Literature Survey on biological data and research carried out in Bonga area, Kafa, Ethiopia

for

PPP-Project
Introduction of sustainable coffee production and marketing complying with international quality standards using the natural resources of Ethiopia

by

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1) Introduction

This literature survey is made in the context of establish an UNESCO biosphere reserve in Kafa Region. The genetic origin of coffea arabica lies in Southwest and South Ethiopia (Kafa Region) occuring naturally in the undergrowth of the montane rainforests between 1,000 and 2,000 m asl. The highly various gene pool of these wild coffees is of international importance (Schmitt, Ch. B. et al. 2005).The aim of this survey is to show the actual status of existing and available Literature about Kafa Region. As a result it should be known in which way there have to be more investigations in this area.

The **Bonga** region is situated Southwest from Addis Ababa as part of the **Kafa** Zone and Keffa- Sheka Adminstrative Zone, respectively (Illustrated in Map 10 in the appendix). It depends to the Northwest highlands and is separated through the Great Rift Valley. **Bonga** depends to the Southern Nations, Nationalities, and People's Region (SNNPR) Region where about 14,085,000 people are living in 77 weredas. The SNNPR is one of the federal states of Ethiopia located in the South and Southwestern parts of the country. The region has a total area of 117,506 km² lying within elevations of 378 to 4,207 m above sea level. The estimated annual deforestation rate in **Kafa** Zone is by 22.500 ha (Stellmacher, T., 2005). The current population of the region is about 14 million people comprised of more than 45 different ethnic groups (CSA, 1996). The town **Bonga** populated with 19,664 habitants is located Southwest of Jima and has a latitude and longitude of 7°17 N, 36°15 E (BirdLife IBA, 2007).

Different agro-climatic zones exist in the region but the *Woina-Dega* (Moist to sub-humid warm subtropical climate) areas, which are situated between 1,500 - 2,300 m elevation, are the most important in terms of agricultural productivity. Most of these areas in the region are categorized as High Potential Perennial zones where the two dominant perennial crops, enset and coffee are grown in an intimate association with other crops, trees and livestock in multi-storey homegarden agroforestry systems. (Abebe, T., 2005)

The topographic situation is signed by the rift valley. The high is between 1,500 – 2,500 m with extreme up to 3,000 m. The landscape is well water-drained.

In general it can be said that land with a altitude between 1,500 m and 2,500 m are originally covered with undisturbed montane broadleaf forest. Highs of 500 m to 1,500 m are originally covered with savannah shrub-/grassland. In areas from 2,500 m up originally bamboo forest is growing.

2) State of available data for Bonga area in Kafa Zone

This literature survey gives an overview on the actual existing literature dealing with the region of wild coffee forests in and around Kafa. This paper includes all information available on flora and fauna, biodiversity, population, historical and recent land use and land tenure of the area of the potential UNESCO biosphere reserve in Kafa region. There is just sparse information on GIS data. Also deficient is the situation on the legal frame for the establishment of biosphere reserves. The only text that was found during this survey is the Proclamation No. 94/1994. Neither there is any information on the existence of amphibious animals.

That means there is a need to research more in GIS data, in the Environmental Law and in the existence of amphibious. The appendix lists basic information on UNESCO biosphere reserves and maps.

Area of research

Almost 100 % of the total coffee production in **Bonga** is wild and semi forest (Bekele, T., 2003). **Bonga** Forest is not a cohesive woodland, it is rather an accomulation of primary forests spots that covering the hills around Bonga Town in a radius of about 40 km (Stellmacher, T., 2006).

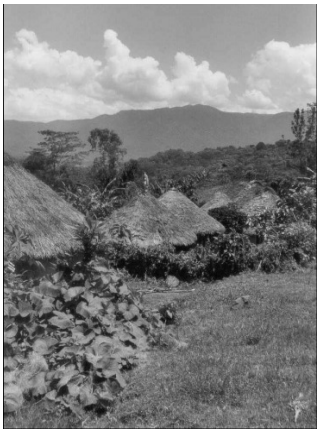
Bonga town is located 440 km Southwest of Addis Ababa and 80 km of Jima. The recent population is 779,659 persons; the number of households is 176,230 (Philippe, L., 2003).

Bonga forest as well as **Boginda-** and **Mankira forest** is situated in the **Kafa zone** in the Southern Nations, Nationalities, and People's Region (SNNPR), which is located within the Southwestern plateau of Ethiopia. The Bonga region is part of the weredas Gimbo and the North of Decha (Schmitt, Ch. B., 2006). The original **Bonga** forest area covers about 161,424 ha; now including forest land, settlement areas, grazing land and agricultural land, and lies within 07°00'- 7°25'N Latitude and 35°55'-36°37'E Longitude, stretching across the boundaries of five contiguous weredas; namely; **Gimbo**, **Menjiwo**, **Tello**, **Decha** and **Chena**. Information on the actual size of the present forest area was not available but it is estimated that it is by far below the original size. The altitude of the area ranges from 1,000 to 3,350 m asl; consisting of a highly dissected plateau, with flat to moderately undulating terrain on areas above 1,500 m asl (Bekele, T., 2003).

Boginda Forest area covers about 7,500 ha of natural high forest. Boginda forest in situated in the Gimbo wereda (IBCR & GTZ, s.a.). According to Philippe, L. Boginda is situated in the Gewata wereda. Boginda is a village with a number of 145 households (Philippe, L., 2003). In the North there is the border to Medabo Kebele and Oromia Region, it's Gomma and Saja Kebeles in the South. Geographic Boginda Forest is situated between $07^0$29.000` to $07^0$33.400N latitude and $036^0$02.580` to $036^0$06.570`E

Longitude. (IBCR & GTZ, s.a.) The village is spread n both sites of the paving road. It takes about 20 minutes to reach the centre of the village. Along the road in direction of Guerra people are selling and buying their things like commodities and coffee. This road takes about 2 hours to walk (Philippe, L., 2003).

