beekeepers with the various basic raw materials in required for honey production. These trees and the land they are growing on are therefore highly valued, distinctively bounded and divided among local residents (Amssalu, 2004 and Hartmann, 2004). But the auxiliary benefits of trees in beekeeping have not been specifically studied in the study area.

Large variation in honey production practices exists. These variations may be attributed to socio-cultural differences among ethnic groups or differences in access rules for bee resources. The nature of the vegetation also varied among study districts, and the fact that beekeepers compelled to use locally available resource implies the possibility of differences in management techniques. However, it is not known whether these differences in tenure and other institutional factors affect the type of hives used between districts and along land use zones within districts. Moreover, it is not known whether type of hive technology affect location preference by beekeeper.

Therefore, this study will address the nature of the various management practices, the dynamics in honey production technologies and its relation to management, and the use of trees as well as tenure arrangements for beekeeping in the different land use zones.

1.3 Structure of the thesis

Chapter one of this thesis provides background information on NTFPs management attributes in general and honey production in particular. The problem is defined against the background. Chapter two sets the theoretical foundation upon which the thesis will be based on. These theories together with the problem enable to define the objectives and operational research question and methods. They also help to test whether the empirical finding are in agreement or against existing understanding of real world phenomena. Chapter three defines the objective and operational research questions based on the problems and theories. Chapter four deals with the methods used for data collection and analysis. Chapter five presents the comprehensive empirical findings from field research. Empirical relevance, theoretical fit and methodological issues is discussed in chapter seven. Major findings is discussed in chapter eight.

2 Theoretical Framework

This research used theories and conceptual models mainly from the fields of forest resource management, animal domestication and dynamics of honey production. Therefore, theories and concepts of forest domestication, animal domestication and evolutionary development and factors affecting beekeeping will be reviewed in the following four subtopics.

2.1 Introduction: Dynamics in natural resource management

The traditional broad division of evolutionary resource use pattern in to Hunter-gatherers, shifting cultivators and permanent field croppers is the commonly used categorization to designate intensity of land and resource use, differentiate level of control and modification of forested environment as well as food getting technologies. However, this simplistic approach is criticized for its weakness in accounting for the variety of technologies used within each group for different ways of resource exploitation. While this general traditional method of classification is useful for some purposes, it does not include the diversity within each system that suggests differences in traditional knowledge of methods of farming, resource conservation and other aspects of each system. There is also a need to recognize the possibilities of systems overlap in many circumstances (Padoch et al., 1983).

The forest dwellers hunter gatherers are flexible and adapted to change with changing environments. They may change not only the products they use, but also the subsistence techniques they employ, the amount of labor they expend, as well as social factors. It is also believed that hunter-gatherers have driven a few species to extinction and have influenced the number and range of other many and by doing so they more or less successfully varied their activities and means of living (Padoch et al., 1983). The direction of change in resource use not only move from less intense to more intense type but may also involve disintensification, e.g. due to depopulation by different factors.

2.2 Evolutionary stages in management of resources

2.2.1 Evolutionary stages of forest management

Traditionally forest management was defined from the perspective of silvicultural and normative timber production practices (Ford-Robertson and Winters, 1983; Anderson, 1990, cited in Wiersum, 1997). Latter, Duerr et al., (1979) cited in Wiersum, 1997) defined it as the process of making and implementing decisions about the use and maintenance of forest resources and the organization of related activities. Thus, it involves the total set of technical and social arrangements involved in the protection and maintenance of forest resources for specific purposes, and the harvesting and distribution of forest products (Wiersum, 1997). Similarly, Reitbergen(2001) also emphasises the inclusion of (unwritten) rule based local forest management practices in the definition. Danks and Fortmann (2004) have also defined the different types of land and tree tenure operatimg in forest management.

Against these definitions and dynamic ecological, technological, economic and

sociopolitical conditions involved, forest management practices include: controlled utilization of wild tree products, protection and maintenance of trees providing valuable products, purposeful regeneration of wild trees and production of domesticated trees (Wiersum, 1997).

The model is developed by analytical explanation of historical man-forest interactions and management by humans to maximize the benefit to be derived from it. These interactions involve a gradual intensification of management practices along nature culture continuum. Differentiation between land and tree tenure, the variety of local rules and the degree of technical measures used to enhance productivity of forest are the attributing factors for the conceptual model (Wiersum, 1997).

According to this model, forest resource exploitation and management activities can be arranged along a gradient of increasing input of human energy per unit of exploited forest (Wiersum, 1997). These include, firstly, the thresholds between the uncontrolled and controlled procurement of wild tree products in natural forests. At this thresh hold, the control of utilization involves the definition and control of use rights, which requires social transaction costs such as time spent on mobilization, and decision making and control. Control measures with a biological objective are developed beyond the second threshold, which lies between controlled procurement of wild products and purposeful regeneration of valuable tree species. And the third thresh hold is between the cultivation of wild tree and the production of domesticated trees.

Concomitantly with this increasing input of human energy per unit of exploited forest land, a gradual transformation of the natural forest into an agroforest ecosystem occurs (Wiersum, 1997). The human intervention in the reproductive biology of tree species is also intensified. This closer interaction also associated with various socioeconomic trends. Firstly, the socioeconomic conditions relating to forest utilization change. Secondly, the complexity of the indigenous rules and regulation change, with common property rights gradually transformed into private land and tree tenure rights. It should beemphasized , however, that different arrangements could exist along the landscape. For instance, Den Hertog and Wiersum (2000) has identified four distinct management practices under different types of tenure condition, access regimes and management intensity for timur(NTFP) collection in Nepal, with increasing input of resource and increases tenure security. Initial management practices involve social controls on collection of common pool resources while the more intensive management practices are found on private lands.

In conclusion, evolutionary stage in forest management includes open access gathering of forest products, controlled utilization of wild trees, selective cultivation of wild native trees and domesticated trees. Wiersum (1997) noted that different evolutionary stages may coexist in a landscape based on the institutional arrangements.

2.2.2 Evolutionary stages in animal domestication

Domestication in animal means the propagation of animals that humans keep in captivity, or, more exactly, man’s breeding of animals under artificial condition (Bokony, 1967).

According to Berry (1967) the first phase of domestication of useful animals started when certain useful animals conserved and tamed near dwelling places (Berry, 1967).

Animal domestication as a process involves three main factors: the man who carries it out, the wild animal that has been domesticated and the domesticated animals that is the result (Bokony, 1967). According to (Bokony,1967), domestication of animals can be defined as the capturing and taming of animals of a species with particular behaviour characteristics, their removal from their natural living area and breeding community and their maintenance under controlled breeding conditions for profit. Bokony(1967) identified two main phases of animal management stages that begins with domestication: animal keeping and animal breeding.

The first stage is the primitive form of animal breeding without purposeful selection or the control of feeding. It is characterized by the presence of one breed of primitive type, with a small size compared to the wild form.

The second phase, animal breeding, involves purposeful selective breeding and the control of both quality and quantity of feeding. In this phase humans threats his domestic animals as individuals, not only as a herd. Furthermore, this advanced phase can be characterized by the presence of different breeds in one population and by an increase in size and productivity of animals. The migration of people and culture has also influenced the processes of domestication (Bokony, 1967).

But for domestication to advance, it must be accompanied by an appropriate kind of change in the conception of property. The extent to which domestication thrives, and hunting declines, will be critically determined by the kind of institutional change which does come about. The type of change, in turn, will depend on various social, economic, and political factors such as the incremental productivity domestication offers, the degree of unity among the domesticators, herders, and cross-groups, the relative military and social power of the two groups, and so on (Bose, 2000). Bose (2000) draws an imaginary example to show how property right could affect domestication.

"initially their may be laws that govern hunting, for example the first hunter to sight an animal may have the right to hunt it, or the hunter whose arrow was the one which killed the animal may be the one to claim it. Suppose now that some agents in our primitive economy discover the art of domesticating cattle, which has the potential of significantly improving productivity. But even domesticated cattle have to graze, and the community as yet has no rules which forbid the hunting of domesticated cattle which is grazing in the wild. There is as yet no concept of cattle 'belonging' to an individual, except in the context of the hunt and the kill. Those who invest their time and energy in domestication will certainly want to identify 'their' cattle in some way".

In this situation, Bose (2000) explained possible scenarios as follows:
"First, the existing property rights may persist, allowing hunters the right to hunt any cattle in the wild. This being a severe disincentive to domestication, this line of

production will fail to develop, and the society will then continue as a (less productive) hunting economy. Secondly, the domesticators may gather enough material strength to police their property, suitably punishing any hunters who kill cattle identified as belonging to a domesticator, thereby establishing a rudimentary state-mechanism to institute and protect this newly defined right of property. Thirdly, the domesticators may be able to bribe the hunters, offering them incentives to stay away from marked cattle. This is potentially possible since by assumption domestication is more productive than hunting. Fourthly, new property conventions may develop in things other than cattle, such as land. Herders may find it possible to fence or otherwise mark off meadowland which is reserved for domestic cattle, and be able to prevent hunters from hunting on that land."
The real world outcome in many cases shows that evolution achieved in the institution and domestication has got incentive as a result of higher productions.

In conclusion, evolutionary processes in animal use include: free hunting from wild population, animal keeping in domestic form and the advanced form of manipulation termed animal breeding. And this process of domestication has been highly affected by institutions, particularly property right and the extent to which the community or society have abided by them.

2.3. Dynamics in beekeeping

2.3.1 Beekeeping as example of interaction between forest and animal management

Evolution processes in forest and animal management do not necessarily take place independently, but may interact. For instance, in beekeeping, bees and trees interact in several ways for their mutual benefits. Humans manipulate this interaction process based on his technological stage to improve their share of the benefits. Svensson (1991) and Hills et al., (1995) have described various forms of bee-tree-human interactions. According to these authors, bees are important to trees because bee based exploitation does not harm the forest resource, but rather beekeepers motivated to conserve the forest, bees stimulate regeneration through cross pollination. Other authors like Tan et al (2002) and Hartmann (2004) also show that beekeepers are dependent of bees and trees and do not abuse these resources.

Svensson (1991) described that bees serve local people by pollinating their crops and wild income resources. For example, One third of human diet in tropical countries derived from insect pollinated plants (Crane and Walker, 1983). Honey itself is a valuable food staff, suitable income generating product and provide an arena for social and cultural reproduction.

For their part, trees provide an essential environment for bees, protect hives and provide materials for hive construction. Trees are also major sources of pollen, nectar and plant tissue (Svensson, 1991; Momose et al, 1998; Kato and Kawakita, 2004).

Management of land by humans not only stimulates bee-tree interaction; there are several possibilities where it could also endanger the normal relationship. Forest clearance and

patch formation for agricultural lands and habitat fragmentation due to built in environments affect pollination. if the isolation of fragmented populations becomes greater than the foraging range of pollinators, or if the pollinator population becomes too small, the outcome may be reduced pollination services and decreased bee productivity (Kearns et al, 1998). Conversely, pollination could also be affected by the density of the plant population which could covary with the population of the pollinators. Interaction beetween population size, density and spatial isolation are likely to have even more complex effects on pollination (Kearns et al, 1998). Furthermore, abundance of social bees decrease significantly with an increase in land use intensity (Kein et al, 2002)

Habitat fragmentation has complex effects on plant reproduction; it affects both plant and pollinator population and may reduce plants reproductive success by reducing or extinction of pollinator populations (Donaldson et al., 2002, Lennartsson, 2002).

Thus, there are always mutual interactions between local bees and forest but the interaction could be affected positively or negatively by anthropogenic interference and management practices.

2.3.2. Evolutionary stages in development of Beekeeping

Like any other resource use, honey collection from natural resource has gone through evolutionary stages of development over time. Crane (1992), has categorized the historical development of honey production and (wo)man's relationship with honey bees in the following stages.

Without bee management

- opportunistic honey hunting from wild (feral, natural) nests
- honey collection from wild nests owned by individuals or communities

Start of bee management

- Tending of wild nests in situ

Start of beekeeping

- Use of stimulated natural nest sites in situ, such as tree cavities for Apis mellifera and rafters for A.dorsata

Start of Apiary beekeeping

- Moving natural nest sites(with their nests) to apiary; these become fixed comp hives

Advances in beekeeping using fixed-comp hives:

- Using simple purpose-made beehives in an apiary
- Using such hives in more advanced way
- Using horizontal hives with removable top or bottom
- Using such hives with an extension for honey storage

Advances to movable-comb hives:

- Single-champer top-bar hives
- Top bar hives with an upper honey chamber

These developmental stages are often discussed as distinct periods.However, Arce (2002) has sparked criticism of this linear development in beekeeping evolution. He criticizes

the notion that “beekeeping will develop world wide through lineal stages from primitive honey hunting to modern rational frame hive beekeeping. Arguing that, it ignores the diversity that exists in beekeeping practice, with beekeepers combining ideas, techniques, materials and technology in ways that defy categorization as simply traditional or modern”. He also furthers his argument that this notion implies that local beekeeping practice as being traditional and in need of modernization according to expert design.

The beekeeping developmet model is different from the evolutionary stages in forest management in some aspects. Firstly, the evolutionary stage of forest domestication is descriptive rather than an explanatory model indicating unidirectional phases where each step indicates phases of societal development from the ancient to the advanced (Wiersum, 1997). The beekeeping model, however, does refer to increasing stages of societal development with increasing hive technology in beekeeping (Crane, 1992). Moreover, forest development model have emphasized the changes in socioeconomic and farming landscape as changing with and affecting the evolution of forest management. But in beekeeping model, emphasis is given to technological advances with respect to hives and little emphasis is given to changes in farming practices and the management of honey trees.

2.4 Attributes of beekeeping practice

Beekeeping practice can be affected by the type of hives used, the management of bee colony, the management and availability of foraging and hive-making tree products. Beekeeping is also affected by tenure arrangement: both for apiary sites and the foraging resources (forest) as well as ownership rights for bees and hive under different conditions.

2.4.1 Production technologies

Beekeeping is a complex practice which requires that different varieties of management technologies to manipulate bee population, habitat and forage. According to (Delaplane, 1997), honey production is a function of local weather, flora, bee densities, types of hives (imported or locally made), bee genetics (types of species used), colony health and colony manipulations by the beekeeper. Hive types, bee colony management and status of forage production are presented below.

a) Types of hives

Hives have been used as one of the indicators of management type and intensity in beekeeping. The most traditional hives are made almost exclusively from forest products and with little labour cost. Gradually the type of hives have changed and the most modern hives use complex materials, skills and higher labour costs. The variants are described below.

Traditional Fixed-comp hives: It is simple purpose –built container for the bees and their combs. They had no fittings such as frames, and the bees secured the top of their combs to the interior of the hive. This type of hives today, called fixed frame hive to differentiate it from the modern movable frame hives and the intermediate movable-comb hives (top-

bar hives) (Crane, 1990).

Movable-comb hives/ top-bar hives: This type of hives has movable combs, i.e. individual can be removed from the hive and replaced, but instead of four-sided frames, the hives only has top bars. The bees build down from each top bar, and the beekeeper can remove any comb from the hive by lifting up its top bar. The single long box can alternatively be used with frames (Crane, 1990).

Movable frame hives: Frame hives are fitted with movable frames in which the bees are persuaded to build their combs. They are usually composed of several boxes, one on top of the other. The lower box, or in some cases, two boxes are used for holding the brood nest, and the upper for collecting the crop. These hives are movable and the beekeeper can move them to a place where the bees can collect nectar. They are expensive but they have far better in its productivity compared to traditional ones (Smith, 1960).

In general, the time spent on the bee management increases with sophistication of beehives. For example, commercial beekeepers move hives up to 6 times a year to maximize financial returns and professional beekeepers monitor the flowering of honey flora and maintain a range of apiary sites for use over a period of years. The sites may be on public or private land, and may be occupied for as little as 6 weeks (Gibbs and Muirhea, 1998).

b) Colony management

Management of bee colony is one of the key bee management components have evolvd over the centuries. In the ancient time beekeepers manipulate the colony during honey harvest by killing the bees. In West Africa, for example, the bees were killed with fire to take out honey from their nest. The Massai of East Africa use puffball fungi smoke to paralyse the bees and the Pygmies of the Cameron use special herb for similar purpose (Hertz, 2002).

But gradually less destructive honey collection techueniques were developed. Some log hive users harvest half of the honey at one time and then nest year harvest a similar amount on the other side, giving the bees a chance to survive and produce more honey (Hertz, 2002). Even some traditional beekeepers move their colony from one place to another to make use of melliferous fodders at another agro ecological location, as in the case of Ethiopia where ecoecology changes in short distance interval (Hartmann, 2004). Beekeepers also know about time of swarming and where prefer to settle, what plants and smoke attracts bee colonies to enter hive and local materials for hive-making and forage (Hertz, 2002).

Beekeepers have long believed that large, populous colonies are superior honey producers and produced more honey per bee in times of nectar flow. Smaller colonies produce more brood per bee than do larger colonies. If colonies are still small and in the optimal brood production phase when major nectar flows begin maximum honey production will not be realized.If populations peak prematurely, then the beekeeper is faced with overcrowded colonies inclined to swarm which, of course, defeats the goal of

large populations (Delaplane, 1997).

Previously where the importance of large bee populations was not recognized, swarming was often considered a positive thing. It was also believed that hive number is more determinant than do colony strength in honey production For increasing hive number, swarming is an easy and inexpensive way; but as the benefits of large bee populations became apparent, swarming was recognized as a serious setback to honey production (Delaplane, 1997).

Other manipulation to stimulate honey production is by using vigorous queens. Queens produce brood which latter becomes the foragers that collect honey. But the effects of queens on honey production go beyond brood production. The presence of a queen, even if she is caged and in a brood less colony, increases colony weight gain during nectar flow and minimizes weight loss during nectar dearth. This is partly explained by a stimulating effect of queen pheromones on worker foraging (Delaplane, 1997). Management of the proportion of male and female group members of a colony is another management aspect affecting colony strength and overall honey production (Reuter and Keller, 2001)

All those practices made to increase bee population, queen rearing, reduce brood formation, increase honey production and controlling of absconding and migration are most intensive beekeeping practices mainly carried out at the modern stage of beekeeping.

c) Forage production

In addition to management of bee (colony) and hive, beekeeping requires knowledge of honey plants and their management. Studies more emphasized description of useful honey plants and technical management aspects like amount of pollen and nectar production, pollinator-pollination interactions, cultivation of bees for these purposes. But for Africa, even these studies are at their infant stage (Rodger et al, 2004). In beekeeping understanding of types of trees of value for bees, which of them are melliferous nectar/pollen producers, when they flower, which produce higher quality of honey, how to manage and improve them is equally important.

It is estimated that about 40,000 plants are used as food source for honey bees (Crane, 1990). However, the amount of nectar, pollen or porpolis obtained significantly varies from plant to plant, season and time of the day (Crane et al, 1984; Crane, 1990). In Ethiopia, study shows that there are about 500 plant forms rich in nectar and pollen (Fichl and Admassu, 1994). According to Amssalu (unpublished) herbaceous and shrubby honey plants flower after the big rainy season (September- November) while honey trees flower during the small rainy seasons of March to May. Amssalu (2002) shows that even if the number of trees flowering are larger in September-November, the amount of pollen collected does not vary similarly. This indicates that the amounts of pollen and nectar are not only determined by the number of flowering plants but also by amount of flowers per tree and amount of pollen a particular honey plant produces (Amssalu, 2002). He also demonstrated that not only forest trees, but also weeds and crops from non forest lands contribute considerably to honey production.

While the use of trees for beekeeping is an anicient knowledge, management of trees for beekeeping does not seem evolve very much based on the literatures consulted. Crane (1990) suggests that some plants are capable of producing high honey yield and it is profitable to plant these types of trees for honey production purpose. About 80 species with such quality are identified and listed (Crane, et al, 1984). But these are not exhaustive studies and the management practices required to improve the potential of honey plants have not yet been properly addressed.

2.4.2 Property rights

Resource management and innovation towards productive options can be facilitated or constrained by existing rights to use resources. According to Schlager and Ostrom (1993), having at least the bundle of rights associated with being "claimants" is a crucial step for effective management of resources. By claimant, Agrawal and Ostrom (1999) mean those who possess the operational rights of access and withdrawal plus a collective-choice right of managing a resource that includes decisions concerning the construction and maintenance of facilities and the authority to devise limits on harvesting rights.

a) Access right to bees and hives
Access to bees has been traditionally considered to belong to the owner of the hive, and communities considere acts against this tradition as theft. However, in reality, more complex access rights exist attributed to sociopolitical position of the beekeeper and the nature of beekeeping. Some examples regarding swarms and hive ownership presented below.

According to Crane (1990), in Roman law bees were considered wild animals, but bees in a hive were the property of the owner of the hives and their unauthorized removal was considered as theft. Further more, in many countries, a beekeeper is still allowed to go on to a neighbours land to collect a swarm that flew from one of his hives-the swarm still belongs to him-although he must make good for any damage done to the neighbours' property. In Sweden, a law still exists which states that "should bees fly to another's forest and the owner follows then to a tree or hole (which they occupy), no one can deny him/ his rights" (Crane, 1990).

It is easier to establish ownership for hives and bees inside them than for swarms, and laws are quit straight forward. However, in reality, theft of hives and bees is a long standing issue and practical complexities still arise in countries practicing beekeeping. Ownership of hives in Tanzania, for example, conveyed by making notches on a tree or in modern hives by branding; however, hives are still stolen and beekeepers know who stole them, legal action is usually difficult because it is impractical to establish the original ownership of bees, combs or frames (Crane 1990).

There are also laws governing sitting of hives; for examples, in Greece, new beekeepers were not allowed to place his bee colony within a hundred-metre radius of sites already established by other beekeepers. Such laws still exists in Spain and some parts of USA with varying dimensions. South African law prohibits the keeping of bees in towns except

for temporary placement of swarm caught in the town (Crane, 1990).

Another legal right beekeepers might claim is that his bees should forage on neighbours' land, the honey produced by the bees should still be their own property (Crane, 1990). But this right might be questioned in some cases, for example, in Mexico where traditional farmers exercising their ancestral rights have forced large scale honey producers not to produce on their communal forest lands (Echazarreta et al, 1997).

b) Access right to production environment

There are varieties of access arrangements and rights under various land use intensities and across socioeconomic conditions. In the following paragraphs, several cases of access arrangements in the use of forest land for beekeeping from around the world will be reviewed.

In Baringo district of Kenya, Gichora (2003) investigates beekeeping as practiced on two types of lands. The first is on individual parcels and the second on communal land. In the first case access is restricted while there is unlimited access on communual land. In the latter case, although people enjoy the unrestricted access, overexploitation leads to limited availability of hive hanging trees and forage. Moreover, this free access arrangement aggravated competition of bees and livestock for shade, water and forage plants which they use in common.

In Vietnam, according to Tan et al (2002), rafter beekeeping was known traditionally and practiced by groups of people in relatively organized way. This study shows that When the state forestry farm was founded in 1982, beekeepers were given the responsibility of replanting trees and protecting them from damage, because they knew the forest very well. Each group of beekeepers is allocated a plot of forest on which they practice rafter beekeeping and which he patrol and protect. A group leader is elected to co-ordinate the group's activities. Groups meet once a month to discuss forest protection issues, exchange knowledge and determine the best time to harvest the honey. In any one month, honey harvesting is allowed only for about 4–6 days. The timing of the harvest is strictly regulated in the dry season, to prevent fires. Beekeepers claim that they are serious about protecting the forests from fire and tree cutting, because, if no trees no bees arrive, and their incomes are threatened.

But according to the same study, changes in forest management policy have lead to further conflicts in the community. This is because the state forestry farm started allocating forest land to individuals by the contract in 1986. Each household was allocated a forest plot of 5 ha, of which 1.85 ha to use for farming and 3.15 ha to be reserved as forest. Because they have signed contracts with the state forestry farm, the owners feel that they had the right to evict beekeepers from their land. Many owners prevent rafter beekeepers from using the forest. The beekeepers, on the other hand, argue rafter beekeeping is their traditional occupation and the forest is their livelihood source; 66% said that the forests still exist because of them; all say that they are professional beekeepers, and never cause forest fires; 40% accused the forest holders, honey hunters and honey stealers of causing fires, because they did not know the proper technique of

honey collection. This example shows that the beekeepers may be negatively affected by change in land allocation rights and skewed policies which distract their traditional management system and replace it with artificial and more volatile land allocation acts. It also leads to the reduction of their income and/or a shift in livelihood practice.

A somewhat different resource use system has been observed among the predominantly hunter Manjo and the settlers Shekacho of Ethiopia. Manjo and Shekacho have separate areas where they hang up their hives. Each beekeeper has individual use rights to the forest trees used for beekeeping, which are inherited from father to son, or from the husband to his widow (Hartmann, 2004). The trees used for beekeeping in the forests as well as in the farms are key species and thus guarantees their preservation and their fast regrowth in the forests (Hartmann, 2004). There are also some conflicts between Manjo and Shekacho, as the Shekacho accuse the Manjo of destroying the forest by felling trees, and the Manjo, complain that Shekacho bewitch their beehives. Besides these internal use conflicts, an external conflict is overlapps these and aggravates the situation of both groups (Hartmann, 2004). Amssalu (2004) also reported that beekeeping areas are divided among dwellers in Masha district.

Another case from Kalimantan, Indonesia, revealed that beekeeping is regulated by a well-developed system of customary law (King, 1993). According to their rules, no person except the owner of the honey tree may slash the forest within a radius of about 100m, unless given permission by the owner (De Jong, 2000). Natural forest for honey production can be occupied by any body who is member of the community that holds rights over a village territory. To maintain their right exclusive they slash the underbrush of the forest vegetation to indicate their claim and they have also exclusive right for a swidden next to their agricultural land in the direction of advancing (De Jong, 2000; Dove, 1985).

In Mexico, traditional farmer beekeepers were able to capture production by restricting the large producers' access to floral resources and by substituting labour for capital. They asserted their legal right of control over the extensive *ejido* (communal) forest lands and forced large producers to remove their apiaries. In addition, peasant farmers' rapid propagation of small apiaries undermined the high yields on which the capitalist enterprises were dependent for profitability. Finally, in many parts of the Yucatan (Mexico), peasants stopped working as wage labourers for the large producers and used their new knowledge of apiculture to produce honey independently. With the labour recruitment difficulties and the decline in yields, commercial apiculture lost its value as a remunerative capital investment, but simultaneously emerged as a high yielding form of production in the peasant sector, where the traditional producer invests his own labour (Echazarreta et al, 1997).

In Nepal, honey collection from feral colony is based on group free access. The honey collected is distributed among group members according to the role and risks taken during harvesting. The leader of the honey hunting team receives the most, followed by the village leader who calculates each member's share, and others follow in decreasing share (Verma, 1991).

These cases show that there are several types of access arrangement across the globe. And each arrangement is a function of the type of technology available and the resource condition of the respective regions.

2.5 Conclusion of theories and conceptual Model

The evolutionary development in the use and management of trees and animals, particularly bees has been reviewed in the previous sections. Notwithstanding the fact that practices for tree management and bee management are not similar; gradual evolution from collection of wild resources to management of domesticated resources has taken place for both tree and bee management. Table 2.1 presents a comparison of phases in the exploitation of trees and honey products. Figure 2.1 gives further analytical model for the management dynamics in honey production as involving both evolutionary trends in forest and bee management. This comparative model with the general beekeeping management model presented in table 3.2 serves as a conceptual basis for the study. On the basis of these models the study will investigate what type of bee and tree management are present and how they are interacted and related.

Table 2. 1 Comparison of phases in the exploitation of tree crops and bee/honey products

	Exploitation of tree Crops (Wiersum, 1997)	**Exploitation of honeybee (Crane, 1992)**
Phase I *Gathering*	Uncontrolled open- access gathering of forest products	Opportunistic honey hunting from wild
	Controlled gathering of wild tree products	Collection of honey from wild but owned by other
Phases 2 *Management of wild resource*	Systematic collection of wild tree products with protective tending of valued tree species	Tending of wild nests
	Selective cultivation of valued trees by artificial in-situ regeneration of native trees	Simulated natural nest sites in-situ like tree cavities
Phase 3 *Wild resource cultivation*	Cultivation of selected native tree species in artificially established plantations	Use of fixed comb hives made from simple materials like bark, grass, lianas etc
Phase 4 *Domesticated Resource cultivation*	Cultivation of domesticated tree crops in intensively managed plantations	Use of movable frame hive and the migratory placement of hive with genetically improved bee

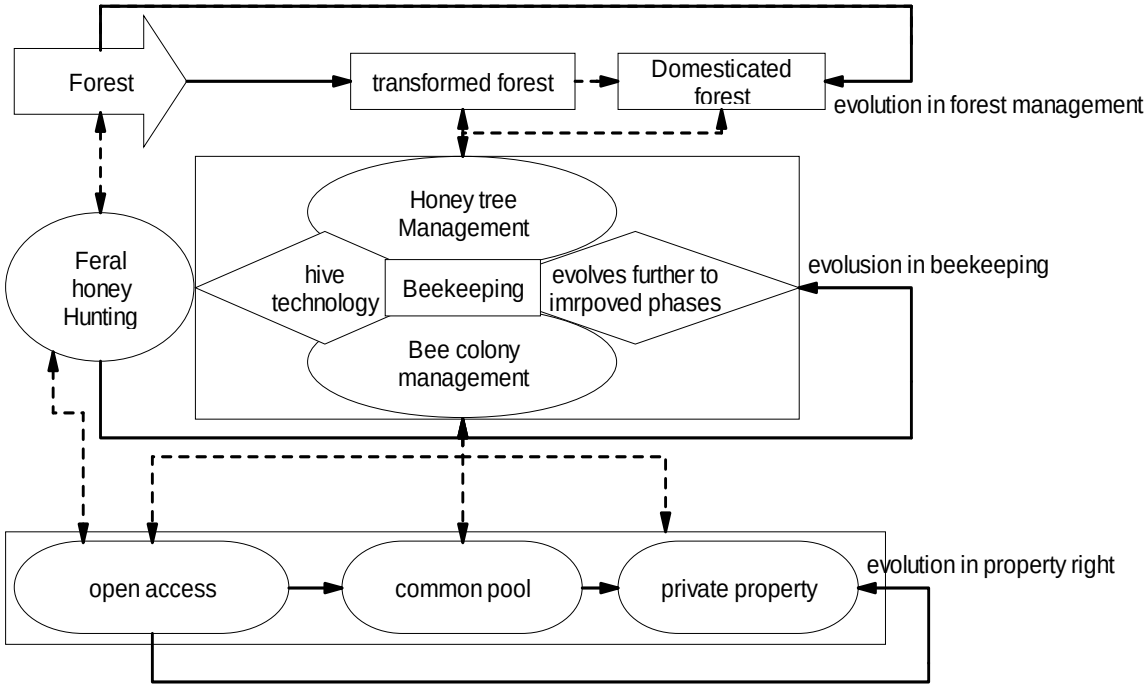

Figure 2. 1 Conceptual model for management dynamics in honey production

3 Research objectives and Questions

Objectives

The purpose of this research is to understand the nature and dynamics of tree-honeybee management interactions in relation to property right at different land use zones

Research questions

1. What are the general characteristics of honey production in the research area?
    - What is the state of honey production?
    - What is the role of and relation of beekeeping with other land use as livelihood activity?
    - What are the main beekeeping activities and responsibilities?

2. What type of honey production technologies are used in different land-use zones?

    - What types of hive technologies are present in the study area?
    - What are the main bee management activities?
    - Where do hives are located in the land use zones and which locations are most preferred?

3. What are the roles and management practices of trees/forest in beekeeping?

    - What roles do trees/forests have in beekeeping and how do the locals perceive it?
    - What types of tree/forest management practices carried on for honey production?
    - How does beekeeping assist forest conservation?

4. What types of property rights and access arrangements exist for honey trees and land?
    - What forms of honey tree/land ownership found in the study area?
    - How does resource access vary within and among land use zones?
    - How do and who is responsible in resolving disputes in beekeeping?

5. What dynamics in bee and tree management practice have taken place?

    - Which factors changed and render change on the bee and tree management practice?
    - What conclusion regarding trends in terms of management intensity can be drawn?

4 Research Methodology

4.1 Study area

Geographic location
The study area is located in Southwestern Ethiopia in the Southern Nations, Nationalities and regional state. The study was conducted in the Sheko district of Bench Maji Zone and in the Masha and Andracha districts of Sheka zone. The study area lies in the latitude range of 6° 45'-8°00' N and longitude 35°00' E (See figure 4.1).

Climate
Masha and Andracha districts are the wettest part of Ethiopia where rain may fall every month, but most of the rain falls between March and November. At Masha (the capital of Sheka) the mean annual rainfall is about 2215mm. The mean monthly temperature ranges between 14.3-15°C while the daily temperature minimum ranged between 9.8-11.1°C , and the corresponding maxima between 20-23.2°C (Kumlachew and Taye, 2003). At Sheko, the altitude is lower, a corresponding decrease in rainfall and an increase in temperature observed.

Honey bee types and resource base
In Ethiopia there are five different types of honey bee races one of which is endemic. Each race occupies distinctive agroecological locations (Amssalu, 2002). The races and their location are *Apis mellifera jemenitica* in the northwest and eastern arid and semi-arid lowlands; *A. m. scutellata* in the west, south and southwest humid midlands; *A. m. bandasii*, in the central moist highlands; *A. m. monticola* from the northern mountainous highlands; and *A.m.woyi-gambell* in south western semi-arid to sub-humid lowland parts of the country (Amssalu et al, 2004).

Ethiopia is also one of the worlds' largest honey producing nations (10^{th} in the world and first in Africa) and fourth largest wax producer owing to the huge bee resource base which intern is the result of agroclimatic and floral diversity of the country. There are about 10 millon bee colonies and an estimated 24,000m^3 of honey produced annually (Girma, 1998, Amssalu, 2002; Pol, 2002; Hartmann, 2004)

According to (Amssalu, 2002), the bee race of the study area is *Apis mellifera scutellata* and it is one of the highest honey producing areas in the country.

Forest composition and status
Friis(1992) classified the forests of south western Ethiopia as transitional rainforest, broadleaved Afromontane forest and riverine forest. This forest region is considered floristically diverse compared to other parts of the country (Tamirat, 1994), and contains over 107 woody species belonging to 84 genera and 41 families (Yeshitila and Taye, 2003). However, deforestation is taking place at alarming rate due to agricultural expansion and rising private investment ventures. Part of the forest has been leased and there is still a growing interest in investment on the remaining parts of this forest (Yeshitila and Taye, 2003)

Reusing (1998) assessed the changes in forest vegetation of south-west Ethiopia using aerial photos of the 1970s and 1996/97, and satellite images of the 1990s. He found that between 1971 and 1975 approximately 40% of the highland plateau of south-west Ethiopia was covered by closed high forest. The closed high forest declined to 18% by 1997 which is a loss of 60% in less than 30 years. Deforestation due to conversion to other kinds of land use is also a serious threat (see table below). Around 235,400 ha of closed and slightly disturbed forest were deforested between 1971 and 1997, a loss of 10,000 ha of forest every year (Taddese et al., 2002).

Table 4. 1 Some of the forest areas converted to commercial land uses in south-western Ethiopia (adapted from Tadesse et al., 2002)

Plantation	Deforested area (ha)	Status, February 2000	2004
Bebeka Coffee (Berhan forest)	5,000	Deforested	
Tepi Coffee (Part of Giz Meret forest)	6,000	Deforested	
Tepi Palm (Meti forest)	1,000	Deforested	
Midrock Coffee plantation	3,000	In progress	Deforested
East African Plc. Tea plantation	3,000	In progress	Deforested

Land use

The land uses of the area includes forest (18.1%), bush and shrub land (8.5%), grazing (26.8), cultivated land (30%) and the remaining 16% used for several other purposes including private tea and coffee plantations (Amssalu, 2002). Beekeeping is practiced in both forest and non forest land (Amssalu, 2002).

Agricultural practices are the sole livelihood sources for the majority of the inhabitants. Enset and maize are the major staple foods and mainly used for household subsistence. Coffee and honey are the major income sources. Coffee has higher importance in Sheko while honey is in Masha-Andrach Districts. A wide range of fruits and vegetables are also cultivated both for subsistence and market.

The land use pattern can be described as enset dominated gardens located around the home, with fruits, vegetables and several types of retained tree species also found in this niche. Cultivated land and grazing land are next to the home garden. Disturbed forest or bushes and shrublands occupy the next niche but often overlap with grazing lands, as they are used for the multiple purposes of woody supply and grazing. Relatively remote areas in reference to the home are occupied by forest where the major beekeeping practices take place; these are either protected state forest or community/kobo lands.

Demographic and ethnic characteristics

According to CSA (2004), the total population of Masha-andracha is 65, 949 and that of Sheko is 50, 039. The study area has several ethnic groups with specific and common economic and political history. They reside adjacent to each other and in mixed patterns of settlement. The major ethnic groups which are reported as indigenous are Sheka (Sheka and Manjo tribes), Majingir, Sheko, and to some extent Meinit and Bench. There are also Amhara, Tigre and Oromos recently settled by government programs and/or random immigration.