Fig 1: Centre of Boginda Village



In both villages there is no access to electricity and no running water. Also there is no junior or secondary school, health post, no police station or any shop. The core of both villages is located between the church, primary school and a little marketplace. The tukuls (swahili word for huts) are punctually situated within the ecosystem. The economy is based on subsistence and agrarian production. The main agricultural produces are teff and maize. Coffee is the only cash crop. Besides them there is main staple food kocho (made of enset plant). The residents are mainly dependent on the fuelwood, building material and wild coffee (Philippe, L., 2003).

Source: Philippe, L., 2003

Mankira is located within the Decha wereda. There do exist about 170 households. Mankira village is closer to Bonga than Boginda but more difficult to reach. The only possibility to transport things is by horse and mules. For detailed illustration on location and coffee management system of study plots in Mankira forest see Map 9 in the appendix.

2.1) Abiotic and biotic issues

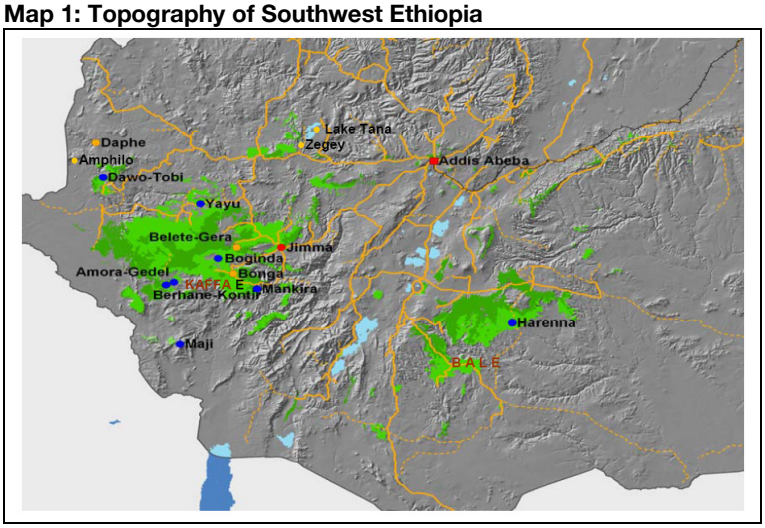
In the following chapter the abiotic and biotic issues information about the abiotic and biotic issues are summarised.

a) Geology, topography and soils

According to Taestensen, F. et al. (2007) Ethiopia is located within two significant Biodiversity Hotspots, the Horn of Africa and the Eastern Afromontane. The Eastern Afromontane contains the mesic highland plateaux, which has major endemism due to isolation of the surrounding landscapes. The Southwestern Ethiopian montane rainforests are the centre of origin and diversity for wild *Coffee Arabica*. "The underlaying basement rock consists intensively folded and faulted Precambrian rocks, layered by mesozoic marine strata and tertiary basalt traps. The tertiary volcanic rocks include rhyolites,

trachytes, tuffs, ignimbrites, agglomerates, and basalt. On these rocks most of the afromontane forests substrates had been developed (Gole, T.W., 2003a).

Map 1: Topography of Southwest Ethiopia



Source: Kotecha, S., 2007

According to TAM Agribusiness (2004) the natural topography of **Bonga** region is highly slopping ranging from 10 % to over 60 %. The high rainfall (over 1,500 mm/yr) had the soils highly leached and much of the soil fertility is tied up in the top 20 cm and maintained through nutrient recycling between the soil and the living forest vegetation. The removal of the forest cover and general vegetation therefore, breaches this cyclic process and leads to rapid decline in soil fertility.

The organic matter recycling continues as long as vegetation such as forest is covering the soil. In case of the vegetation get lost because of forest clearing for agriculture, two things happen: Soil organic matter (SOM) is lost rapidly (greatly aided by the high rainfall run-off), and soil erosion sets in. That leads to the loss of the topsoil, which contains most of the soil fertility. But studies by SCRP have shown that organic matter levels decline to about 30 % following forest clearing within 4 to 15 years resulting in crop yields decline at the rate of 19 % annually, stabilizing after 12 to 15 years at 35 % of the original level (TAM Agribusiness, 2004).

Unfortunately, the positive elements of climate and seemingly good topography (undulating) and the richness of natural vegetation under natural forests, cover up the major problems: rapid soil fertility decline and soil erosion as well as loss of biodiversity. The Omo-Gibe Development Plan rightly concluded that " failure to manage these soils properly may lead to rapid and possibly irreversible soil degradation, leading in the future, to much lower crop production and non-sustainability". The field observation of TAM Agribusiness confirms this where maize yields (the major crop) in the **Bonga** and the **Kafa** Zone in general, are the lowest in the region (TAM Agribusiness, 2004).

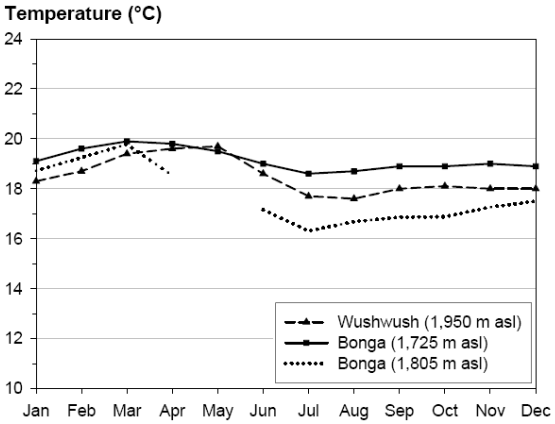
But the farmers keep on clearing more land and bring under cultivation. Their aim is to establish more secure land tenure on the evidence of increasing trend of settlements and allocation of large tracts of lands to commercial concerns (TAM Agribusiness, 2004).
According to Gole, T. W., (2003a), the soils (red or brownish ferrisols) are derived from volcanic parent material. The spreading of high rainfall has hided other soil forming-factors and hence, very similar soils have developed on a repertory of parent materials. Other soil groups in the area are nitosols, acrisols, vertisols, and cambisols (Gole, T.W., 2003a).
According to Schmitt, Ch. B. (2006) the rich in humus makes the soils of Bonga ideal for coffee growing, they are well drained, and have good water-holding capacity. Moreover the Ethiopian coffee forest soils are similar to the best soils on which Arabica coffee is cultivated in other parts of the world. The soils are characterized as deep red to brown red, lateritic loams or clay loams of volcanic origin with high or medium fertility, and with pH values ranging from 5.3 to 6.6. “The pH values of soils in **Bonga** region are at the lower end of this range. This corresponds to the fact, that coffee favours slightly acid soils in Ethiopia [...], and grows well on soils with pH between 4.37 and 6.78 [...]" (Schmitt, Ch. B., 2006). For detailed data on differences in soil parameters between four forest fragments icluding Mankira forest see Tab 17 in the appendix.
The **Bonga** region is characterised by poverty and landlessness. The area under forest in the Kefficho-Sheka zone is only 29 % while area under cultivation is 55.9 %. Considering to the cereal agriculture expansion, soil-conservation becomes important (TAM Agribusiness, 2004).

b) Climate and Weather

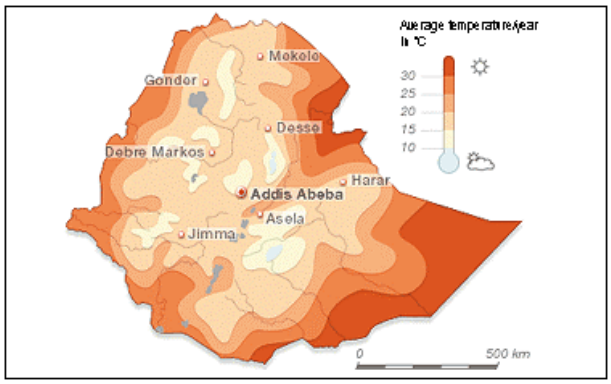
The Inter-Tropical Convergence Zone (ITCZ) signs the Ethiopian climate. The weather determinating factors are the humid Southwest monsoon and the dry Northeast trade winds. Summarised there are four seasons: dry season (December – February), small rainy season (March - May), main rainy season (June - August), and transitional period (September – December). Intensities and frequencies of rainfall in the entire Ethiopia depending on altitude and exposure of the area (Schmitt, Ch. B., 2006), so it is difficult to give clear information on a determined area.
In **Boginda** there does not exist a meteorological station so the data from Bonga station has to be used, which has almost the same altitudinal range as Boginda forest. (IBCR & GTZ, s.a.) **Bonga** region is humid and has warm tropical rainy climate [...]. The rainfall is uni-modal with low rainfall from November to February and the wettest months between May and September. The coolest months are July and August in the middle of the main rainy season, while the hottest months are from February to May.

Climate data are taken from the meteorological stations of **Bonga** (7.13 °N, 36.17 °E; 1,725 m asl) and Wushwush (7.16 °N, 36.11 °E; 1,950 m asl). Precipitation data range from 1953 - 2001. Temperature data contains the years 1970 - 2001 for **Bonga** and 1954 - 1995 for Wushwush. The data have been aperiodic recorded and values are missing for several years. Data for 2004 are derived from measurements taken in **Bonga** (7.15 °N, 36.15 °E; 1,805 m asl) (Schmitt, Ch. B., 2006).
In the Map 2 & 3 (originally from Ethiopian Meteorological Service Agency) is illustrated the temperature around **Bonga** and in Ethiopia.

Map 2.: Average temperature/year in Bonga and Ethiopia



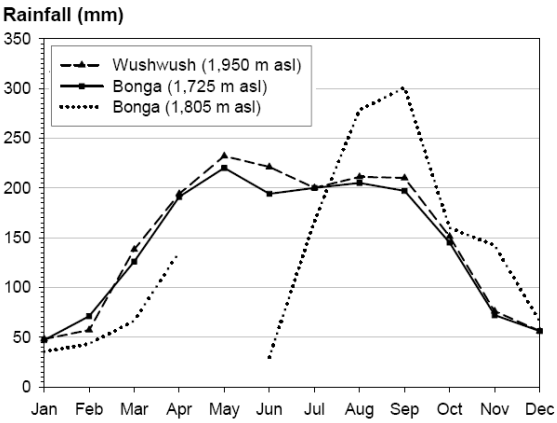
Source: Schmitt, Ch. B., 2006 (verified)



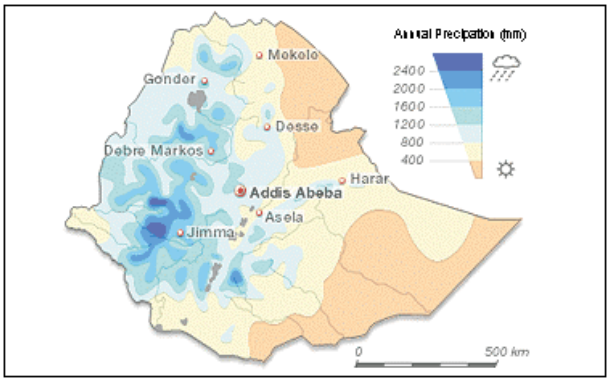
Source: http://www.rawland.de/php/pub/main.php?rubric_id=6&project_id=96