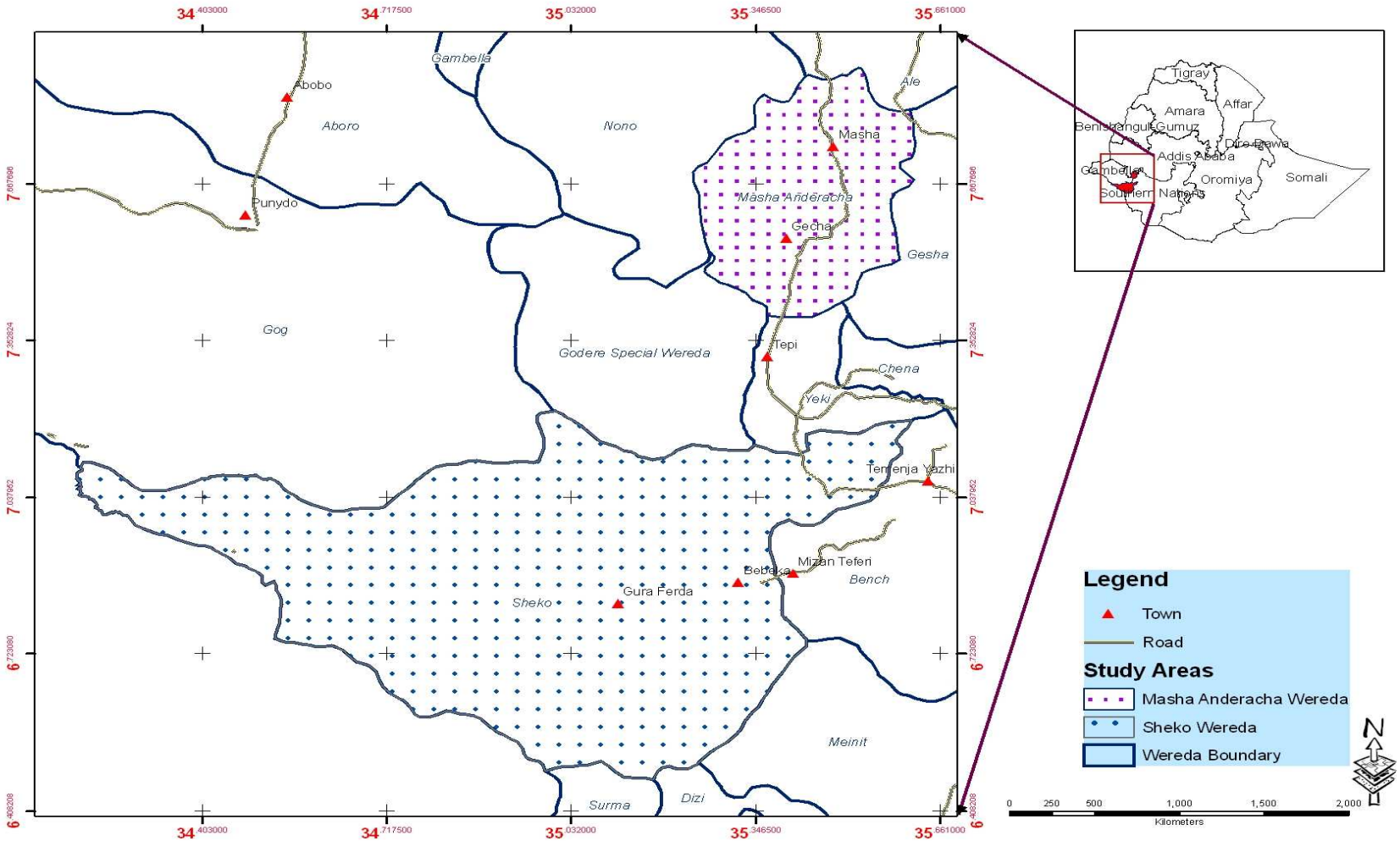

Figure 4. 1: Map of the study area

Table 4. 2 Study area disaggregated by Zone, districts and sites

Zone	District	Sites	No. of households interviewed
Bench Maji	Sheko	Shiyta	12
		Shimee	10
Sheka	Andracha	Yockchichi	10
		Chegecha	10
	Masha	Beto	10
		Bada	12
Total			64

Selection Criteria of the study area
As described above, Southwest Ethiopia is still relatively forested region and beekeeping is the major forest based livelihood activity in the area. Several nations and nationalities, each with their own indigenous bee management techniques, reside in the region. Selection of actual research sites in this diverse region was made based on several considerations: the need for NTFP research in south west Ethiopia; an attempt to include the diversity in socioeconomics and agroecology within the area; the goal of understanding the variation in significance of the practice in the economy of the different districts; and consideration of accessibility conditions.

4.2 Data collection

This research is both of explorative and explanatory types, where it attempts to provide a descriptive evaluation of existing beekeeping practices as well as further explanation of the causal relationships among practices and the dynamics in resource management. Hence both primary and secondary data were collected in order to address the research problem.

Primary Data
Most often secondary data will not suffice to achieve a research objective. Hence, it is necessary to collect primary data using a combination of methods. For this research primary data were collected using in-depth household interview, group discussion, Observation and expert interviews.

Semi structured interview: The majority of the data for this study were collected based on semi structured questionnaires. Open ended and closed questionnaires were used for sixty-four pragmatically selected from six sites of the three districts of the study area.

Households were selected systematically to accommodate variability in age, number of hives possessed, management condition, agroecology and ethnicity. These factors helped in analyzing variations and similarities among the different households and respective management conditions.

Data about details and specific issues and the causes were fully covered by this method. The different hive technologies, special and temporal arrangement, tree/forest use and management and the reasons for each issue were addressed in detail by this method.

Questionnaire development procedures

The bases for the questionnaires are the research objective and research questions with the help of the theoretical and conceptual frame work. At a first step in the field, multiple reconnaissance surveys were made to collect firsthand information on the research site. Available information and field situation were compared. A first draft questionnaire was prepared and given to foresters, beekeepers and NTFP production and research team for comment, and their comments included. Finally research supervisor edited it before it was subjected to test farmers. After this testing the final questionnaire was translated into the operational language groups.

The first questionnaire which was prepared in English and translated to Amharic, the language with which the enumerators and researcher communicate. These questionnaires were given to a personal friend, a sociologist, to edit the translation. Finally, since the questionnaires would not be conducted in Amharic, as all interviewees do not speak Amharic and the researcher do not speak the language of the subjects, there was a need to interpret those questions further into other respective languages. While the questionnaires remained in Amharic, development agents who were the enumerators and some other informants in each language group were participated in translating the meanings of the questions independently and then in groups. Enumerators of each language region shared the agreed upon meanings. After this process, questions were made ready to use for the survey. The questionnaires were subjected to Sheko, Majengir, Sheka and Amharic speaking interviewees.

Group discussion: In-depth group discussions were made for more than three hours at each location. Participants were stimulated to discuss issues of beekeeping as it is more than a practice and they considered the research team as their allies, as opposed to the investors. The major participants were elders and opinion leaders and representatives of the average beekeepers. But the number of participants gradually increasing in most of the cases as uninvited farmers also took part of their own initiative. Development agents and local administrators selected original group participants.

Issues addressed by this method were dynamics of beekeeping, deforestation, labour calendar for beekeeping, major tree species used for beekeeping and their flowering season, as well as in-depth discussion of land and tree tenure from past to present in terms of access, ownership longevity, inheritance and dispute management. Related issues that were raised during the discussion and that have universal relevance to that community were also discussed.

Group interview helps to view phenomena from different perspectives and serve as crosschecks for consistency of data collected by other methods. It also help to evaluate the extent of impact or occurrence of an issue/phenomena that is raised by some individuals but missed by most respondents, and hence appeared less prominent during averaging out.

Observation: Observation is a continuous practice and was made during the entire field stay. Observations were made in a form of transect across the landscape. During this time,

direct observations, informal interviewing and discussion with peoples on the transect line were also made. Observation helps to collect special information that might be skipped intentionally or unintentionally during interviews. On the other hand, observation is weak in generating information about the past or about networks of actors. It is also difficult to observe annually distributed practices in the short time frame of the study. The research area also covers a wide region of rugged topography and closed forest, so it should be backed by other methods.

Interview of authorities: Experts of beekeeping, forest and land use planning were interviewed from the regional office. Issues raised at this level were state land tenure condition, beekeeping development plan and its role for conservation of forest. Expert interview helped the researcher to compare perception of decision makers and local peoples who are the immediate beneficiaries and/or victim of decisions.

Secondary Data:
A review of documents (reports, Journals, thesis and dissertations, manuals, proclamations, rules and regulations) about forest, land use practices and honeybee management were made from different sources. Secondary data has helped the researcher to get an overview of the study site and sharpen the study in away to trace properly the aspects to be explored.

4.3 Data Analysis

Data were analyzed both statistically and logically. Microsoft-excel and statistical package for social sciences (SPSS) were used to systematically record and analyze the empirical data and to put in to frequencies, tables and figures. Collected qualitative and quantitative data from group discussion and observation were analyzed through logical reasoning, explanation, comparison and interpretation of management interactions. The results from various methods were compared to check consistency.

5 Results

This part of the thesis presents the results of the field data collection. The chapter is divided into six sections. The first section describes the general characteristics of honey production with respect to socioeconomic condition and land use systems. The next section deals with the various honey production. Section three looks at the role and management practices of trees and forests in beekeeping. Ownership and access arrangement for honey production explained in section four. Finally the dynamics with respect to hive technology, the resource environment and institutional effects are summarized in section five.

5.1 General characteristics of honey production

5.1.1 History of honey production

Discussion with older farmers showed that honey production is an age old practice in the study area, but owing to the length of time and absence of recorded evidence, the exact date to which honey production started can not be known. Moreover, it is not clear at which point honey become an important trading commodity. What older farmers do know is that both their father and forefather used to hunt feral honey in larger quantities than they do now.

Moreover, honey production practices have long been part and parcel of their sociocultural system and hence highly imbedded in their lifestyle. The number of hives possessed is used as a criterion to characterize wealth and social status. Honey has been used as an important currency in bartering system with neighboring people, and government tax was also once paid in the form of honey. Honey has always been a major and easily accessible medicine. All the ethnic group in and around the study area have had common characteristics with respect to the valuing and practicing of beekeeping; however, the types of technology they have used are slightly different.

5.1.2 Current state of honey production

Honey production is still an important practice. Except for parts of Sheko, where coffee gradually substituting as the leading product, in the rest of the study area, honey production is still the primarily income generating activity. Only a few farmers, who either became handicapped while climbing trees for honey harvesting and/or adopted other land uses, are reported to be without hives. As a result hives are observed in high density in the still forested areas of the study sites. There is a positive correlation between hive concentration and the presence of forest. The highest hive density is found in relatively forested areas of Sheka, while the lowest in the shiyta areas of Sheko, where forests are almost depleted. Despite this trend, hives have also found in cropland and homegardens where there are scattered trees. Placing hives in non-forested landscapes is a recent phenomenon, and the number of hives in this latter land zones is smaller but increasing compared to the forested landscape. All farmers place their hives everywhere but show a practical preference for the forest (extending the definition to far and wilderness area) arguing that bees prefer calm environments and its damage to domestic

resources will be minimized.

Farmers are concerned about reduced yields from their traditional hives due to the reduction in bee colonies and the increased number of beekeepers. Respondents in Sheko also mentioned that a reduction in the number of bee colonies and smaller yields has resulted from a detachment from the local culture and the taboos that used to control honey yield. In particular, the conversion of the clan leader to Christianity and the absence of someone to takeover his position and deal with the honey giver is frequently mentioned as real cause. However, it is observed that crop cultivation and coffee production have become their major occupation and it seems likely that people give up honey production in favour of latter practices. In Masha-andrach beekeepers blame the expanding tea and coffee producing private entrepreneurs as the main reason for reduced honey yields. Despite this complaint, it is observed that farmers' still gain attractive returns of cash from honey sales compared to other practices.

Discussion with the farmers also showed that a single household could have up to 200 traditional hives and that it is common to have hundred hives for well-to-do adult farmers. The holding often varies from region to region and person to person. On the bases of household interview, the average number of hives per household is 37. As shown in table 5.1, regional differences are highly significant; the lowest average of 8 hives is found in Sheko while the highest average of 71 hives is found at Masha.

Table 5. 1: Average bee-hives ownership per family in the various districts

District	Av. no of hives	Remark
Sheko	**8**	Only some parts of the district are still major producers
Andracha	**32**	
Masha	**71**	

5.1.3 Division of labour in honey production

Honey production is considered to be a man's activity and hence there are no female-headed households with hive unless there is a son capable of keeping bees. The role of females according to the group interview result is provision of food and drink to beekeeper and only in some cases where hives are near to home, might a woman help in giving rope for her husband as climbing device. Even the latter practice is often done by younger son or accompanying beekeepers.

A significant amount of adult labour is invested in honey production. In most part of the study area healthy men without hives are considered lazy. Younger sons often accompany their fathers to carry some equipment. They also eat honey broods, as it believed that this will help them gain the required skills in short time.

Moreover, as honey production requires skill and maturity, beekeepers age distribution is skewed towards older men. However, the majority of beekeepers are still in middle aged, because aging also has a negative effect on tree climbing efficiency and thereby the practice.

The youngest beekeeper interviewed is 21 years old, and he claimed that he started the practice 5 years ago. He lives with his mother and this may be the reason that he becomes independent beekeeper at such an early age. Actually, boys could start honey production practice as early as 15, but they usually do it with their fathers or their elder brothers. The oldest respondent is 85 years and mean age of interviewed beekeepers is 41.

The result from household interview and group discussions also showed that honey production is life long practice from younger ages to older age with decreasing intensity at older and younger extremes. According to the interviews, the years of experience range from a minimum of two years and to a maximum of 67. Moreover, the years of experience and the age of beekeeper positively and strongly correlated (0.01 probability of one-tailed test). The average number of years in which beekeepers engaged in honey production practice is 21 years.

5.1.4 Beekeeping activity calendar

The major practices in traditional beekeeping are assessment of hive site; cleaning round of trees; looking for quality trees that provide good view, foraging access, shade against sunburn; preparation of hive; cleaning and baiting of hives; perching at suitable hanging tree; tying firmly the hive on hanging tree; covering the hive with grasses and bamboo leaves as protective cover from rain; fencing the tree around with thorny twigs and teff straw to block point of access to tree stem by honey badger. Sometimes corrugated sheets of iron are used to protect climbing up of both badger and ants. Then the hive will be ready for visiting bee scouts. After the bees entered, hives will be monitored and fastenings will be checked to fix again if there is any loose fitting. Harvesting of honey from the hives will be the next activity followed by collection of empty hives if the bees are left. The hive could be used for next year provided it is not damaged while harvesting.

Thus, although traditional honey production is not an intensive practice from the perspective of labour requirement, activities are seasonally distributed mainly governed by the flowering season of the dominant forage trees. Explorations, cleaning the area, construction of hive, cleaning and hanging it on suitable tree are usually made from September to December and harvest during the period of March to June. But there could be minor harvest during the period of September to November in some of the study areas. Brief monitoring of the status of hive, whether bees colonize the hive when it is hang, the safety condition like the tightness of the fastenings, liability or damages encountered by pests etc., will be conducted in the period between hanging and harvesting.

After the honey harvest beekeepers usually collect their empty hives (as the bees have already evacuated) somewhere near big trees for use in the next year. If the hive is damaged during throwing down for honey harvest, it will be replaced by making another hive. Young beekeepers also construct additional hive to increase their total number of hives. Hive construction is often coincided with hanging period.

5.1.5 Contribution of Beekeeping to livelihood condition

Beekeeping provides several livelihood assets. It beekeeping provides food, both honey and brood; honey is also the leading cash source in most part of the study area. Moreover, honey is used as medicine, help to reproduce social and cultural values and to create family ties, as hives, honey tree and land are given to heirs and also to close friends. In some areas a bee colony is also a marketable commodity; however, in the study area, it is hardly sold in market and considered as free access forest resource.

Due to time constraints, this study has not produced detailed data on the contribution of honey from the perspectives of labour expenditure, gross and net return. However, responses from selected farmers show that a hive could produce 3-8 kg of honey per harvest depending on forage availability, the number of bees or colony strength and length of time bees stay in the hive. The higher the forage availability, the stronger the colony and the longer time a colony stayed within the same hive are all reported to provide higher honey yields. A hive could also produce more than once, especially in areas where bees are not displaced in the first harvest. It is also reported that beekeeping practices have lower cost requirements compared to other practices.

5.1.6 Beekeeping interaction with other practices in the general land use system

Beekeeping is not a specialized practice in the study area. Agricultural practices like crop cultivation, coffee farming, enset culture and livestock rearing are handled among with beekeeping. In addition, there are externally induced land uses like tea and coffee plantation. Interviews were conducted to see whether beekeeping contradicts or complements with existing practices.

Honey and coffee are mentioned as the main cash crops in the study region. Coffee is dominant in the southern area while honey prevails in the northern part of the study area. However, they coincide in most parts and interact with different degrees of relationship. According to the responses of the household interview (n=53), 85% of the respondents do not agree that the two systems are contradictory; rather, they feel that they complement each other. Some farmers also noted that forage from coffee is important because it flowers in periods of reduced forage availability. However, about 15% of the respondents believe that coffee expansion does not only threaten bees through deforestation and loss of forage but also it shifts a significant amount of the work force away from beekeeping in entirety and consumes a significant portion of the time of those who are still practicing both. They also noted that coffee returns are better than the return from honey, which stimulates the expansion of coffee. Settlers and younger generations prefer coffee to honey production as it avoids the skill of tree climbing and the associated risk.

Almost all farmers agreed that honey production can not be practiced in the same place that enset is cultivated, arguing that the aggressiveness of the bees does not allow farmers to accomplish the most routine and intensive enset management and harvesting practices. However, there are several hives placed adjacent enset gardens. According to our observation, ants are also associated with enset and are common in home garden at

large, threatening beekeeping.

Asked about effect of crop cultivation, 58% of respondents reported that crop cultivation is preceded by forest clearance and hence leads to a loss of bee trees. About 25 percent responded that can provide fodder by themselves provided there are enough scattered trees to avoid nesting paucity. Similarly, tea plantations and timber extraction are also mentioned as serious threats to beekeeping (table 5.2).

Table 5. 2: Summary of the relationship of honey production with other land uses

land use	Mutualistic	Conflicting	Drivers of interaction	Remark
Coffee	✓		Forage & pollination, shade trees, increased income	
Enset culture		✓	Stinging of bees, ants, low nesting and forage provision	Can be solved by improving the hive
Crop cultivation		✓	Lack of hanging tree, stinging	Could be both
Tea plantation		✓	No flower, no hanging tree, bees are not required	More conflicting
Timber extraction		✓	Trees felled, fodder and nest paucity, noisy	Synchronization could be possible

5.2 Honey production technology

There are three general types of honey production technologies that are currently in use but at varying levels of intensity. The first and antiquity practice is feral honey harvesting from habitats like tree cavities, caves or other natural openings. The second and most important method in this region is traditional hive-based production, which in turn has several variants. The third is the recently introduced modern hive often, called Kenyan top-bar hive. In the following section, several aspects and management characteristics of traditional hives and brief account of feral honey hunting and modern hive-based practices are presented.

5.2.1 Feral honey hunting

Farmers both in individuals interview and group discussion noted that feral honey hunting from habitats like tree cavities, caves or other natural openings is a little more than history and only on rare occasions do they encounter feral honey (see table 5.2). Asked about the causes, deforestation and forest fragmentation as a result of population pressure, crop cultivation and road-opening rated as major cause by group interviewees. Increased numbers of hives present in the forest and the preference of bees to these hives, and increasing threats to bees in feral habitats by humans through several activities including damaging their feral cavities and felling the trees in which these bees live to access their honey or for other purpose are also mentioned as secondary causes. Beekeepers also noted that if such types of honey are obtained, especially from well-established nests the amount will be much higher than obtained in the hive.

Opportunistic hunting is mostly performed during the highest honey-flow period (February to May), but it can also be done during non-harvest periods so long as hunters come across with such colonies. Presence of these colonies is also most visible in the honey flow period when the bees' mobility is highest. The evolution of the practice into hive-based forms will be dealt in section 5.6.

Table 5. 3: Status of feral honey collection practice by respondents

Likelihood to get feral honey	Frequency	Percent
No	42	66.7
Occasionally	16	25.4
Only before EPDRF	4	6.3
Once in my life	1	1.6
Total	63	100.0

5.2.2 Traditional hive-based production

As can be seen in table 5.4, traditional hive-based honey production is by far the most important type of honey production method in the study area, providing almost all of the returns from beekeeping. However, there are variations among traditional technologies and different regions have adopted different types of hives suitable to their biophysical and socioeconomic conditions. The most common types are log hives from *Cordia africana* (Sheko technology) hereafter called type-II log hive, and bamboo hives in Andracha and some parts of Masha. The third and most common technology is log hive made from a variety of soft woods (Masha technology); hereafter referred as type-I log hives. This latter technology is mainly used in Masha and also partly used in Andracha. These latter two districts are adjacent and the peoples are of similar ethnic type. Hence, technology overlaps is evident, in contrast to the marked differences with the Sheko/Majingir peoples of Sheko district.

Table 5. 4: Types of hive technology and proportion of users

Type of hive	Number of users	Percent
Log from Cordia	19	30
bamboo	9	14
Log & bamboo	16	25
Log	17	27
Top bar*	4	6
No hive	3	5

*top bar is owned by both log hive and bamboo users as new adoption and only one Top bar per head

In addition to the three common technologies above, there are other traditional methods. For example, hives from twigs and climbers are used in Sheko area while bark hives are used in the Masha-Andracha areas. But except in a few cases, these traditions are almost

extinct and only often reported as they were known in the recent past. None of the household questionnaire respondents reported using these traditional techniques, and only five of them used them in the recent past, while about 14 of the respondents know that other people who are still using them. The remaining 40 respondents had no idea about such types of hives. Their reason for this abandonment trend is that people are satisfied with their current technologies. Beekeepers also mentioned that climber hives are labourious while bark hives are less durable.

5.2.3 Modern Hive-based production

Modern hives, referring to Kenyan top bar hive, are reported as a new type of technology in the region. Attempts to introduce them by the rural development office (RDO) were not successful and the majority of the hives observed still remain in the district RDO. Only a few farmers have adopted this type of hives and they are pessimistic about the technology. Only a minority of them expects it to suit the bees and to produce higher return than their traditional technology. There is no yield record yet, as it was last year's extension campaign and they said it does not contribute to their livelihood so far.

Group informants in Andracha noted that modern hives are not important at all even if the price were to come down. According to them, there is no need to have them unless bees are particularly attracted to them to make honey, but bees have absconded immediately and repeated attempts to introduce them have failed. Asked about technical help from experts, farmers reported that experts also have no solution to make bees stay in this type of hive. However, responses from household interviews shown in table 5.5, revealed that most of the reasons for limited adoption are due to economics and lack of awareness rather than technology failure.

Table 5. 5: Reasons why beekeepers do not adopt modern hive

Reasons for non-adoption	Frequency	Percent
Lack of awareness and experience	26	47.3
Economically less feasible	8	14.5
Thinking about starting since I heard about it	5	9.1
I have started it	4	7.3
Modern is tiresome, requires more follow up	3	5.5
I practice coffee as major, so it is not priority	2	3.6
It is not beneficial technology to us	2	3.6
honey production reduced, so no need to introduce new technology	1	1.8
Bees are not familiar with it	1	1.8
Traditional is our cultured practice	1	1.8
No available new technology	1	1.8
I stopped modern hive since bees refuse to enter/settle	1	1.8
Total	55	100

Experts in the regional office explained that some adverse misinformation is always the case in new technology adoption, but according to them the technology has several improved features including the separation of bees, brood and honey from artificially constructed chambers. A particular advantage of this style of hive is that bees are easily confined even when the hive is open by smoking them away from the open end and harvesting can be done comfortably. But they also agreed that the price of hive is unaffordable for poorer beekeepers. They are confident that it will be adopted well in the near future.

5.2.4 Major management features of traditional hive

In view of the limited number of modern hives in use, only management of traditional hives will be elaborated. The following aspects are presented: bee having methods, colony management, construction techniques and differences and similarities among traditional hives with respect to these factors.

i) *Traditional methods of bee- having and colony management*
As bees are requirement to start beekeeping, their production depends on the availability and the methods of improving the state of the bee colony. Traditional honey producers mentioned several ways by which they could obtain bees. These are through voluntary visit of baited hives which the beekeeper possesses and by forcefully diverting the flight destination of bees to his hive. More over, like land and trees bees are also possessed through inheritance from fathers or gift. A third option, quit rare, is transferring feral bees to a private hive.

The most common by which a beekeeper will own another colony of bees is by voluntary visitation of baited hive by bees. Beekeepers perform intensive practice to make the hive attractive and visible for visiting bees. Most beekeeping practices are geared towards achieving colony attraction and if there is another intensive practice in beekeeping other than this is only harvesting. Tree species selection for hive, sitting them in dense forest, cleaning, baiting and hanging them in tall trees are all geared to make the hives suitable and attractive so that they will be selected by bee colonies.

Beekeepers noted that bees need a quit forest environment with as little human contact as possible. Consequently, beekeepers limit frequency of visit and try to accomplish required practices in as little time as possible. Actually, beekeepers accomplish most of their practices before the bees settle in the hive and reduce any form of disturbances as much as possible thereafter. By doing so, farmers believe colony migration will be prevented until harvesting time and in some regions even after harvesting. Beyound this, they do not perform any practice with respect to increasing bee colonies nor decreasing excessive brood formation. Most of the interviewed farmers also have no plans to make more intensive colony management, arguing that it is not important as there are enough colonies in the forest. However, 15 of the 65 interviewed beekeepers did express interest, but lack the knowledge for action.

In most parts of the study area, bees are not considered as a resource and will be evacuated from their hives immediately after honey productions. As a result searching for bee colony is a permanent annual practice. On the other hand, beekeepers give due attention to honey trees and forest land than anywhere else. Beekeepers believed that bees are not scarce as far as there is forest and a place to hang empty hive. It is true that the forest with which they are concerned has thus far continuously providing them with these valuable resources. In the following sections, major differences in terms of hive nature and construction, colony handling and honey collection issues are discussed.

ii) Log based (Type-I) honey production

In this form of honey production technology, beekeepers wait for a new colony to settle in their hive. Settled bees will be allowed to stay in the hive during the honey making period and will then be evacuated during harvest period. This technology users have not concerner to the bee colony after honey harvest. Since all honey and brood extracted, any surviving bees are doomed. Many farmers report that have no alternative to avoid this, but they do understand the damage caused.

Other groups of farmers, especially those in Beto (the most intensive users of this type of hive), do not agree that it is destructive. They claim that this is an adaptation of the hallow out log and that it eases honey harvest; which otherwise would be difficult even after application of smoke. These beekeepers also argue that bees will not go anywhere permanently and will come next year during flowering season of the local vegetation. Farmers note that it is a strategy to make use of other area having different agroecology and trees that flower in different periods than this area. Thus, allowing the bees to leave away is a strategy to let them escape the scarce period of this area and to make use of the resource in other regions somewhere before coming back. Thus they consider it as a creative practice, not destructive one.

However, it is obvious that while they throw the hive from big tree, a significant number of bees will die and the brood will be damaged and eaten. Only small numbers of bees will survive. The survivors will also face problems as they do not have any food reserve. However, if flowers are still available, they will soon start resettling and making honey soon. Unfortunately, the beekeeper again will collect this small amount of honey and leaving them at risk again. There are some farmers who said “bring to us an option where we will not remove the bees. We know that bees that stay more than a year could produce two to three times more honey than seasonal bees”. Experts recognize that this process is destructive and note that development effort will be aimed at improving the existing technology in addition to introduction of modern hives.

Soft wood log hives constructed in the following manner. First, the beekeeper selects the most workable tree species available in close proximity. They fell, debranch and crosscut the wood into appropriate hive-sized logs. Then the logs are split into two equal parts. Each split will be hallowed out living both ends untouched, so that it will be completely closed at both sides when they rejoin the parts again. As in other regions, this people also make small openings for bee entrance. In other type of hives, both ends are opened and used to take out honey.

iii) Bamboo based honey production

Bamboo users do not remove bees from their hive during honey harvest. Management of the hive, like baiting before the bees settle and frequent cleaning of the hive vicinity after wards, are practiced more intensively than with log hives. Hives are inspected to control possible dangers from badger and incidences of ant. Any openings except those for the bees will be well sealed. This hives are durable and can serve for a periods of 5-8 years. The only difficulty reported with respect to this type of hives is the time spent in hive construction. Also in the extreme highlands it is too cold for the bees and may lead for frequent abscond of the colony.

Bamboo hives are made by splitting highland bamboo and making a mesh-like structure. It will be formed in to hallow cylindrical structure like bark or log hive. Latter it will be completely covered by grasses or the leaves of the bamboo itself. It also has holes for bees' entrance. Unlike many hallow out logs which could have one or two openings, it always have two openings. This helps the beekeeper to harvest the honey by pushing bees to the opposite side. Some honey will be also left for the bees. These people also favour eating the brood, but they are careful not to empty the brood as it is next year's vigorous honey-producers.

iv) Log based hive (Type-II) honey production

This can be considered as Majangir/Sheko technology. This type of hive is made exclusively from *Cordia africana* and used mainly by these ethnic groups; settlers also follow the same type of technology although they know other technologies in their previous locality. This type of technology basically looks like the Masha type. The difference is that these hives are made from hard durable wood, mainly *Cordia africana*. It also has two openings at both ends of the hive in addition to small bee entrance holes. These openings sealed with grass to make warm and dark environment as bees prefer such type of hive which may be an adaptation from the feral habitat. This log hive is as durable as the bamboo type. Bees remain for several years in the same hive, as beekeepers do not evacuate them during honey collection.

To construct this type of hive, hive-sized Cordia log will be selected. Then it will be split in to two equal parts. Both will be scoop out to form a hallow and on the lower part of the slit two to three holes will be made for bees' entrance and proper aeration. The lower component of the hive, where bee entrance holes located in, is called female while the upper part male. Hives in this area are generally larger than sheka areas.The upper part remains completely sealed to prevent rain or moisture leakage. Size of hives varies from region to region.

These traditional hive technologies are similar in that they all do not have frame, separate brood or super, and are made from locally available materials. Aspects of bee management are also partly the same. In all hives the inside will be smoothed out to prevent damage to bees and debris will be removed and completely cleaned. Bees will make the final smoothening by propolis. All of them have at least one opening for bees' entrances (see table 5.6).

Table 5. 6: Summary of characteristics of different traditional beehives management

Criteria for comparison	Log hive(type I)	Bamboo hive	Log hive(type II)	Climber/twig	Bark hive
Center of use	Masha and partly Andracha	Andracha and part of Masha	Sheko (by Majingir, Shekos, and Immigrant)	reported in Sheko area, but rare this days	Few cases reported in Masha area
Construction material and techniques	Soft wood trees of several spp. Logs split apart each will be hallowed out and merged together again	Highland bamboo, constructed in the form of mesh	Hallowed out mostly from cordial log. A log will split apart and each hallowed out and merge again and tied firmly	Clematis, other lianas and similar size twigs in which twigs used as stand and climbers used as mesh.	olea, gonji, croton, etc. hive size bark will be debarked and rolled again to form a hive
Labour investment	Less time, materials found excess and hallowing out easier	More time to split into pieces and to construct there from	Material available but since it is strong, more labour required to drill and hallow out	More labour required to collect, make and avoid unwanted openings	Less time required
Size of hive	Often smaller	medium	large	Medium size	Medium
Durability	Less durable	Durable	Durable	depend on type of spp	Less durable
Nature and purpose of hive opening	May not have openings at the ends, small holes will be drilled for bees at the side of the lower split. Difficult to harvest honey unless the components split apart	two openings at the two ends, allows to harvest honey without displacing bees, just by pushing bees to other end by smoke	two openings at the two ends, allows to harvest honey without displacing bees, just by pushing bees to other end by smoke	two openings at the two ends, allows to harvest honey without displacing bees, just by pushing bees to other end by smoke	Have two openings, allows harvesting without removing bees from the hive.
Longevity of colony stay in hive	Seasonal/temporary	Relatively permanent, beekeepers let some honey for bees during harvesting to prevent absconding during dearth period			
Ease of harvesting	Easy but bees will be displaced	Less easy and risky to smoke and harvest honey being on tree branch			
Control of absconding	There is no effective method but reduce the prevalence by preventing attack from ants and honey badger				
Ways to attract bees	Cleaning, baiting and hanging on tall trees. Visitation of any hive by bees is mainly opportunistic, as all do the same practice				

5.2.5 Spatial distribution of bee-hives

In traditional beekeeping, the practice is not fully controlled by beekeeper. Locating hives is a function of bees' natural preference for a location with respect forage availability, nest sites and nesting resources which largely affect the beekeepers preference of a locus. Practical problems like stinging damage, pest incidence, availability of hive-making and hanging trees, noiselessness of the environment also determines selection of apiary site by traditional beekeepers.

i) Distribution of bee-hives along the landscape

Beehives are often placed in all parts of the landscape and across land use forms: around home, farmland, coffee forest, grazing areas with scattered trees, forests that are protected state forest and/or forest kobo; but the highest concentration is found the forestland (table 5.7). Within the forestland, there is variation from kobo forest to non-kobo state forest and also from dense forest to sparse forest. The highest density of hives is found in the intact kobo forest area, and relatively lower densities are recorded in the disturbed non-kobo forest and forest-based grazing areas. Next to dense forest regions higher numbers of beehives are placed around home yards. The lowest numbers of hives are found around croplands and coffee fields. However, on the basis of field-level observation, substantial numbers of hives are also found in forest coffee areas. However, only a few samples were taken around major coffee forest areas, and that may account for the lower figures in the household interview results.

Table 5. 7: Bee-hive distribution in the different land use zones(n=62)

District	sites	Home garden	Natural Forest	Kobo Forest	Disturbed NF	Coffee forest	Crop field	Total
Andracha	**Yockchichi**	88	190	130				408
	Chegecha	31	207	0				238
Masha	**Beto**	119	0	591				710
	Bada	144	240	318				702
Sheko	**Shimee**	20	51	0	5	7	0	83
	Shayta	2	33	0	21	0	25	81
Total		394	696	1039	26	7	25	2187
Percentage		18	32	48	1	0	1	100

ii) Preferred hive locations

Bees prefer some locations over others, and beekeepers respond similarly by locating their hives in places where bees like to live. This preference could be between ground-level or the crown of a tree; between a tree-top or lower branches; between plains, mountaintops or foothills. There is also variation in preference between foresst and human-developed areas like cropland/home gardens.

According to the beekeepers, there are also temporarily preferred locations that help to attracting swarming bees. For example, interviewees reported that bees easily colonize hives hanging in upslope areas as they are easily visible and have higher chances to be visited by bee scouts and thus bees to make their new home. However, these areas could be less suitable during dry windy periods and in this case the bees may be forced to

migrate again, so the beekeepers transfer the hives after the bees have entered to flatter areas to prevent possible migration.

Forest versus home garden

Interview results show that hives located in remote forest have the highest chance of visitation and colonization by bees. Of all the respondents, only two believe that home gardens and cropland are better places to attract bees, arguing that since the forest is getting cleared, there is no difference anymore between forests and home yards. But except one who had no idea, all the rest (61) believe that the forest is the best place to attract swarms. There are several reasons for this. The first reason is the high forage availability and the presence of the largest colonies of bees in the forest compared to other modified landscapes. Secondly, bees have a tendency to favour forest areas and as a result bees swarming from forests or even home yards may search for a hive in the forest; this in turn is the result of abundant forage and quiet space in the forest. See figure 5.1.

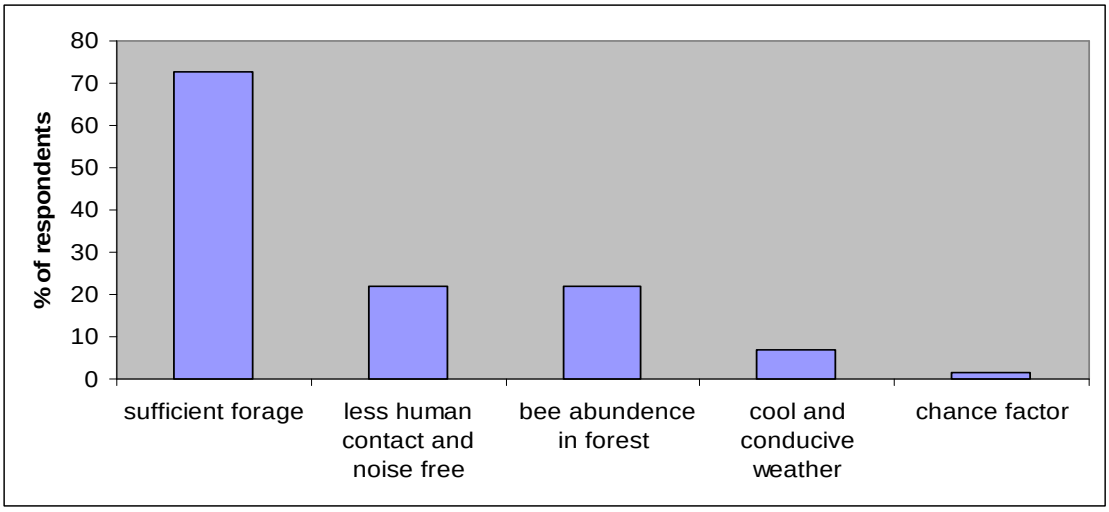

Figure 5. 1: Reasons why farmers prefer forests for placing hives

Ground level versus tree crown

A comparison was made to find whether there is preference of bees to a hive placed in trees versus at ground level. All the responses but one show that bees have a strong tendency to prefer elevated position and tree tops than ground level.