The forest experiences one long rainy season, lasting from March /April to October. The mean annual rainfall ranges from 1.710 mm at **Bonga** station to 1.892 mm at **Wushwush** station. Over 85 % of the total annual rainfall, with mean monthly values in the range of 125 - 250 mm occurs in the 8 months long rainy season. The mean temperature is 19.4°C at **Bonga** while it is 18.1°C at **Wushwush** station, which is located 200 m higher than **Bonga** (Bekele, T., 2003). For the eight years average climatic data refer Tab 16 in the appendix.

Map 3: Annual Precipitation in Bonga and Ethiopia



Source: Schmitt, Ch. B., 2006 (verified)



Source: http://www.rawland.de/php/pub/main.php?rubric_id=6&project_id=96

There are three major river bodies that drain the catchments of **Bonga** forest; they are Gojeb, Dinchia and Woshi rivers. The Gojeb River along with its numerous tributaries drains the Northeastern part of the areas on the Eastern block accounting for about 22 % of the total catchments. The Dinchia River together with its tributaries drains the central parts of the forest. The Woshi River drains areas situated along the Western most parts of the forest accounting for about 28.8 % of the total forest area (Bekele, T., 2003).

The drainage of Boginda forest is determined by the in the North located Gojeb river. The river has 7 smaller feeding rivers. One of these seasonal rivers is the Boginda river, which has the biggest drain of them (IBCR & GTZ, s.a.).

According to the recent inventory carried out by the Institute of Biodiversity Conservation and Research through the GTZ-supported Forest Genetic Resources Conservation Project, **Bonga** forest is characterized by three distinct vegetation types (Bekele, T., 2003). These vegetation types are described below. About 106 woody plant species belonging to 74 genera and 38 families were recorded during the inventory of **Bonga** forest.

c) Flora (Bonga, Boginda and Mankira)

Upland Rain Forest Vegetation This vegetation occurs at altitudes between 1,500 - 2,200 m asl and characterized by big tree species such as *Olea welwitschii, Scheffleria abyssinica, Euphorbia obovalifolia, Croton macrostachyus, Albizia schimperiana, Prunus africana, Syzygium guineense, Polyscias fulva*. It also contains common smaller trees and shrubs such as *Milletia ferrugina, Teclia nobillis, Dracaena steudneri, D. afromontana,*

Galiniera saxifraga and *Coffea arabica*. Ground herbs include false Cardamom (*Afromomum corrorima*).

Upland Humid Forest Vegetation This vegetation occurs at altitudes between 2,450 - 2,800 m asl. and characterised by tree and shrub species such as *Hagenia abyssinica, Ilex mitis, Myrsine melanophloeos* (Rapaenia *simensis), Maesa lanseolata* and *Barsama abyssinica.*

Sinarindunaria /Bamboo Thicket This vegetation occurs at altitudes between 2,400 - 3,050 m asl and characterized by bamboo undergrowth either in pure stands or may exist in mixture with trees, including *H. abyssinica, M. melanophloeos,* and *Hypericum revolutum* (Bekele, T., 2003).

The areas in and around **Bonga** forest are inhabited by a minimum of 48 mammalian species, representing fourteen families and 100 bird species were recorded from the area. Fifteen of the bird species are reported to comprise the “Highland Biome Species”, thus accounting for 31 % of the Restricted Highland Biome Assemblages in Ethiopia” (Bekele, T., 2003).

According to BirdLife IBA, 2007, the tallest trees are *Aningeria adolfi-friderici*. Besides them there are growing *Ocotea kenyensis*, *Olea capensis*, *Sapium ellipticum*, *Macaranga capensis*, several species of *Albizia*, *Euphorbia ampliphylla*, *Polyscias fulva*, *Schefflera abyssinica* and several different *Ficus* spp. The rich understorey is including the tree-fern *Cyathea manniana* found in moist ravines and near waterfalls, *Dracaena steudneri* and *Coffea arabica*. "The higher parts of the forest support smaller trees such as *Hagenia abyssinica* and *Prunus africana*. **Bonga** forest has long been exploited for its large timber species and this is continuing. Some areas have been left to regenerate naturally, but over 2,000 ha have been planted with exotic and native species such as *Eucalyptus*, *Hagenia abyssinica*, *Cordia africana*, *Cuppressus*, *Grevillea* and *Pinus patula*. Local people make extensive use of the forest and many non-timber forest products are collected, particularly coffee and honey" (BirdLife IBA, 2007).

In **Bonga** forest had been 106 woody plants recorded. 94 of them are identified to species level. 5 are identified to a Genus level and 8 are unidentified. The major Genera are:

Combretum, Erythrina, Euphorbia, Myrsine, Rubus, Schefflera, Solanecio, Teclea, Vepris, Acacia, Dracaena, Ficus, Maytenus and *Vernonia.*

The major families are: *Bignoniaceac.e, Combretaceae, Fabaceae, Moraceae, Myrsinaceae, Rubiaceae, Rutaceae*, and *Sapindaceae*

The predominant species are: *Ocotea kenyensis, Prunus africana, Syzygium guineense, Pouteria adolfi – friederici, Olea capensis, Ekebergia capensis, Ficus vasta, Syzygium*

guineense, Prunus africana, Albizia gummifera, Schefflera abyssinica, Ficus sur and *Schefflera volkensii.*

In **Boginda** forest had been 73 woody plants recorded. 66 of them are identified to species level. 4 are identified to a Genus level and 3 are unidentified. The major Genera are: *Albizia, Euphorbia, Ficus, Maytenus, Schefflera, Tiliachora* and *Vernonia*.