Table 5. 8: Reasons of preference tree crown to ground level

Reasons	% of respondents
Lessen Vermin susceptibility	56.4
Ease visibility for bee scout	67.7
increase foraging efficiency	22.6
Reduce liability for theft	4.8
Prestige(respect for tall tree climbers)	1.6
suitable to hang many hives on single tree	1.6

The justifications for tree top preference include the lower susceptibility of bees to pests, and that it eases their foraging activity and improves the visibility of hives for flying bees. See table 5.8. Beekeepers also hang hives in trees rather than on the ground to escape the above problems and to maximize the chance of obtaining bees. No traditional hives placed at ground level were encountered in the study area during the survey period.

In addition to bees' preferences, practical difficulties force beekeepers to stick to locations where these difficulties will be minimized. For example, almost all the respondents fear the defensive bees as undomesticable and recommend that bees are placed in the forest.

iii) Influence of types of hive on spatial distribution

This issue was addressed in areas where two or more types of hive are used; interviewees were asked whether they found a site-suitability difference with respect to the type of hive used. As a result, in areas using bamboo and log hives, we assigned responses to a preference matrix of site versus type of hive technology. 82% of mixed hive users prefer to place bamboo hives near to home with the notion that they are more liable to attack by honey badgers and ants than are log hives. Bamboo and other log hives which have entrances at both ends make it easy for badgers to steal the honey by driving bees out of the hive by blowing their poisoning wind. Moreover, bamboo needs closer monitoring and is also useful to get household consumption honey at any time. Thus, they prefer to put the bamboo hives nearby and the log hives in the forest. On the other hand, the remaining 18% argue that bamboo is susceptible to ant attack and ants are abundant around the home, so these hives should be placed in the forest. In the case of log hives, the badger cannot take the honey out unless it splits apart after being thrown to the ground. Thus, if the fastenings are strong it cannot be detached and hence the liability of damage is reduced.

The issue was raised in group interviews and it was commonly accepted that ants are more common in home yards, but that if the hive is on the tree crown the risk is reduced. They also noted that log hives can be placed anywhere as they are highly resistant to vermin compared to bamboo hives.

5.2.6 Conclusion: variation in hive management intensity

Compared to other land-use practices, beekeeping using the current technology is not considered to be very labour- or capital-intensive. Despite this, the technologies used are not entirely similar from the management requirement perspective. The study shows that different types of honey production require different levels of management intensity. A summary of the management intensities with respect to materials and tools used, the management of bees and vegetation, monitoring of the colony status and security of honey production is given in table 5.9. It can be observed that increasing management intensity is in the first place related to the beekeeping technology. With increasing levels of bee management, there is also a tendency to give more attention to the management of the production environment. The management of trees/forests is further discussed in the next section.

Table 5. 9: Comparison of feral honey hunting, traditional hive and modern technology in terms of management practice

Criteria	Honey hunting	Traditional technology	Modern technology/top-bar
Materials and tools used	No tools required but axe which required to fell the tree or branch where feral bees. Also smoke to drive bees away while harvesting.	Tools made from local resources including the hive, fumigation, covering. But axes, machete and knives required for constructing, cleaning around and harvesting honey. Hives placed in living tree	It is improved technology where materials could be locally available but for technical reasons they are either imported or made somewhere else in the country. It uses external products like artificial wax & corrugated iron sheet for cover and protection. Mostly hives put on stands, less on tree.
Management of bees and honey plant	Neither bee management nor tree or other practices except collecting honey from the wild habitat any time they faced the chance.	Trees and hives managed with labour investment with known calendars on the basis of flower phenology. Management of trees and land, administration of resources and particial domestication of bees. Transfer to area they think appropriate but at night	Requires intensive labour but can be made by women as there is no tree climbing and hives are mostly found nearby. But possible to put in/adjacent to forest provided there is no theft risk. More over, the technology separates the bees and honey by comp and bees do not cause stinging damage.
Monitoring of colony status	No monitoring except searching for feral honey. No purposeful, planning, seasonal practice and the like activities.	There is monitoring but not intensive and it is to check wether bees entered, fastenings are still intact and to see pests. It is not possible to check presence or absence of honey	Intensive monitoring, queen rearing, preventing swarming by studying reproduction status
State of bee ownership	Hunters are not sure whether they will get honey this year or not. They do not know exactly where bees found nor where they can get.	Bees are partially controlled and know number of bee colony they have for the year, but no guarantee for next year.	Bees assumed to perpetuate for longer period as reproductive swarming and abscounding somewhat controlled unlike the previous methods

5.3 Role and management of Tree (forest) for Honey production

5.3.1 Introduction

Honey production practices in the study area are heavily dependent on trees and other forest products. It is mentioned that trees are the source of fodder, it is a nesting place, the sum of raw materials for hive production and covering obtained from, trees and shrubs also serve for smoking and fumigation of hives. It protects bees from adverse climatic factors and moderation of temperature extremes through shading, reduce susceptibility for pests and theft and to some extent from vermin. All the interview farmers except one agreed forest (in this case an area with trees) is crucial for beekeeping.

Asked about type of tree, frequency of use and level of priority, several tree species were listed out and the tree they put at higher priority also found to be used by the majority of the traditional beekeeper. Consequently, the tables showing frequency also shows the level of priority farmers give for a honey tree. On the basis of household interview, field observation and group interview, the major trees, shrubs and climbers mentioned for forage, hive making, hanging and fumigation are presented below.

5.3.2 Multiple roles of trees/forests for honey production

Major trees and shrubs used for bee forage

A tree is defined as best honey tree if it has attractive and melliferous flowering characters which attract and provide sufficient nectar and pollen with lesser effort. Honey producers in all districts assign the highest value for a fodder tree on the basis of the colour of and amount of honey produced from it. As such, the most preferred trees for honey production especially for forage is *Schefeleria abysinica*(geteme). It is a tree with beautiful white flower that helps to produce white honey which is the most preferred honey type by local consumers. This tree grows abundantly in the montane forest regions of Masha-andracha (see table 5.9). But all white honey is not produced from white flowers.

In Sheko, the best tree for bee forage is butich, also serve for hive hanging and making. The second preferred forage tree in this district is *Cordia africana*-a multipurpose honey tree serving all function from forage (flower) to baiting (bark and leave). The timber from Cordia also provides the best product for traditional and top bar hive making. It is durable and its colour and smell attract bees naturally. The cordate shape and spreading branch provide a suitable hive perching position. As shown in table 5.10, there are regional differences with respect to the purposes of tree for bee forage. The number of trees used for forage also varies in the two regions.

Based on the group interview, most common blossom trees flower during February to May, often called honey flow period. There are also trees flower outside of this period and mainly used for bees' self consumption. But in some instances minor honey harvest obtained in other seasons.

Table 5. 10: Most preferred trees for honeybee fodder production disaggregated by agroecology

Species Name	Frequency of users		
	Masha-Andracha	Sheko	Total
Schefflera abyssinica	41	1	42
Ficus thonningii	21		21
wondabo (local name)	11		11
Manilkara Butugi		15	15
Ekebergia capensis	9		9
Celtis africana	13	6	19
Vernonia spp	21	14	35
Croton macrostachys	12	17	29
Cordia africana		12	12
Aninjeria spp	10	3	13
Allophyllus abyssinicus	8		8
senber (local name)		7	7
Maeso lansceolata	4	3	7
Olea welwitschii	5		5
kushita (local name)		5	5

Use of trees for nesting/hive hanging

Beekeepers noted that they have quality criteria to choose a tree for hive hanging. The quality criteria, albeit vary from region to region, are fair abundance of the tree species, multiple branching with fairly dependable strength, branching that are found higher up the tree crown and reasonable above the middle strata. Branchings should have strength that could carry the hive with all its contents, especially during maximum honey and brood production period. Moreover, a tree has to provide a good standing space for beekeepers while fastening hives or during honey harvest. Trees with thorns or prickles are not favoured as hanging tree. Some trees with much slippery bark are also reported as risky and lower the probability of selection. Mostly trees selected for this purpose are those structurally occupy the dominant and co dominant strata. The reason is that the extreme tree top is liable for wind. Hives on emergent trees have the highest chance to be colonized as they can be easily seen above the forest crown when bees fly over there. They also mentioned that trees used for this purpose should be living, because dead trees has less strength, could be rotten easily, insufficient shade provision for the hives and also bees do not like to be on dry tree.

On the bases of these criteria, it is observed that many tropical tree species qualify their need and used for hanging their hives (table 5.11). Trees have to be also the type preferred culturally. For example, celtis although has good characteristic branching, it is often less preferred and used.

It is crosschecked with field observation and found that most commonly used trees occupy the dominant canopy stratum and reveal multiple branching characters. Aninjeria spp and *Prunus africana*, for example, grows straight up and will start branching only after it surpass the dominant and co dominant strata. *Polyscias fulva* another important

hive hanging tree grows straight until the maximum height achieved and then continuously bifurcate forming an ideal place for hive seat-its local name also implies that it is a chair for wild lives. *Ficus* spp continue branching indefinitely starting from early stage. But hives will be placed on the branches that are found high above the dense canopy level.

Table 5. 11: Most preferred hive hanging trees disaggregated by agroecology

Species Name	Frequency of users		
	Masha-andracha(n=22)	Sheko(n=12)	Total
Aninjeria adolfi-friederici	41	1	42
Ficus sur	21	3	24
Prunus africana	21		21
Polyscias fulva	14	1	21
Ficus thonningii	20		20
Other Ficus spp	2	17	19
Croton macrostachys	15	2	17
Ekebergia capensis	15	1	16
Manilkara Butugi		12	12
Albizia spp		10	10
Senber (local name)		9	9
Gonji (local name)		9	9
Washu (local name)	8		8
Celtis africana	8		8
Olea welwitschii	5		5

Trees used for hive making

Preference for hive making trees are not uniform throughout the study area and it is affected by the type of trees available in the region and the mode of beekeeping practice. For example, in soft log hive users, strength is not a problem but workability. For these group of beekeepers, best hive making tree are those abundantly found nearby, easy to hallow out which enable them to make several number of hives per day. Durability is not a major concern, as they could change it for next year.

In bamboo growing areas (part of masha and most of andracha) significant number of farmers use bamboo hive.It is prefereed for its durability. Most bamboo users also equally use soft wood log hives.

In the case of Sheko, cordia african is used almost exclusively. All respondents who have hive reported that they use Cordia. In these area durability and strength of wood is the major criteria to select as best hive-making tree.Top bar hives, currently deployed by extension office are also made mainly from Cordia africana. As it is strong, durable and has good structure and attractive smell. This latter quality also makes it preferred by honey bees. In the previous period twig, bark or climbers have been used for hive construction. But they are no more in use these days. Climbers/linians are now used for hive fastening and their flowers for bee fodder. On the basis of these criteria several trees are mentioned as preferred hive making trees (table 5.12).

Table 5. 12: Most preferred trees for hive construction

Species Name	Frequency of users		
	Masha-andracha(n=22)	Sheko(12)	Total
Euphorbia abyssinica	34		34
Ficus Species	22		22
Aninjeria spp	19		19
Worango/local name	29		29
Cordia africana		22	22
Croton macrostachys	9		9
Arundinaria alpina	13		13
Folyscias fulva	7		7
Ficus sur	11		11
Celtis africana	5		5

Trees used for fumigation and smoke

Baiting is often considered as determinants of the rate at which a hive could attract bees and be colonized. Neatly constructed, baited and cleaned hives is reported to be attractive to bees if it is located in places where bees found at higher density-often in the forest. Beekeepers stated that the success of beekeeping, among other things, depend on the efforts vested on quality assurance of the traditional hive; as the forest (resource environment) is more or less similar. To this end, they have listed several tree species that they use to increase the fragrance and neatness of the hive (table 5.13).

Table 5. 13: Trees and shrubs frequently used for baiting and fumigation

Plant species	No. of users		
	Masha-Andracha	Shiyta	Total
Ekebergia capensis	33		33
Piper capense	6		6
Clausena anisata	11	13	24
Olea spp	30		30
Cyathea manniana	8		8
Vernonia spp	2	10	12
Desha (local name)		2	2
Gojibar(local name)		2	2
Eucalyptus	2		2
Soyoma (local name)		5	5
Maesa lanceolata		1	1

NB:Wax is the best baiting material mensioned several people, but as harvesting of wax and baiting time do not coincide and farmers are not able to store for next year, they often use other substitutes from tree/shrub products. Only four farmers reported as wax users.

Conclusion

In summary *schefeleria* spp. and *vernonia* spp. are the best forage trees while Cordia and bamboo the major hive making and *aninjeria, Polyscias fulva* and *ficus* spp are given the top priority as hive hanging tree. *Eckebergia* and *Clausena* are the most preferred tree and shrub for fumigation of hives. Some tree species has cross cutting use. In addition to

Cordia africana which mentioned earlier, trees like *Folyscias fulva* used for hanging making and fodder. *Vernonia* spp are used as a hive making and fodder tree. *Eckebergia capensis* mentioned as useful fodder, hanging and fumigation/baiting. Croton serves several functions except fumigation and because of its abundant in all agroecology and sites, it is found to be the most frequently used species for beekeeping.

5.3.3 Tree/forest management practices for honey production

i) Introduction

Farmers stated that they are partaking in several tree management and forest protection practices with their own initiatives. The major practices they are currentely involving are protecting and preserving big trees, tending and protection of younger trees. They also make some planting activities from seedlings. About 97 percent of the respondents involved in one or other forms of forest management practices (fig. 5.2).

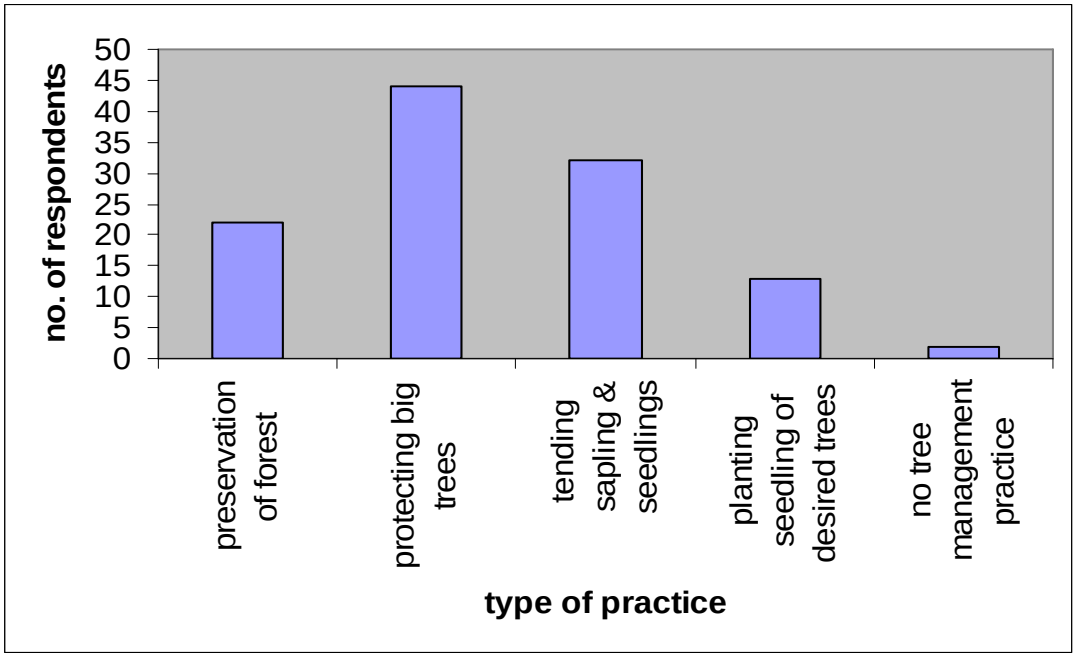

Figure 5. 2: Farmers' level of involvement in tree management for honey production

ii) Protection and preservation practices

Preservation of valuable trees: Farmers contribution to the preservation and protection of scattered big trees found in inside farm, home yard and grazing lands. Big trees are preserved for they need them for their hive hanging especially on non forest land uses. Scattered trees in the non-forested landscape are well used as for example, farmers were asked whether they do or do not preserve indigenous, economically valuable honey tree species on their lands, that a 'yes' response represented by 79% of the respondents and reported that they retain big trees in their holdings and even do not fell big trees that are found in non owned forests (figure 5.2).

More over, it is culturally rude and unpleasant undertaking to fell big trees and may lead to out casting of the doer and/or abided by fear of bad luck as a consequence of the act. Hence, less pressure will be expected even on privately non-owned big trees. This could be indirect and systematic method institutionalized in their culture to save honey plants. However, elders reported that the younger generation with less interest for honey production often less abided by local rules and extract big trees for sale. Beekeepers also reported that they tend and protect naturally growing tree seedlings in their homeyard crop land and kobo forest.

Protection of entire forest: 34% of the respondents reported that they work for the conservation of the forest by lobby, local discussion and in some cases by reporting free riders act to state forest service. In sheko area beekeepers have entered pact to abort likely causes of bushfires during honey harvesting and if in case it occurs they have agreement to communicate each other and check it before it eat the forest.

In conclusion, about 20% of the respondents plant tree, while 50% retain and tend sapling and naturally regenerated seedlings at their home garden and kobo lands while 79% and 34% engaged in preservation and protection of big trees and entire forest respectively. See figure 5.2.

iii) Planting

Farmers plant both exotic and endogenous trees around their home. The major planted exotic trees are Eucalyptus, cupressus and to some extent grevilea and pinus. These exotics are not meant for beekeeping as prime objectives. But some indigenous species like prunus, folyscias, olea are planted in their homeyard for beekeeping, mainly as suitable hive hanging trees. On the bases of household interview, 20% of the respondents started tree planting among which about 12% planted for the purpose of honey production especially to get good hive nesting tree at suitable location.

Purpose of management

The purpose of tree/forest tending and management practices are diverse, but the major ones are; to proactively response for dangers of honey tree scarcity, secure construction demand, and to prevent dangers of drought and for other uses (table 5.14).

Table 5. 14: Diversity of purposes for tree management

Purpose of tree planting/retaining	Frequency	Percent
To get suitable hive hanging tree at suitable place	17	26.6
For hive making and hanging	15	23.4
Hive making	10	15.6
For other wood based benefits	5	7.8
No planting	5	7.8
Increase forage	3	4.7
Hive making and increase forage	3	4.7
Hive making, hanging and foraging	3	4.7
Multiple uses	3	4.7
Total	64	100

5.3.4 Perception on the relation of trees/forest and honey production

All respondents agreed that the forest particularly trees are important for beekeeping. They also noted that not only trees but also the entire forest with all its components like the climbers required. Farmers stated that the value of trees for honey production is comparable to cultivable land to crop production. Thus questions were asked whether the reverse is true, except one all give a "yes" response. The major reason is that beekeepers will protect others from tree cutting in his beekeeping area; they are also concerned and refrain from felling for minor purposes and make efforts to the sustenance of the entire forest (table 5.15). Similarly, experts from the regional office recognize the role of beekeeping for forest conservation and it is prioritized as option for benefit generation from forest to forest dwellers and forest fringe communities while conserving the forest.

Table 5. 15: Why does beekeeping assist forest conservation?

Reasons	Frequencies	Percent
Forest conserved to sustain beekeeping practice	29	45.3
Beekeeping is exclusively tree and flower dependent	13	20.3
Protect other from tree felling in my beekeeping area	13	20.3
Beekeepers refrain from tree felling	4	6.3
Fire problem easily traced and checked by beekeeper	3	4.7
Because I need bees which obtained from forest	2	3.1
Total	64	100

Tree management by beekeepers is mainly a response to deforestation. Because of all the interviewed households 74% believes that is the forest gone no more beekeeping. Some of the farmers are even surprised that we have asked them whether deforestation affect honey production or not. 40% of the respondents also mentioned deforestation as the major cause of colony reduction.

Table 5. 16: Perception about tree planting

Planting is not necessary	Frequency	Percent
Strongly agree	3	3.3
Agree	13	21.3
Disagree	37	60.7
Strongly disagree	9	14.8
Total	53	100.0

Even if tree planting is not an intensive practice at this moment, responses show that they are aware of the necessity of tree planting. To confirm their attitude, a negatively constructed question was asked that tree planting is not required for them since there is enough natural forest. But, their response was against this premise and 75% of the respondents disagree to the question and stressed the requirement of tree planting to lessen burden on the forest (table 5.16). This fact also shows that there is a room to increase tree cover by helping beekeepers to involve in planting.

5.3.5 Conclusion: Tree/forest management practice at different land use zones

On the basis of household interview and field observation tree management practices found to vary across land use zones of the survey sites. Tree planting entirely limited to home yard in Masha Andracha but in Sheko especially Shemee areas, tree planting practiced both inside and outside of the home yard in the form of woodlots. But it is still in reasonably closer area for control and also to use for several purposes.

Further from home yard and adjacent woodlots, farm fields occupy the dominant niche. Trees are purposefully maintained in this niche. These trees are protected and tended and receives close protection by the land owner. Little planting activity observed. Trees in this niche in most cases belongs to the owner of the land, except in some cases where tree kobo owner claim entitlement.

Trees in communal grazing land are mostly communal property unless it is honey tree. If it is honey tree and someone has ownership right, even if its location is in communal land, it receives better protection.

The land use zone, next to farmland and grazing land, is occupied by disturbed natural forest. Trees in disturbed or relatively undisturbed forest if it is not known hive tree could not be managed well and little protection made. But forests under kobo holding, although it occupy the remotest niche relative to the previous zones, it will be fairly protected, trees tended to grow as good hive hanging tree. Climbers, deformed trees that they think will compete or divert the proper growth of the hive tree will be cut and small promising trees promoted. They also reported that during tree felling for hive construction or honey harvesting, maximum care will be taken to protect young potential trees from damage.

Non-kobo forests are found relatively far from residential areas but may or may not be far from kobo forest. There are no tending practices involved for trees or the forest at large. Beekeepers reported that except few people who engage in felling big trees for lumber most of the community want its preservation. In any case this is the forest where little protection and sense of ownership reflected, even if state is known as its protectorate.

5.4 Resource ownership and access arrangements for honey production

5.4.1 Introduction

In the previous section, beekeeping practice and technology as well as its interdependence with tree/forest has been discussed. It is also shown that beekeeping has a tendency to depend on the nature of tenure for trees and land. In this section, the various access arrangements governing beekeeping management will be further elaborated.

In the study area there are both legally protected and non protected forests. In the case of protected state forest, access is limited except for fuel wood and non timber forest products including honey harvesting. Experts noted that beekeeping is normally allowed to be practiced both in protected and other legal state forests provided beekeepers do not

inflict damage or extend their use of forest beyond the permitted products. Obviously honey production does have some side effects for example while cutting some endangered trees for hive. *Cordia africana* is, for example, legally prohibited. But it is still the major hive construction tree.

Even if it is theoretically allowed for all farmers to produce honey in state forest, it is not always possible in practical terms. This is because; these protected and non protected state forests are also subjected to a diversity of local ownership arrangements irrespective of the de jure arrangement which are basically kinship based. Several features of honey based ownership and access arrangement presented below.

5.4.2 Access rules to honey production areas

In beekeeping several local regulations in respect to hive locations are presented. These access rules govern both the type of land where hives can be located and the type of trees in which hives can be hanged.

In respect to land, a hive could be located in several locations in compliance with their right to and suitability as a hive hanging place. But the rules governing access and also the reasons a beekeeper has for entitlement to respective locations varies significantly. For instance, a forest could be an apiary site, may be because it has no owner, because honey collection is free in state land, owned by inheritance or other location specific reasons. Therefore, hives located in a certain place could be a privately owned land, communally owned or free access state owned lands (table 5.17).

Table 5. 17: Reasons that enable beekeepers to access hanging sites

Hanging site/location	No of response	Reason
Forest	25	Has no owner
Forest kobo	17	owned by inheritance
Protected state forest	7	Beekeeping allowed
farmland	5	Usufruct right
Homestead	9	Owned by de facto and de jure
All land within the kebele for the kebele inhabitants	2	Local arrangement to exclude outsider when kobo weakened
Forest not occupied by others coffee	2	This is also free land but refers forest coffee areas
Waste land far from other ownership(grazing land)	3	Communal land with where no individual ownership for land
No free land	1	This guy refers state ownership

Asked about the rules and regulations that help them govern the use administration of all hive hanging places, respondents' response vary from site to site. Masha and Andracha districts more governed by local rules under the leadership of elders while in most of the Sheko areas traditional rules eroded and most of beekeeping related issues resolved by common understanding and witnesses. See table 5.18.

Table 5. 18: Rules governing honey production site ownership

	Traditional rule	No rule/ free access	State
Yockchich	7	3	
Chegecha	2	7	2
Beto	9	1	
Bada	3	6	1
Shimee		9	
Shiyta		10	
Total	21	36	3

In respect to trees, the trend is somewhat different than for the land. In some places where there is no arrangement for land, there exist for trees. In Bada area, for example, honey tree ownership respected and accepted by the majority than for the land (table 5.19).

Table 5. 19: Rules regulating honey tree ownership

	Rules		
Study sites	Traditional	No rule/ agreement	state
Yockchich	7	2	1
Chegecha	7	3	
Beto	9		
Bada	9	1	
Shimee	3	6	1
Shiyta	5	5	2
Total	40	17	4

Similarly, bundles of rights beekeepers have for hanging trees in forest land and else where were asked and the responses show that more number of rights exercised in Masha area and decreasing gradually to the Sheko district where rights do not exceed from using the honey from his hive. In this latter case no right could be exercised to exclude other or to inherit. In the latter case, especially Shayta, any body can hang on a tree irrespective of presence of other party hives as far as he found suitable branch on this same tree (table 5.20).

Table 5. 20: Regional variation in Honey tree ownership rights

Sites	Protecting other	using	Chance to inherit	Full private ownership
Shiyta		8		
Shemee	6	7		
Yockchich	10	10	10	1
Chegecha	3	8	8	2
Bada	10	11	10	3
Beto	9	10	9	4
Total	38	54	37	10

Interview about whether these entitlements will perpetuate to the next generation shows that two-third respond yes and the remaining reserved and mention some points to which transfer of property right may end. The major reasons mentioned are absence of male heir, longer years of abandonment of a tree or forest land without using for honey production or cleaning around, allocation of the land for private entrepreneurs by the government and natural felling/death of the tree due to aging. Interviews who mention private entrepreneurs as cause are those found near private farms and who have the experience so far.

The result above for both land and tree ownerships shows majority of the rules that allow to or deprive from free riding are traditional rule and trust among themselves. Comparison of the tenure systems for land and tree shows that there is more right for hive hanging trees than for land. As table 5.15, shows only Beto of the Masha district that have higher right for hive hanging land(forest kobo) followed by Yockchichi. In Bada there is still the kobo existent but it does not rule the practice and can no more be dependable. And only small portion of people agree that it is worth to conserve the tradition. Moreover, in all districts, even if there are many hives in state forest, they do not believe that state will regulate their ownership and will secure their owner rights in case of conflict. Expert interview shows that beekeeping is allowed in forest lands but they do not think that, unlike croplands, there will not be issued use right certificate for kobo lands. It is observed that land ownership certificate is being given for farmers to ensure their holding as an option to increase sense of security while the land is still under state control.

5.4.3 Diversity of hive-based tenure arrangements

Data from household interviews and group discussions clearly revealed the presence of large variation in tenure arrangement. As a result, it is found appropriate to present it in comparative form.

The arrangements of land and tree tenure for honey production can be approximated into four major types. These are free access to use hanging tree, temporary tree tenure, tree tenure and forest land tenure for beekeeping. The arrangements vary as a function of regions (from Masha to Sheko) and across landscape (from home garden to the remote forest areas) of the same regions. But variations are not clear cut in all its characteristics.

Free access: is a type of arrangement where a person can put/hang his hive at any forest, tree or land and some other person can do the same on the same land or tree at the same time without any precondition. In some cases, there is several hives of different people on the same tree. Thus, only their hive and the colony inside that could be regarded as owned by someone. The rest of the resources freely accessible “common property” and any one coming from that community could be legible to make use of it. As a result, more than one person reported to hang on the same tree if he found the tree as suitable.

This type of arrangement is very common in the disturbed forest areas of Sheko. It also found in far and inaccessible forest zones of all districts where there is less honey

production stake so far and if the land has no owner with respect to honey production or other land use practice. Those lands are free from the respondents perspective but it is known that it is under de jure ownership of the state.

Temporary tree tenure/communal ownership: Beekeepers reported that, in this type of arrangement, the tree upon which a beekeeper hanged his hive will be under his ownership so long as his hive stays there for any length of time. Once his hive is removed for so many reasons he can not claim for ownership and any body who is interested for such specific tree can replace the ownership just by putting his hive on. These areas are communal by de facto while state owned under de jure tenure system. This type of arrangement is mainly found in Sheko.

In shemee, although indigenous people assert that hive tree ownership still respected. It is found that there is no common understanding of the rule because there are several new settlers and youngsters who started beekeeping and does not know the indigenous local rule. The latter group assumes that hive hanging constrained by skill and time other wise they believe they can do on any tree they believe appropriate. But it is reported that indigenous people hang their hive far from residential area and have their own separate hive sites but not claimable as own land. They said that before the Derg regime, land surrounding the hive tree is under the ownership of the hive tree owner.

In Shiyta, the system is dissolving and there is no responsible body to exercise the previous rules. So, by common understanding, they agree that a hive hanging trees remain under the ownership of the hanger if the hives ones removed any person can hang on it and continue his possession as far as his hive is there. But there are other exceptions. If the tree on which the hive is perched on found on the hive owners' cropland, coffee forest or other legally owned land the tree will remain at the hands of the land owner without restriction. Thus, in this latter case, the tree ownership was more secured. But the increase in number of right and length of use is the result of cropland ownership and does not attributable to beekeeping ownership ideals. In any case, it has offered more ground to use for beekeeping.

Tree tenure: in this case the tree on which one has ever been used for hanging hive belongs to the hive owner not only with hive presence but also with possible extension after he removed his hive. In this form of arrangement, unlike the previous forms, trees are the owner of the hive and could remain under his entitlement for future use for hanging. And there is a right to exclude or protect from others. But if the owner totally ceased tending the tree, cleaning around and hanging hives for longer period, ownership of trees could end and be shifted to other peoples. And not only tending but also he needs to make known by his neighbours or other peoples that he is still practicing. Because it is mentioned that in case of disagreements there has to be witnesses. Other wise elders can not know all property ownership distribution throughout the village and only by the help of witnesses that they (elders) will help resolve the conflict.

Another situation is that, when a person gets older and has no and has no male successor, other peoples will ask his consent to use his trees and most often he will allow them. But

if he refused to transfer to other person, it will stay under his ownership for several years or even decades. The number of years to which ownership claim sustain reported to be dependent on the powerfulness of the person or his relatives apart from the local rules. Thus, if he is less powerful, it is likely that ownership will lost shortly and viceversa.

This system is practiced in sites where there is no ownership right for the land to which the honey tree is found. It is mainly practiced in grazing lands, non kobo natural forest. With respect region, this system is more dominant around Chegecha, also around Yockchich and Bada. In the latter two, it is reported that kobo land system still surviving but with tighter tension from youngsters, non indigenous farmers and outside stakeholders.

Tree and land tenure: This form of arrangement is found in forest kobo and homegardens. But in the case of homegarden and crop land entitlement to land stem from other land use system and beekeeping is subsidiary. Thus only in kobo land that land ownership exercised as a result of beekeeping for beekeeping purpose. In the arrangement locally called “KOBO” the trees and forest land distinctly bounded (and known by the community, local elders, clan leaders and at least by some of the local community as bounded) and owned by respective heirs. It is a tenure system which bases on ancestral claim and strongly based on this principle in case of conflict resolution.

The system works even crossing federal state administration and any person from Southern state could have kobo holding in Oromia state and vice versal. Adjacent owners will always negotiate in case of disagreements. And only when they are unable to solve by themselves that they will take the case for elders. It will be often resolved by elders and clan leaders at last. Only few cases reported to pass this step and reach at legal administrative bodies. Local government administrations also often solve cases by consulting elders or taking them (elders) as testimony to make a final decision.

In kobo system, it is mentioned that trees are properly managed and promising trees that could be a good nest tree will be tended and protected from damage. Beekeepers remove less vigorous trees to avoid competition on potential hive hanging tree that grows tall and straight. Climbers, although, favoured for their flower provision, could hinder straight growth of hive hanging trees. In this situation they will remove the climbers or lianas. Maximum protection is made to avoid damage on standing trees while felling trees for hive making or other purposes. Beekeepers noted that kobo forest close to access roads and home yards are more susceptible for poachers and they reported as difficult to control.

According to the group interview result forest (land) kobo exists in Masha and part of Andracha and reported to exist in Sheko only in the past. Across the landscape, kobo land is far from residence but this time as residences expanding and closer to forest they showed us that the kobo land is a few kilo meter far in Yockchichi but still remote in the case of Beto.

In all areas where land ownership entitlement claimed, because it is their homegarden, crop land and/or coffee field, trees and hives found there belong to the land owner.

Exceptions have been also identified. For example if some one cleared a certain area and possess the land, it does not have the right to exclude the ancient kobo owner from using trees unless they mutually agree to do so with some sort of compensation. More over, If there is common vicinity and if formerly one of them used to use the tree for hanging, it still belong to him and theoretically allowed to hang. But the latter reported to be constrained to implement practically as bees will frequently sting the neighbour and could urge to stop hanging there. Trees both in crop land and home yards of such type are normally not allowed for the hive owner to fell it. Because they said honey tree is not to fell, for that purpose the land or home yard owner has equal right. Thus, there are some complexities, but it is successfully administered through the auspices of trust and common understanding.

5.4.4 Disputes and their resolution mechanisms in honey production

Respondents listed several types of disagreements in using trees and forest land for honey production. But two of them are the most important. The first is that arise among beekeepers and the second that could arise between beekeeper and other land users.

In the first case, disputes mainly occur when a beekeeper knowingly or unknowingly hang on other person trees. From the interviewed households about 20 respondents have been quarreled with other beekeepers. The sources of the conflict and resolution mechanisms are reported to be different. They have listed about ten different types of conflict sources. These are hanging on other hive tree, boundary conflict in kobo land, felling of tree from others kobo land or ones honey tree, dispute of ownership entitlement over tree or land, competition for single tree which has no owner before, harvest conflict because two person have been using same tree for hanging, killing of neighbours' livestock by bees, fell the branches of hanging tree as the tree is found in home area of the non hive owner, hanging hive on others farm land without consent and honey theft. In Masha, the problems are more of boundary conflict in Andracha hanging tree conflict in Sheko, less conflict reported. Most of the cases arise from the first two weredas.

As for resolution, most of these handed to and managed by local leaders, only two cases taken to kebele administration while three other cases solved by mutual agreement of the contesting parties. When conflict arouse, local elders often try to know whose ownership long years ago and use it as a hint to infer the current owner, especially if the claimants are young and less known as whether he possess the respective lands or not. Thus, if elders or clan leaders know that it is owned by father of the claimant it is automatically given for him and who his father has no ownership right will be considered as breacher of the regulation and will be warned not to raise such type of contest again.

The second type of conflict arises from contesting use of the forest for honey production and other land uses. The most frequently raised of such type is the conflict between honey producers and tea and coffee producing entrepreneurs. This is still a conflict area as it is beyond the local capacity and still remained deadlock. There are also conflicts that arise from fuelwood and other forest product extractors, mostly Manjo tribes and beekeepers. This is solved easily through edir (a local institution) and local elders. In this

case the beekeeper always has the authority to check the act as far as he saw the wood collector and found disastrous for his practice. So it is often less significant problem. Another conflict arise with beekeeper and illegal loggers who want to extract valuable timber trees like *Aninjeria* and *Cordia* that are hive hanging trees or trees in kobo land. In this case, problems mostly solved by legal procedures.

Conclusion

Honey production and administration of related resources heavily relied on the local rules, common understanding and arbitration by local elders as well as the will of residents to be abided by these rules. Honey trees and hive hanging sites have various forms of arrangements. These variations are a function of districts; location within districts and also the level of frequency and management beekeeper invest on the honey tree or land. If a farmer ceases to use a land for long time, ownership privilege could be lost. Trees found in home garden and kobo land have high degree of ownership than other locations.

Beekeeping has three levels/hierarchy of ownership. The first is the right to own bee colony. One can claim ownership of bee colony found in his own hive irrespective of the location where it is found. And ownership for bees will end immediately as it leaves the hive for any reason and no right for swarming bees. The second is ownership of honey tree/hive hanging tree. Honey tree ownership has some room for youngsters without predecessors compared to koboland, in a sense that, the chance of claiming entitlement for emerging young trees is equal for all individuals of the community. As a result degeneration and unacceptability of rules is found more prominent in kobo land than tree kobo. In this case trees are private property while land is communal. But, unless supported by other source of ownership, honey tree ownership alone does no guarantee tree uses other than for beekeeping. The third is ownership for beekeeping land. This form of tenure ensures the owner to use all trees growing in the kobo land and transfer the title to his heir for beekeeping purpose.

5.5 Dynamics in tree-bee management

5.5.1 Introduction

It is reported that honey production has subjected for change due to several factors. The major factor attributes of change are type of technology used, size of hive holding, and location of hive in time and space as well as changes in institutional and ownership arrangements.

5.5.2 Evolution in type of hive technology

According to group discussion and in-depth household interviews, there occur gradual changes and shifts in technology as a result of changing social context, biophysical features and subsequent needs for intensification. As described earlier three types of technologies are identified: the antiquity practice of honey hunting which is withered away and replaced by the dominant traditional technology and also emerging modern technology.