The major families are:

Rubiaceae, Euphorbiaceae, Celasteraceae, and *Fabaceae*.

The predominant species are:

Pouteria adolfi – friederci, Bersama abyssinica, Schefflera abyssinica, Trilepsium madagascariense, Polyscias fulva and *Coffea arabica* (IBCR & GTZ, s.a.).

There is only one emergent species from the 20 - 30 m high canopy, namely *Pouteria adolfi-freidrci.* The 10 - 30 m high main canopy consists of *Albizia gummifera, A. schimperiana, A. grandibracteata, Blighia unijugata, Cassipourea mlosana, Celtis africana, Croton macrostachyus, Ekebergia capensis, Euphorbia ampliphylla, Ficus sur, F. ovata, F. thoningii, Hallea rubrostipulta, Ilex mitis, Macaranga capensis, Ocotea kenyensis, Olea welwitschii, Polyscias fulva, Scefflera abyssinica, Prunus africana, Sapium ellipticum,* and *Syzygiun guineense.* A discontinuous lower canopy of smaller trees (< 10m high) includes *Allophylus abyssinicus, Apodytes dimidiata, Bersama abyssinca, Brucea antidysentrica, Calpurnea aurea, Cathium oligocarpum, Chionanthus mildbraedii, Clausena anisata, Coffea arabica, Cyathea manniana, Deinbollia kilimandscharica, Dracaena afromontana, D. fragrans, D. steudneri, Ehretia abyssinica, Erythrina brucei, Galinera saxifraga, Lepidotrichlia volkensii, Lobelia gibrroa, Milletia ferruginea, Nuxia congesta, Oncoba routledgei, Oxyathus speciosus subsp. stenocarpus, Phoenix reclinata, Pittosporum viridiflorum, Psychotoria orophila, Ritchiea albersii, Rothmannia urcelliformis, Solanecio gigas, Solanecio manni, Teclea nobilis, Trema orientalis, Turrea holitii, and vepris dainellii* (IBCR & GTZ, s.a.).

The shrub stratum includes *Acanthus eminens, Maytenus addatp., Phyllanthus limuensis* and *whitfieldia elongata. Hippocratea goetzei* and *Landolphia buchanani* are the most frequent liana species that exist in this forest.The ground cover is dominated by grasses and certain thorny species such as *Acacia lahai*, *Acanthus spp*., *Dichrostachyus cinerea* and *Solanum spp* (IBCR & GTZ, s.a.).

More floristical information such as regeneration of **Boginda** forest is listed in GTZ, for more information about plants and their distribution within Mankira see the Appendix of Schmitt, Ch.B., 2006.

d) Fauna (Bonga, Boginda and Mankira)

The **Bonga** Forest contains more than 15 species of highland birds (Biology Online, s.a.).

During forest avifauna survey in December 1995 more than 100 species were recorded. In the following they are listed. Black-winged Lovebird (*Agapornis taranta*), White-cheeked Turaco (*Tauraco leucotis*), Banded Barbet (*Lybius undatus*), Dark-headed Oriole (*Oriolus monacha*), Thick-billed Raven (*Corvus crassirostris*), White-backed Tit (*Parus leuconotus*), Stuhlmann's Starling (*Poeoptera stuhlmanni*), Abyssinian Ground-thrush (*Zoothera piaggiae*), Rueppell's Robin-chat (*Cossypha semirufa*), Abyssinian Slaty Flycatcher (*Dioptrornis chocolatinus*), Swainson's Sparrow (*Passer swainsonii*), Baglafecht Weaver (*Ploceus baglafecht*), Abyssinian Citril (*Serinus citrinelloides*), Brown-rumped Seedeater (*Serinus tristriatus*) and Streaky Seedeater (*Serinus striolatus*). Further information about the avifauna gives BirdLife IBA (2007).

During a BirdLife survey the team found Colobus and Vervet Monkeys as well as Tree Squirrel. Information of locals are telling about the presence of Lion, Leopard, Buffalo, Elephant, Porcupine, Aardvark, Wart Hog and Forest Pig. Moreover the people of the tribe of the Mandjah are eating *Colobus guereza* what plays a significant role in the exclusionary relationship between Kaffa and Mandjah (Stellmacher, T., 2006).

In and around **Bonga** forest there are at least 48 mammalian species, representing fourteen families and 100 bird species. Fifteen of the bird species are reported to comprise the “Highland Biome Species”, thus accounting for 31 % of the Restricted Highland Biome Assemblages in Ethiopia (Bekele, T., 2003).

High-altitude forest is severely endangered in Ethiopia. "Although **Bonga** forest is designated a National Forest Priority Area, little has been done to enforce the existing legislation. The current forest extent is unknown, but it has decreased since the 1970s. The forest is next to two major roads, making the removal of timber relatively easy. The more accessible parts of the forest are highly disturbed and now comprise thick undercover that could certainly be a hindrance to the larger mammals reported to occur. The fact that any forest remains is almost certainly due to the broken terrain within the Dincha watershed. Major threats include the introduction of exotic tree plantations, clearance for agriculture, and some grazing. The effect of grazing is currently not serious, but could become so, severely affecting the potential for forest regeneration. The forest coffee, *Coffea arabica*, of Bonga is genetically important, as it was from this area, near Wushwush, that the first plants with natural resistance to coffee berry disease were identified. Tree-ferns *Cyathea manniana* are known from only a few locations in Ethiopia; they require well-shaded and moist conditions to grow and would disappear if the forest was destroyed" (BirdLife IBA, 2007). Forest hogs are living 30 km around Jima we.There are also some of them in the **Kafa** Mountains. A list of List of species recorded in **Bonga** region gives the appendix Table A 1 of Schmitt, Ch. B., 2006.