Before the mid of the 20th century, wild honey hunting have been crucial and significant

amount of honey used to be produced through this means. However, the chance of obtaining it and its role sequentially reduced with increased in hive-based honey production, increased accessibility to forest as a result of deforestation, expansion of crop cultivation and other built in environments adjacent and inside forest areas.

The group interview revealed that feral honey harvesting method itself contributed to the degeneration of the practice. Because, while harvesting honey, hunters either fell the tree or branch in which the feral bees found and/or damage the specific holes or hallow where the bees found. Thus, they push the bees and gradually lead to process of shift from natural based habitat to artificial hive-based habitat. Also intensification of honey production with hive-based technology gradually attracted bees used to settle in the feral habitat. Informants also point out that deforestation significantly reduced old growth trees which are often rich in cavities and natural hallows and in turn reduced bees' chance of getting suitable natural habitat. In this case artificial hives become the available alternative. Thus the practice and the chance of getting feral honey significantly reduced (See table 5.2).

Even if traditional technology is still the dominant practice, there was also evolution within it. According to group interview, bamboo was the leading hive construction material in Mahsa- Andracha area about thirty years ago. But log hive adopted from Oromia has substituting it recently and the highest substitution takes place in the area nearest to Oromia region. As a result, in Beto for example no farmer found using this technology. Other bamboo hive users are still using it but the number has decreased and currently less than log hives.

However, the dynamics in hive technology seems some what stagnant at this stage. Although the first attempt for top bar hive (locally called modern) introduction started around Sheko in 2000/2001, relatively intensive attempt to introduce it to all study area takes place in 2004. This period is the first of its kind where outside technology intervention for honey production improvement launched in this place. But little extension was made to demonstrate the extra advantages of the new technology (table 5.3). Thus, this is the major reason for not adopting the new technology. Beekeepers are also reluctant to accept the new technology due to the high price compared to their own.

5.5.3 Change in number and location of hives

Based on the respondents, there is change in the average number of hives for the last ten years. The change in Sheko towards decreasing while in Masha-Andracha it is increasing (figure 5.4).

There is also observed change in the location of hives. In the earlier periods, hives was exclusively in the remote forest but in the recent periods although forest beekeeping still dominant, hanging of hives on trees near home garden and in cropland has increased compared to the situation ten years ago.

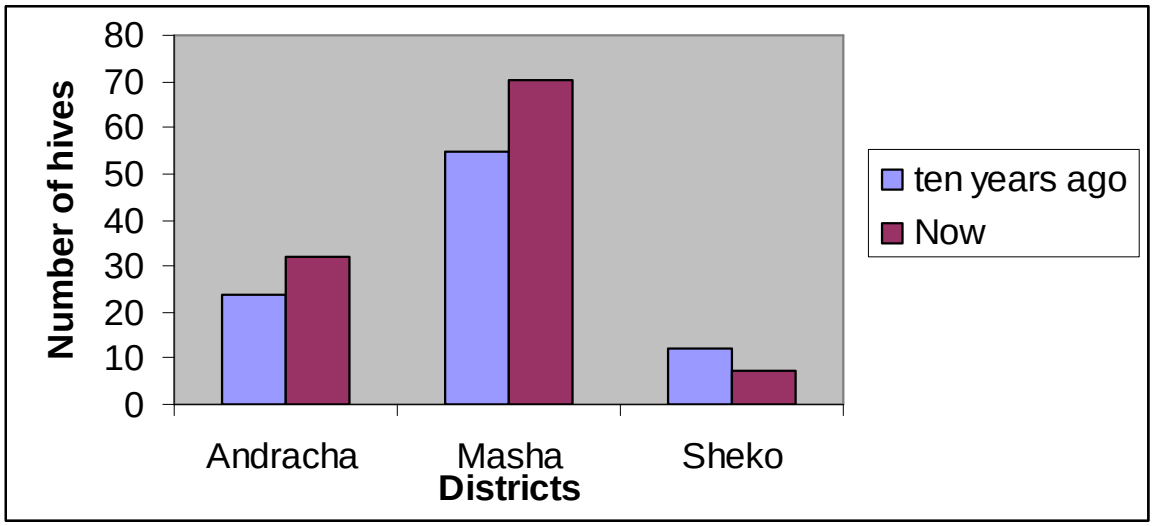

Figure 5. 3: Change in number of hives over time in three different districts

5.5.4 Change in access arrangement to natural resource

Group interview with elders show that a general decrease in legacy and execution power of traditional institution. In Sheko, the Majangirs reported that there used to be a system as that of Masha where hive area is considered as their own land and trees are also their exclusive property. This is not the case these days. In part of Andracha (Chegecha area), kobo land is replaced by tree kobo mainly as a result of state intervention during the previous two governments.

Beekeepers reported that even in Masha where better forest kobo still operational, some parts like Badda area implementation of forest kobo ownership is getting increasingly difficult and unable to exercise kobo right for land even if they still knows that a certain land was ancestrally owned by some one.

The major dynamics with respect resource access is the deterioration of kobo land tenure system due to outside and inside socioeconomic dynamics. The problem of unequal access among local residents particularly disfavoured young and immigrants continuously try to end its existence as institution. Emerging alternative land uses also indirectly contributing by converting kobo forest into agricultural land. State priority to private investment has also lead to substitution of kobo lands to other land use.

5.5.5 Change in legal institution and governance of natural resource

Not only local changes in access regimes, but also national changes in institution on land use changes have impact on bee and tree management for beekeeping. Thus, the constant changes in institution and governance at national level has been reported to have impact on the traditional honey production practice and beekeeping forest resources of the study area.

Elders noted that in the imperial period, land was under the ownership of respective landlords and hives were hanged inside it with the prior consent of them. They also remember that for placing bee hives it was not so serious and the numbers of hive users are also small. So there is little problem and the traditional arrangement was not deteriorated except a few areas.

During the Derg, there was radical and intensive change in land use which goes to the level of redistributing the kobo holdings among local residents as in the case of Masha. It also affected traditional leadership and shifted the power balance by empowering other groups in the local state administration. A settlement program of the period around Sheko is another factor that leads to dynamics in local resource use and administration which raised as a treat for their beekeeping.

The most frequently raised problem especially in Yockchichi and Beto is the result of the investment policy of the incumbent government. They reported that this policy gave land to outsiders at the expense of our displacement from our traditional hive hanging forest areas and changed to tea and coffee plantation.

5.5.6 Conclusion: change in management intensity

Beekeeping management intensity can be characterised by the type of hive technology used, level of tree management practices and tenure condition. As summarized in table 5.6, the hive technology in turn characterized by the type of hive, construction materials used, labour requirement and type of bee having methods and colony management techniques. The current technology particularly the bamboo based hive demands more time than the pretechnology level of honey hunting. But unlike “modern” beekeepers, beekeepers of all hive users do little colony management practices. Traditional beekeepers using traditional hives more interested in increasing their hive number than improving the technology. As a result, increase in the number of hives has observed in most of the study areas for the last ten years which implies increased amount of gross labour input, not because of improvement in technology but as a result of extensification. The traditional hives are used on lands under different tenure regimes from communal to private farmlands. But modern hives are located in privately owned home gardens.

Tree tending intensity decreases across the land use zones from homegarden to far forest except the kobo land. But trees wherever they are located, receive relatively higher management input if they are used for beekeeping. But tree planting is only done inside home garden and honey trees outside homegardens receive only protection and maintenance. So in home yard all practices from planting to protection and tending of young and big trees practiced. Further away, the type of management decreases but at the kobo areas management of trees revitalized. In the kobo area trees receive enough protection and tending practices than trees found in non kobo lands. It is interesting to note that kobo lands are understood as private land by the locals. Generally tree planting for beekeeping is not yet intensive, but there are some undertakings. Table 5.21 summarizes the relation between the intensity of bee management and tree management. It can be observed that there is no direct linear relation between the level of intensity of bee management and forest management. The traditional beekeeping practices are taking

place in different forest management systems under different property regimes. Modern beekeeping practice, however, practiced on privately owned home gardens.

Table 5. 21: Relation between intensity of management of bee/hive and vegetation

Management of bee (hive) →

Vegetation Management ↓	Phase 1 *Hunting*	Phase 2 *Tending wild nest*	Phase 3 Using Various traditional hives	Phase 4 *Modern hive use*
Phase 1 *Gathering*	Wild honey hunting		Production of honey with seasonally disposable hives in open access forest land	
Phase 2 *Management of wild resource*			Use of hives that allow harvesting of honey without displacing bees. Practiced in locally preserved (Kobo) natural forest. Relative stablity for bees. E.g Bamboo hives. Alternatively, temporary hives like soft wood logs are also used.	
Phase 3 *Wild resource cultivation*			Traditional hives placed in home garden systems. Exclusively private land and most often bees keept to the other sides of people and animal centers of activity, to avoid stinging damage	Modern hives in home garden system. more intensive management of bee colony
Phase 4 Domesticated resource cultivation			Placing traditional hives in coffee plantation; in private land of the beekeepers and/or non-beekeeper with permission to keep bees inside	

6 Discussions

6.1 Representativeness of empirical findings

In the study area and the country at large, management interactions of trees/forests and honeybees have not been studied in-depth. Available research has mainly focused on either the biology of forests or of honeybees. For example, Amssalu (2002), studied the biology of bees and gave a brief account of traditional practices, while Kumlachew and Taye (2003) and Friis (1992) looked at the ecology of the forest.

Nevertheless, a few anthropological studies attempted to address the social interdependence of people on forests and honeybees. The first study was by Stauder (1971), dealing with the "ecology and society of Majingir". This study briefly describes the significance of honey production as a major livelihood practice for the Majingir people and their forest ownership arrangement with respect to beekeeping. Individual Majinjirs have well-defined beekeeping areas which they call my 'gang' area, meaning hive area. However, this type of local arrangement is not functional anymore in the Majingir area.

The second study that addresses social issues of beekeeping in the moist highland part of the study area is by Hartmann (2004). This study shows the relationship of the people with forest beekeeping and the internal and external conflicts in resource use and conservation efforts. Similar to our study, Hartmann's research has showed that the local people are aware of the forest significance for their living, especially for beekeeping. He does not explain, however, micro differences in resource management arrangements within the same ethnic group and locality; rather, his emphasis is focused on tribal differences between Manjo and the settled Sheka tribes, and social and resource access discrimination against the Manjo tribe by the latter. This is the only study that looked at the social context of bee-tree interaction. It expresses the importance of trees and forest conservation for beekeeping.

In Zambia, a study showed that beekeepers conserve forest as it provides them with honey from which they earn cash income (Wainwright, 1992). Similarly, our study has found that farmers' awareness and concern for forest conservation is stimulated due to the economic incentive from forest-based beekeeping. Brown (2001) also has found that bee keeping's return to labour is quite high compared to other livelihood activities. However, Brown (2001) argued that beekeeping may not necessarily lead to conservation of tropical forests based on their study in the Amazon forest. He believes that the ideals of productive conservation through beekeeping could be achieved if grants properly reached local beneficiaries and if their continuity is maintained through strong local institutions.

When compared to some other regions, the beekeeping management practices in the research area are still very traditional. For example, a case study in Buttajira-Ethiopia shows that about half of the interviewed households have 1-9 movable frame hives (Derege, 2004). Also, in a study in northwestern Kenya, Gochora (2003) has found that the share of modern hive technology reaches 9%. Compared to these studies, insignificant number of modern hives have been adopted (four households from the 64 interviewed) in

southwest Ethiopia. Those regions are similar in log-hive usage albeit the types of species and customary rules for beekeeping are different. Moreover, in northern Ethiopia, movable hives are reportedly easily made by beekeepers themselves from local materials like the traditional technologies (Tilahun, 2002). In our study area, however, the locals do not make hives of this technology, at least up to this data collection time.

6.2 Comparison with theories

6.2.1 Management practices

Management of forest/tree

Forest management is defined by Wiersum (1997) as the process of making and implementing decisions about the use and maintenance of forest resources and the organization of related activities. Forest management involves three major types of practice: controlled utilization of forest products, protection and maintenance of forest stands, and purposeful regeneration and domestication (Wiersum, 1997). Thus it includes all technical and social arrangement with respect to utilization, maintenance, regeneration and planting practices and its administration (Wiersum, 1997). Normally these principles are elaborated in respect to tree resources only; however, animals also form an important forest resource. As indicated by our study, the principles indicated by Wiersum (1997) can also be applied to animal resources, even if there are some differences as a result of the nature of animals, for example, the uncontrolled long-range foraging of bees. Types and intensity of management vary along land use zones and tenure conditions. Controlled utilization is common in the forest, purposeful regeneration in all land use forms and tree planting around homegardens. Forest management, especially retention and purposeful regeneration of trees and forests, are well conducted with the beekeepers' own initiatives. Cultural respect for big trees has also helped the intensification of these forms of management.

Hive and colony management

Hive management**:** According to Crane (1990 and 1992) several types of hives have been used in beekeeping history in the tropics and the world at large. The first controlled utilization in honey production started mainly with log-based hives, often with one opening. But in its advanced forms, it may have two openings and be fitted with removable closures (Crane, 1990). This is comparable with the log hives of Masha and Sheko respectively. Evolutionary higher on the ladder, Crane (1990) also described the variants of movable hives. One of these variants, the Kenyan top-bar hive, a top-bar system with Langstroth hive boxes, has recently been introduced in the study area. Except for the baiting of hives and protection against vermin, more intensive forms of colony management are not practiced in the study area.

Factors affecting intensity of management interactions

Types of forest management practices and their intensity could be affected by social imperatives like resource access and institutions (Gilmour 1990; shepherd 1992; Arnold, 1995 cited in den Hartog and Wiersum, 2000; Agrawal and Yadama, 1997, Paudel and Wiersum, 2002; Melaku, 2003) as well as increased market prices and population pressure (Agrawal and Yadama, 1997; Wiersum, 1997; Den Hertog and Wiersum, 2000).

In this study five issues are worth mentioning: tenure, the peculiar nature of beekeeping and its relation to other land use systems, population pressure and marginalization of beekeeping.

The management interactions in beekeeping are governed by varieties of local tenure and legal property-rights arrangements. Feral honey collection takes place in open-access conditions within the claimed land of the ethnic groups. Later, hive-hanging sites changed from free access forests to communal lands, partially private kobo ownership and recently to homegardens. Moreover, three government changes resulted in three different constitutions and tenure policies for trees and land (Melaku, 2003). Hence legal forest tenure changed from free access to private ownership by feudal lords, to state ownership in the military regime and current adminstration. Despite amorphous state regulations, beekeeping has been mainly administered by gradually evolving local rules that has changed from communual ownership to privately owned kobolands. But while tenure has affected the type of management a beekeeper invests in trees, and a gradual intensification in tree management is observed, it does not have a prominent impact on the type of beehive technology used.

In the kobo system, which is more remote than other parts of the area, stronger local rules are exercised compared to the disturbed forest and croplands. Security of hive ownership decreases with decreasing respect for the kobo system. Whereas land, tree and hive ownership are well protected in the kobo regions, the number of rights for these resources decreases in other land uses except home yards. Yet, it is less intensive compared to home gardens and no tree planting is practiced there. To compare differences with homegardens, kobo rules are limited to beekeeping. Even if beekeeping is allowed in the kobo land, withdrawal of other tree products is not allowed, and trees are mainly meant for hive-hanging and construction with no guarantee or compensation if the state allocates the trees for other uses. Thus state laws limit the right of locals to manage internal use patterns (Agrawal and Ostrom 1999). Consequently, the amount of expenditure for management is lowered compared to homegardens. The fact that tree and land ownership rights are better exercised in home gardens may stimulate investment in tree management practices including planting. Moreover, trees in home gardens can be used for any purpose the owner would like, and in case the state needs the land, compensation will be given. Comparatively, the land use zones in between homegarden and kobo land are less intensively managed with respect to beekeeping. Thus, the Kobo system can be seen as an exception in the traditional system of management where intensity increases from deep forest to homegardens.

Marginalization of beekeeping and faster evolution of other income drivers have lead to deintensification of the practice in Sheko, and slow intensification in other areas. De-intensification in the Sheko area, is the result of unequal promotion of local practices. For example, there are a number of coffee varieties and people are stimulated to adopt them due to government incentives since the previous regime, and there is research station for coffee development. But in beekeeping there is no effort to modernize the traditional practice. Local beekeepers are losing their beekeeping land to private coffee and tea entrepreneurs. Youngsters are also gradually shifting to other alternatives as beekeeping

is risky and requires additional skills of tree climbing. These factors, coupled with the more immediate return from coffee than from beekeeping, and the lack of awareness and capital by beekeepers for modern hives, leads to de-intensification or stagnation in beekeeping rather than intensification. De-intensification has also been reported in other areas and transition from one form of production to another is not necessarily towards intensification (Fairhead & Leach, 1994; Wiersum, 1997; Ros-Tonen and Wiersum, 2005).

Management interactions of beekeeping are also affected by the peculiarities of the practice. Placing hives requires little area, while bees forage over large areas (Visscher & Seeley 1982; Seeley, 1995). Moreover, bees use resources like pollen, which is hardly used for other purposes, and the pollination role of bees to the source plant enables the beekeeper to keep bees on other private lands (Crane, 1990). In this case the beekeeper may not spend money managing forage sources. On the other hand, honeybees in the region are aggressive and this may deter a beekeeper or land owner from placing hives in nearby areas; this in turn affects intensification.

With respect population pressure, it has resulted to extensification, because there is enough tree cover even in the domesticated land-use zones for expanding production. Moreover, beekeeping as a production process neither harms nor consumes the production environment, nor competes with other primary production practices except for making hives. As a result, the additional labour due to increasing population resulted in an increase in the number of hives. According to McNetting (1993), intensification could be “a higher total output in the spatial and temporal context”, and if the number of hives is considered as proxy for increased yield and intensification, beekeeping practice of the study area can be considered as intensified and in agreement with the forest exploitation model of Wiersum (1997).

6.2.2 Dynamics in management

Several evolutionary development models have been developed for different resources: animals, forests/trees agricultural crops and beekeeping development models (Bokony, 1967; Harris, 1989; Wiersum, 1997; Crane, 1992). Wiersum (1997) noted that in the process of domestication, factors like exploitation practices, institutional arrangements and ecological effects covary with the level of forest management stages. According to Wiersum (1997), three thresholds can be identified: between the uncontrolled and controlled procurement of wild tree products in the natural forest; between controlled procurement of wild products and purposeful regeneration of valuable tree species; and between the cultivation of wild trees and the production of domesticated trees.