According to to the reports of Consulting for Coffee Conservation written in IBCR & GTZ, s.a. there is following wildlife in and around Boginda:
Vivera civeta ("Tirign"), *Silvicapra grimmia* ("Midaqua"), *Papio anubis daguera* ("Zinjero"), *Syncerus caffer* ("Gosh"), *Traglaphus scriptus* ("Dekula"), *Patomochoerus porcus* ("Asama"), *Cercopithecus mitis* ("Cheno"), *Colobus guereza* ("gureza"), *Genetta rubiginosa* ("Genet"), *Viverrdae sanguineus* ("Shelmitmat"), Ethiopian hare ("tenchel"), Jakal ("Kebero"), *Hyaena hyaena* ("Jib"), *Felis pardus* ("Nebir"), *Felis leo* ("ambessa"), *Hystrix cristata* ("Jart"), Rock python ("Zendo"), Snakes (black, red and stripped), *Phacochoerus africanus* ("Kerkero"), "Worebo" and *Caris simensis* ("Tekula").
Bird species which were found in or arround Boginda Forest are: *Bostrichia caruculata* (Watttled Ibis), *Cyanochen cyanoptera* (blue winged goose), *Poicephalus flavifronse* (Yellow fronted parrot), *Parophasma galinieri* (Abyssinian cat bird), *Parus leuconutus* (White backed black tit), *Onchoganthus albirotris* (White billed starling), *Oriolus monanacha* (Black headed forest oriole) and *Caruvus crassirostris* (thick billed raven).
Information about the layer species and epiphytes, ground layer species, woody species and climbers of **Mankira** is given in appendix Table A 3 and Table A 4 of Schmitt, Ch. B. (2006). Information on conservation status of major mammals and birds in Ethiopia gives Tab 18 in the appendix. Information about reptiles and amphibians are not available.

e) Biodiversity

The Southwestern part of Ethiopia is known as the genetic home of coffee. During a study between 1966 and 1984 more than 600 coffee species were found by the Ethiopian National Coffee Collection Programme. Now, 20 years later more coffee species have been found but not really documented (Stellmacher, T., 2006). The chapters 2c and 2d show the large scale of biodiversity.

3) Population

The SNNPR has about 15,000,000 inhabitants. The density of SNNPR has a maximum of 680 persons/km^2 (Soil and Water Conservation Team, 2001).
The SNNPR is the most ethnically and lingually various administrative region in Ethiopia. The **Kafa** people are the indigenous inhabitants of **Bonga** region who are speaking omotic language. In the past, the **Kafa** society has been earmarked by a highly inflexible and complex class-system, based on occupation, descent and status. The Mandjah people form for 5 to 10 % of the total population. They are the largest minority society that still faces prejudices and discrimination today. With a maximum in the mid-80ies, there was a governmentally introduced and spontaneous resettlement of peoples from

North and central to Southwest Ethiopia. In **Bonga** region, Amhara, Oromo and Gawata became the largest groups of new settlers. **Bonga** town is the administrative centre of **Kafa** zone and the major town in the area with 16,278 inhabitants (CSA, 2007). Ufa (1,000 inhabitants) and Chiri (1,655 inhabitants) are the administrative centres of Gimbo and Decha *wereda*, respectively. Most of the people are living in hamlets or small villages in the countryside. The average population densities of Gimbo and Decha *wereda* are 103 and 33 inhabitants/km², respectively (Schmitt, Ch. B., 2006).
Gimbo wereda has a high population rate. 45 % of the population of the Gimbo wereda are younger than 15 years (TAM Agribusiness, 2004).

Tab 1: Number of habitants (in thousands) in the SNNPR and Addis Ababa City (2007)

Urban SNNPR			Rural SNNPR			Total SNNPR		
male	female	total	male	female	total	male	female	total
665	673	1,338	6,954	7,029	13,983	7,619	7,702	15,321
Urban Addis Ababa City Admn.			No rural population in the city			Total Addis Ababa City Admn.		
male	female	total				male	female	total
1,469	1,590	3,059				1,469	1,590	3,059

Source: Central Statistical Agency, 2007

Tab 2: Number of habitants of the town Bonga in the wereda Gimbo (2007)

male	female	total
9,518	11,087	20,605

Source: Central Statistical Agency, 2007

The health situation of SNNPR is shown in the following. In the SNNPR there are 17 hospitals with 2,717 beds. The average of Ethiopia is 11 hospitals with 1,154 beds. The SNNPR have the highest number of beds and have even more beds than the capital region Addis Ababa, which have 2,502.
In the GTZ leaded study was found that women 19 of 60 asked Head of Households (HH) were female. The average family size is 4,32 persons per household. The table shows the percentage of head of households (HH) ordered by sex.

Tab 3: Head of Households by sex

	Sex		
	Male	Female	Total
Number	41.0	19.0	60.0
%	68.3	31.7	100.0

Source: Zerfu, S., 2001

The marital status shows that the majority of HH is married, just 3,3 % are singles. The status of marriage is determining for landownership and supply for fuelwood.

Tab 4: Marital status of Head of Households

S/N	Marital Status	No of Households	Percent
1	Single	2	3.3
2	Married	45	75.0
3	Divorced	3	5.0
4	Widowed	10	16.7
	Total	60	100.0

Source: Zerfu, S., 2001

In addition to the age it is shown that 56,67 % are in the age-group 15 - 49 years. The study shows also that young people as well as landless women and adults are involved in deforestation.

Tab 5: Age Grouping of the Head of Households

Age	15-19	20-29	30-39	40-49	50-59	60-69	70+
No of Households	2	7	12	13	13	8	5
%	3.33	11.67	20.0	21.67	21.67	13.33	8.33

Source: Zerfu, S., 2001

As regards of education 71,7 % are illiterate, just 5 % of the HH had a secondary education.

Tab 6: Educational level of respondents (Head of Households)

S/N	**Educational Level**	**No of Households**	**Percent**
1	Illiterate	43	71.7
2	Informal Education	5	8.3
3	Elementary (1 - 6)	9	15.0
4	Secondary (7 - 12)	3	5.0
	Total	60	100.0

Source: Zerfu, S., 2001

The sample people had been asked in what distance they live to the forest. They had three possibilities to answer. Living within, living adjacent or living in the surrounding. Almost 50 % of the people living adjacent to the forest.

Tab 7: Location of respondents residence from the forest

	Location of Residences in Relation to the Forest			Total
	Within the forest	Adjacent	Surrounding	
Number	18	25	17	60
%	30	41.7	28.3	100

Source: Zerfu, S., 2001

Relating to the ethnic affinity the result is that most of the sampling are Kefficho people. Just Tigre and Bench Maji people have just one representative.

Tab 8: Ethnic composition of Head of Households

Ethnic Group	Number	%
Amhara	5	8.33
Oromo	6	10.00
Tigre	1	1.67
Kefficho	47	78.33
Bench Maji	1	1.67
Total	60	100.00

Source: Zerfu, S., 2001

4) Land use

There are 10 weredas (districts), which have a centre town. In the weredas Sheka, Bench and Maji there are populations of wild coffee. Especially in Amora-Gedel, Berhane-Kontir, **Boginda**-Yeba, Dawo-Tobi, Geba Dogi (Yayu), Harenna (Bale mountains), Maji and **Mankira** forests exist a high abundance of coffee trees and a high importance to reserve this localities. Except Harenna forest, which is located East of the Great Rift Valley, all places are on the Southwestern plateau (Gole, T.W., 2003a). Ongoing there is a description of the Land use of the Kafa weredas interpreted from the maps of the " Sustainable Poverty Alleviation in Kafa" (SUPAKS, 2002).

The land use 10 km around **Bonga**/*Gimbo* is ranking between undisturbed montane broadleaf forest, to disturbed montane broadleaf forest, highly disturbed forest and intensively cultivated land. In the West there are perennial marsh and seasonal swamp. More to the North there exist some areas with undisturbed montane broadleaf forest with some coffee investment areas.

More to the East in the weredas *Menjiwo* and *Tello* the topography rise up to 3,000 m. The land use is intensively/moderately cultivated, a big bamboo forest is situated at the more than 3,000 m high border region between Menjiwo and Tello. More to the North there are some dense shrub/bush in combination with wooded/shrub grassland.

In *Chetta* the topography is from 500 m – 2,500 m. The use of land is intensively cultivated direct around the wereda centre Shama. The remaining surface is a

combination of montane broadleaf forest undisturbed/disturbed/highly disturbed. There is also some lowland forest disturbed/undisturbed. In the South of Chetta Savannah shrub-/grassland is dominating.

The most South wereda *Decha* with Chiri as the centre town has oblong propagation of about 60 km and reach nearly to **Bonga**. The South of Decha is marked by land high between less than 500 m - 1,000 m, partly 2,000 m. The land use of the South is very homogeneous. Just savannah shrub-/grassland with particularly dense shrub-/grassland disturbed lowland forest and disturbed montane broadleaf forest are existing.

In the middle West in *Chena* the landscape ranges from 1,000 m to particularly 2,500 m. In the South of *Chena* intensively cultivation is dominating with exception of the Eastern part where disturbed/undisturbed montane broadleaf forest is located. Also a few parts with dense shrub and open grassland are available. The Northern part of *Chena* is marked of a mix of undisturbed montane broadleaf forest, perennial marsh and intensively cultivation.

The Western wereda *Bita* ranges also from 1,000 m up to 2,500 m, particularly up to 3,000 m. In the Southwestern part of *Bita* there is a 25 km * 12 km big area of undisturbed montane broadleaf forest. Just at the edge there is intensively cultivated and highly disturbed forest. More to North the land use is differently. Seasonal swamp, perennial marsh and bamboo forest are existing in the Northwestern area. The Northeastern part shows undisturbed montane broadleaf forest with punctually cultivated land and disturbed/high disturbed montane broadleaf forest. At the borderline to Gimbo there are some coffee investment areas.

More to North the wereda *Gesha* with a high from 1,500 m to partly 3,000 m is located. The land is moderately/intensively cultivated. Around the centre town Daka exists perennial marsh cultivated land. Just in Northwest of *Gesha* there is an area of around 10 km * 20 km with undisturbed montane broadleaf forest.