Beekeeping starts with the uncontrolled procurement of honey and continues through controlled collection from feral bees found in ancestral claimed land, to honey production from traditional hives located in the forest, and recently in their croplands, coffee fields and home yards. Honey collection from modern hives (KTBH) is not yet experienced, although the technology has already been introduced, as it is very recent venture. Thus, in comparison to the forest domestication model (Wiersum, 1997), the transition from opportunistic hunting to hive-based forest beekeeping occupies the first threshold. The

shift from traditional hive-based forest beekeeping to modern hive-based technology practices may occupy the second level and the third threshold has not occurred. The third threshold would have been the technological transfer from Kenyan top-bar hives to the movable frame hive where fully domesticated and sometimes hybridized and genetically improved bees are kept.

Tools and technologies used in beekeeping have been changed from 'no hive' through a series of steps and have marginally reached the stage of modern hives. The situation in the study area is in line with the basic principle of technology development, as evolution took place from no hives to top-bar hives, with several variants at each level (Crane, 1992). However, there is evolution within traditional hives that are not in agreement with the Crane (1992). For example, bamboo and climber-based hives were generally replaced with soft wood based log hives. Soft wood log hives may ease practice, but it is at the expense of damage to the bee colony, the honey quality and the hive itself, rather than a technology development. Moreover, it is less complex in its nature than the bamboo or climber-based hives. The objective of log hive use is, therefore, unlike the evolutionary model which hypothesized that intensification results from increasing labour and capital to produce more from small units of land (Harris, 1989; Wiersum, 1997); it is rather to produce more hives in a shorter time and thereby increase production. Thus bamboo, although durable and enables harvest without chasing out the bees or damaging the hive, due to its high labour requirement and resource scarcity, has been replaced with soft-wood log hives.

With respect bee and colony management, there is an unequal level of change among regions. In the Masha area, bees are managed in a single-opening log hive, which is often called an improved variant of the bee-killing stage of honey production (Gentry, 1982), while in the rest of the area hives with two opening are used, the latter modification enabling the harvest of honey without damaging or removing bees and generally considered an improved stage (Crane, 1990). But in general, it is still at its traditional stage and only partial domestication of bees from the earlier uncontrolled bee use to controlled procurement has been achieved. According to Terrell et al (2003) a species is considered domesticated if another species is able to exploit it.

The production environment has also gradually been converted from closed forest to disturbed forest, croplands and home gardens. These days, hives are located around homes, croplands and in any forest patches, compared the traditional system that mainly used only deep forest. Although each of these landscapes is in use for beekeeping, the size of production has increased in the domesticated landscapes compared ten years ago.

Conclusion

Management of forest-beekeeping practice in southwest Ethiopia is in agreement with the major concepts and principles of forest management and beekeeping evolutionary development models. But there are a couple of incongruencies noted with respect to the kobo system, bamboo-log hive transitions, intensification with respect amount of labour input per unit of land and de-intensification in the Sheko area. Limited promotion effort by the state and low acceptance/adoption rate of modern hives by beekeepers is also

another factor that has slowed down technological development.

6.3 Reflection on Methodology

The method used for data collection in this research is triangulation, the accepted method in social science research. The multiplicity of methods is usually considered as a strength, as it addresses several issues and explain the set of phenomena and interactions in a given context from various angles.

However, there are limitations as well as strengths in the overall procedure and also in specific methods. Questionnaires were prepared in multiple steps and various epistemic and local communities were consulted before addressed to actual respondents. Thus they are fairly logical and powerful enough to collect the required information to achieve the objectives. However, it is found that the questionnaires were too long and some respondents show uneasiness. Certainly the questionnaires could have been reduced considerably without affecting the research objective, as some data was left unused.

Major constraints on interviews were the three-step translation of the original questionnaire. Some responses showed that a few questions were flawed in the process of interviewing, although efforts have been made to avoid this incidence. This was found to be partly due to the limited earlier experience of the enumerators and the researcher.

Enumerators were local development agents and rural development experts, the majority of who are familiar with the culture. The fact that they are familiar with the culture may be taken as a merit, but they are also considered as government agents and this limits the willingness of farmers in some issues. For instance, it is found that respondents are hesitant to reveal quantitative figures about their yields. Figures about production were also found to be inconsistent, for example, between total production and production per hive. This problem coerced the researcher to leave the livelihood variable left unexplained.

Group discussion was entirely led by the researcher with the help of a translator. It was made clear for them that the researcher is not a government agent and they agreed to discuss the issues without hesitation. Group discussions continued for unexpectedly long times in most of the sites as a result of the groups' interest. However, it was observed that the locals were reluctant to criticize boldly the former speaker and there was a tendency to dominate the discussion with some outspoken people at the expense of many abstainees. Several techniques were used to create open discussion environment and avoid abstinance.

Results from experts were too general, partly as a result of the nature of the questionnaire and partly maybe to keep consistency between the working legal rules and their personal responses. It was also found to be difficult to get interview responses from some of the experts. Due to the nature of the samples (purposively selected type), data analysis was restricted to descriptive statistics.

7 Conclusion

Forest resource management does not only involve trees but may also involve animals. Beekeeping provides a good example of interaction in tree management and animal management. As demonstrated by this study, both tree and bee management practices are dynamic. Beekeeping in Ethiopia has a long history and is gradually evolving from one form to another. In the history of honey use by humans, opportunistic hunting of wild honey from feral habitat occupies the distant past. It is followed by traditional-based honey production which has diverse variants based on the type of material they are made from, their durability/strength, the labour requirement to make the hives and bee colony management approach. On the bases of these criteria, three major traditional hives can be identified: the bamboo hive, cordia-made log hive and soft wood log hives. The first two are considered as durable but expensive to make, and the latter easy to make but less durable. Change of technology from bamboo hives to soft wood log hives is the dominant trend in the study area. A change from traditional to modern hive has occurred only marginally in the research area. The causes include; lack of extension to familiarize and introduce the technology, unaffordable price, needs for frequent monitoring and etc. It is also found that beekeeping is further expanded outside of forests to cropland and home gardens, even if forests are still the dominant niche. Management dynamics in terms of extensification, by increasing the number of hives and the area of coverage from forest to all landscape forms was found to be the dominant feature in the research area, rather than intensification through the use of modern hive and intensive labour over small unit of land.

Dynamics in beekeeping technology is not uniform throughout the study districts. Some already started settled form of beekeeping while others (Masha and part of Andrach beekeepers) still displace bees during every harvesting season. Beekeepers have a diverging view in the destructiveness of seasonal displacement of bees. Some praise it as strategy to use seasonal patterns of flowering in low land and highland while others consider it as lack of alternative. Basically, bees of the region migrate in search of food. But the fact that serious damage inflicted on the colony during honey harvest makes the possibility of successful migration unachievable.

A prominent feature of beekeeping is its dependence on trees and forests. Previously, trees and forest in beekeeping are often associated and praised mainly for their value as forage resources. However, it is found that in addition to fodder, trees and forests has also other multiple values like hive making, perching/nesting, baiting and fumigation. Climbers and lianas are also used to fasten hive components together and also to the tree crown so that wind and vermin can not easily knock down the hives. The multiplicity of benefits derived from the forest/trees increases their value and the services thereof may stimulate the local people to actively conserve and manage forests and trees. Apart from the harmlessness of beekeeping on the forest, unlike many agricultural activities, it has strategic significance which encourages the local people to be on the side of conservation, in contrast to the conventional situation where the government call for forest conservation while locals prefer to convert forest into locally utilizable land use forms. Beekeepers are well aware of the need for the need of the forest and concerned about the increasing

deforestation trend by different actors. Furthermore, beekeepers perform forest management practices mainly focusing on retention of trees and protective tending of naturally sprouted young growing trees, so as to use for hive hanging at suitable places. However, these latter are more pronounced on private lands. Tree planting is also started in home gardens.

Beekeeping is often considered as a practice without or with little land. In the study area, however, beekeeping lands are highly valued and extensive forest areas (called kobo) maintained for beekeeping purposes. There are also established traditional institutions and local arrangements to manage beekeeping lands. These arrangements allow local people to inherit beekeeping tree/land. But strength of local rules varies from place to place, and in some places ownership right may not be transferred to heirs. It is also found that internal dynamics with increasing non-kobo owner farmers and external influences, particularly state priorities and associated regulations have significantly reduced local authority to govern these resources. As a result, the sheer size of kobo administered land is shrinking and only around Masha Kobo land still prevails. But beekeeping is not limited to this system and it is further expanding to non-kobo lands like homegarden and croplands.

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9 Annexes

9.1 Annex I: Household Questionnaires

I) General information

*ZONE*_____ *Age* _____ *sex*_____
*DISTRICT*_____ *No. of family*_____
*KEBELE*_____ *Name of enumerator*_____
Name of HH head _____

II) History of beekeeping

1. For how long have you been practicing beekeeping?

2. Which beekeeping technology did you use ten years ago? And now? Why did you (not) adopt a new practice?

3. How many beehives did you have ten years ago? And now? Why was the number changed?

4. Where was your hives located ten years ago?

5. What problems do you experience with the beekeeping technology that you use?

III) Hive technology

1. Which hives do you use? Why?
    i. No hives = honey hunting
    ii. Log hive
    iii. Bamboo hive
    iv. Top bar hive
2. If you get honey from opportunistic hunting, how often you obtain such chance? What about ten years ago?

3. Please explain the advantage and disadvantage of each hive technology

4. Is there any option other than wood for hive making? If yes what type and why don't you adopt it?

IV) Spatial distribution of hive locations

1. Where do you locate your hives?
    i. Natural forest kobo land
    ii. Natural forest non-kobo land
    iii. Secondary forests
    iv. Religious forests
    v. (Coffee) plantation
    vi. Home garden/crop land

2. How many hives do you have in each location?

Homestead	kobo land	religious forest	2dary forest	plantations	Other sites

3. What type of hives do you use in each location? If different, Why?

Homestead	kobo land	religious forest	2dary forest	Plantation	other sites

4. Where do you think is the appropriate site for modern hives? Why?

5. If you locate majority of hives near homestead don't you face scarcity of bee forage problems?

6. If you agree with the above, what option will you use?

7. Is there a difference in colonization of a newly hanged hive by bees between residential areas and forest land if you hang the same quality of hives? Why?

8. What about between at ground level and on tall tree?

9. Why do you hang hives on tall trees?
   i. to protect theft
   ii. to avoid vermin attack
   iii. To make visible for swarming bees
   iv. To ease pollen collection for bees
   v. Other

V) Competition of honey production with other forms of forest use

1. What is the effect of forest coffee production on honey production?
   i. No effect
   ii. Slashing of undergrowth and vines decreases bee forage
   iii. Coffee flowers give good honey production and stimulation of coffee growing increases bee forage
   iv. People cultivating forest coffee do not allow beehives on their lands
   v. Anti-fungi used for coffee are poisonous for bees
   vi. Coffee generate better income than beekeeping and therefore replaces it
   vii. Other, specify

2. Can you handle enset production and beekeeping on the same land use at the same time?
   i. Yes, there is no any problem
      Yes, But _____
   ii. No,
      Bees prevent frequent visits to home yard

Enset don't provide fodder
It invites more ants
Undergrowth cleared

iii. Other specify

3. Do you know any other crop that negatively or positively affect honey production practice? If yes, mention which crop/s and how does it affect?

VI) Important tree species

What are the 3-5 most important tree species for honey production?

1. For manufacturing your hives
2. For hanging your hives
3. For bee forage
4. For smoke/charcoal making, fumigation
5. Other purposes
6. Please tell me the flowering season of fodder tree species

VII) Forest and tree management practices

1. Have you ever undertaken any activity?
   i. To preserve forests for honey production
   ii. To retain specific old trees for use in honey production
   iii. To protect any young trees for future use in honey production
   iv. To plant trees for honey production
   If yes, describe which type and why

2. In case you protected young trees or planted trees, for what purpose did you do so?
   i. To be assured of future material for hive production
   ii. To get trees which are well-suited for hanging hives
   iii. To increase the availability of bee forage
   iv. Other

VIII) Perception on the role of forest in honey production

1. Do you think forests are important for beekeeping? 1=yes; 2= no
   Yes (explain why)

   No, because

2. Do you think that the disappearance of forest has a negative effect on honey production?
    i. Yes, why?

    ii. No, why?
3. Do you think that beekeeping does stimulate forest conservation?
    i. If yes, in what way?

    ii. If no, why

4. Who do you think much affected if this forest has gone?
   i) Honey collector ii) Government iii) Cereal farmers iv) Livestock owners
   v) Other

IX) Tenure arrangements regarding honey collection and hive locations

a)Land tenure arrangements

1. Are there any places where you can freely collect honey and/or place your beehives? If yes, where?
2. What regulations exist for putting beehives on the locations where you have placed them?
    i. I can hang hives everywhere:
    ii. The hives are hanged in trees on my own private land;
    iii. I am entitled to rights for hanging trees on kobo lands;
    iv. I had to get permission of the owner of the land on which the tree is growing
3. Who gave you permission to put your hives at the locations where they are?
    i. Land owner
    ii. Clan leader who oversees kobo-forests
    iii. Village head
    iv. Representative of forest service
    v. Free right
    vi. other

b)Tree tenure arrangements

1. What are the regulations regarding hanging hives in trees where you put them?
    i. I can hang hives everywhere as far as the tree is suitable;
    ii. The hives are hanging in trees on my own private land;
    iii. I am entitled to rights for hanging on trees on kobo lands;
    iv. If I have hung a hive in a tree, no-one else can use that tree for hanging hives;
    v. I had to get permission of the owner of the land on which the tree is growing;
    vi. other
2. Who has to give permission for hanging a hive in a tree? See 9a.

3. What type of rights you have for trees once you had hanged hives

i. It will be mine for ever
ii. If someone cultivated the surrounding, I may receive compensations or handle to him for free
iii. my ownership right is dependent on the presence of the hive
iv. other

4. What rights you have for trees around your home yard?

5. Is there any condition by which you would lose these rights? If yes how?

6. Are there any threats to your traditional tree tenure arrangements? Yes/no Why?

7. Which tree tenure you respect more? 1=Traditional 2=state 3=other

8. Did you ever have a conflict with other beekeeper in relation to locating your hive or other practices for beekeeping? If yes, How was it solved?

9. Have you ever had a conflict with other land users? If yes what type and how it solved?

10. Is there difference in land/tree tenure in different land use zones? What types of tenure govern homegarden, cropland, state forest, kobo forest and others?

11. Have there taken place any changes in regulations regarding land and tree use for honey production over the last ten years? If yes, which?

X) Perception on future of beekeeping

1. Please indicate whether you strongly agree1, agree2, disagree3,strongly disagree4, and I don't know5, for the following.
    a. If the price of modern hives improves, I will use it_____ Why

    b. If the price of coffee gets increasing, beekeeping is no more worthy as an activity.

    c. If my family number increased, enset production will replace honey production.____Why

    d. At this moment there is no need to plant trees, as there is enough in the natural forest.

    e. If traditional ownership arrangement replaced by legal tenuresystem, forest clearance will be aggravated.

    f. I cut more trees from state forests than I do from religious or kobo lands.

2. Why you chess out bees when you collect honey? Is that not important to keep bees in your hive for next year?

XI) Extension

1. Is there any encouragement/initiation you received from external agents to improve your beekeeping technology and tree planting (e.g. rural development office, NGO, Local administration, other)? Yes=1 no=2

   Institution Type of assistance

2. If in case you are familiar with modern hives, do you think it is better than your traditional hives? Explain the pros and cons of it.

XII) Bee (colony) management practices

1. Do you think bee colonies are decreasing? If yes why?

2. Do you know ways to increase your colony size? How?

3. Do you protect absconding of bees? How?

4. How do you characterize sites as appropriate for locating your hives?

5. What type of management practices you perform for different technologies?

Technology Level →	Modern(Kenyan top bar)hives	bamboo hives	Soft wood Log hives	Cordia hives	Other technology
Management practices					

XIV) Livelihood questions (optional)

1. List type of practices you undertake for your livelihood. E.g. honey, crops, coffee, animal products

Type of practice	Amount/yr/unit of measure	Amount consumed	Amount sold	Income

2. How much labour you invest to produce the respective amount in mandays?

3. Is there overlap in seasonal labour distribution among activities? If so, which activities?
4. Which livelihood activities you want to expand and to cease practicing?

9.2 Annex II: Guides for group discussion

1. Describe the history and development of beekeeping chronologically.
    - The practice
    - Local institution and administration,
    - Hives number and location
    - Forest condition

2. What is the current status of beekeeping?

3. List, in order of decreasing importance, trees that are used for;
    - Bee-forage source (include flowering season)
    - Hive making
    - Hive hanging
    - other subsidiary uses(to cover hive mouth, to use for smoke/charcoal, fumigation etc)

4. What qualities are used as distinguishing criteria for each of the above purposes?

5. Do you think beekeeping can stimulate forest conservation? How?

6. Do you think that the topographic feature of a land (eg. gorges, mountain, leeward/windward side of mountain/foothills etc) affect hive colonization and productivity of bees if other factors kept similar? Which areas are best to attract bees?

7. Explain the organizational arrangement of hive construction, hanging and honey harvesting from the home to the field level.

8. What is the responsibility of each household member in beekeeping practice?

9. How does beekeeping scheduled seasonally?

10. Explain ownership administration and access to swarming bees, colonies in a hive, hive hanging trees and beekeeping lands? How does ownership of honey trees defined in home garden, cropland, forests (protected and non-protected) and kobo areas?

11. What problems you faced in the administration of traditional tenure regimes? Why you terminated kobo system of land use arrangement (Andracha only)?

9.3 Annex III: Questionnaires for experts

Name: _____ Position/title:_____ Educational status:_____

1. Land demarcation and ownership certification is underway in the region. Does ownership certificate will be given for forest beekeepers for the forests that have been used traditionally as distinctive honey production area? Explain

2. Holetta beekeeping research center claims that it has ant resistant hive technologies, have you been attempted to introduce this type of hive to solve peasants problem as it was repeatedly complained as a constraint to put hives inside home gardens? If yes how effective?

3. Do you think that beekeeping stimulates forest conservation?

4. Do you think that different types of beekeeping technologies have different impacts on the use of different forest resources?

5. Do you think that people will shift to modern beekeeping or will continue with their traditional technology using log or bamboo hives? Why? What is its implication for forest conservation?

6. Do you think that honey production/ beekeeping practice competes with other forms of forest use such as forest coffee production, enset cultures and etc? Why?

9.4 Annex IV: Check lists to guide observation of beekeeping practice along the land use

Related to hive technology and hive location

- Location of hive in the land use zone
- Location of hives vertically in the forest canopy
- Types of hives used
- What type of trees and branches are used for perching hives
- Where does higher density of hives found?
- Observation of hives presence in coffee field, forest coffee, homegardens and cropland
- Location of settlements in reference to hive locations

Forest condition and management of tree/forest in the land use system

- Trends of afforestation/deforestation
- Nature of the forest; disturbed, protected state forest, kobo forest in which hives found
- Observation of tree management practices (particularly planting and preservation), type of species and purpose of planting.
- Type of land use other than beekeeping
- Any other beekeeping practices, special features