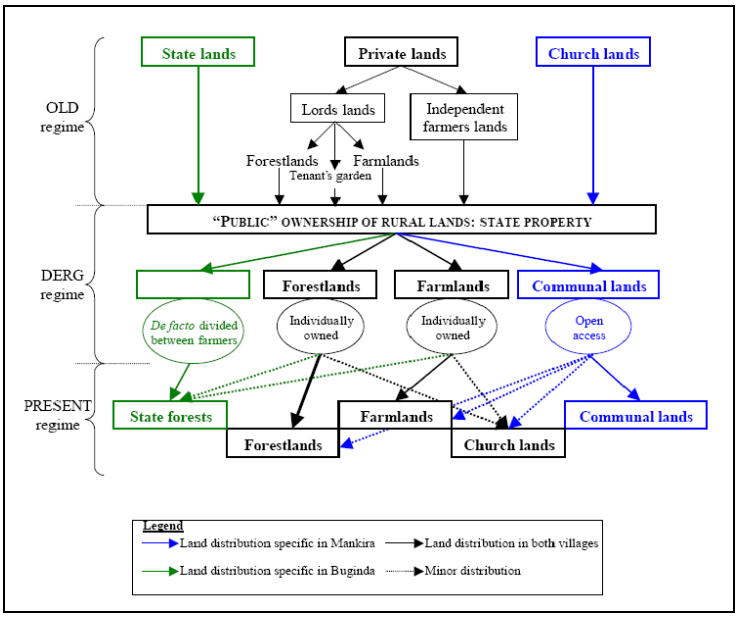
The most Northern wereda *Saylem* ranges between 1,500 m till 3,000 m, but the most is about 1,500 m to 2,000 m. The vegetation is in general parted in to the Western almost undisturbed montane broadleaf forest and in to the Eastern part with intensively cultivated and bamboo forest.

In the last wereda *Gawata* neighbouring with *Gimbo* the land is 1,500 m to 2,000 m high. The land is covered by a proportionally big area undisturbed montane broadleaf forest (30 km * 10 km). Small areas with perennial marsh and seasonal swamp are located in the South and North. A few coffee investment areas are also located in the North of Gawata.

5) Land tenure

In advance there is a graphic that shows the land tenure and land distribution during the three regimes in Mankira and Boginda. The graphic is taken from Philippe, L. (2003) who has detailed information about the historical pathway of land use and landtenure.

Fig 2: Land tenure and land distribution during the three regimes



Source: Philippe, L., 2003

5.1) Historical situation

Before 1974 in **Kafa** was a feudal landlord system established, which regulated the management and the property rights. The landlords who gave use rights to the peasants ruled most of the forest. To use the land they had to pay a fee in form of e.g. honey. The use of the forest and the cultivation of coffee were traditional determined in local institutional systems (Stellmacher, T., 2005).

After the revolution in 1974 the new military government known as *derg regime* empowered the landlords and everything came under direct possession of the state. This had many negative impacts on the relationship between state and local communities (Stellmacher, T., 2005).

In the 1980ies there was governmental ressetlement-programme. Between 1985 and 1988 about 50.000 households (~ 250.000 persons) were brought from drought-stricken regions of Ethiopia to **Kafa** because of the better fertile situation of the region. From this resulted a change in ethnic and institutional composition in that area. More the pressure of nutrition became higher on **Kafa** forest (Stellmacher, T., 2005). Further information give Philippe, L., 2003 and Reusing, M., 2000

5.2) Recent situation

In Ethiopia the farmers have use rights the government can annul at any time. In most parts of Southwest Ethiopia the average land holding per family is between 1,25 – 2,0 ha (Tafesse, A., 1996). In **Bonga** region, it may vary between 0.8 – 2.5 ha. Forest is faced *de jure* as "common good" even though *de facto*, the **Kafa** communities have complex traditional systems of forest use rights (Schmitt, Ch. B., 2006).

Industry doesn't exist in **Bonga**. Most of the people work in agriculture and homestead animal husbandry. The main crop is enset (*ensete ventricosum*), maize (*zee mays*) and teff (*Eragrostis tef*) (Schmitt, Ch. B., 2006). Nowadays the land use is still/again traditionally ruled. In the military dictatorship the land people nevertheless managed and owned the forest but without the landlords. The **Bonga** Forest was divided into plots, which were owned by the traditional people. The size of the plots varies from 1 to 15 ha. In general the Mandjah, traditional hunters and beekeepers, own larger plots than the **Kafa** people. The new settlers are mostly non-forest owners (Stellmacher, T., 2005).

The property rights are depending on the features of the forest resource. The following table, took over from Stellmacher, shows the property rights of the Mandjah, the **Kafa**, the new settlers and the Kebele administration in **Bonga** Forest.

Tab 9: Traditional forest resource property rights in Bonga Forest

	Mandjah, forest 'owners'	Kafa, forest 'owners'	New settlers, non-forest 'owners'	*Kebele* administration
Honey (hang beehives)	EXCLUSIVE Sharecropping	EXCLUSIVE Sharecropping	EXCLUSIVE Sharecropping, *("if the owner is serious")*	EXCLUSIVE Sharecropping
Forest coffee	EXCLUSIVE	EXCLUSIVE (in productive areas)	OPEN ACCESS *("sometimes the owner* complains")	EXLUSIVE
Firewood	EXCLUSIVE	OPEN ACCESS (for personal need)	OPEN ACCESS	OPEN ACCESS (for personal need)
House construction materials	OPEN ACCESS (for personal need)	OPEN ACCESS (for personal need)	OPEN ACCESS (for personal need)	OPEN ACCESS for personal need)
Spices	EXLUSIVE	EXCLUSIVE Sharecropping	OPEN ACCESS	EXLUSIVE

Source: Stellmacher, T., 2005

The table shows that the right to use honey is exclusive to the different people. Also the use of forest coffee is distributed exclusive except for the new settlers. By traditionally

property right Forest Coffee is individually owned, but de facto an open access resource. The more valuable a product is, the more limited is its open access character (Stellmacher, T., 2005).

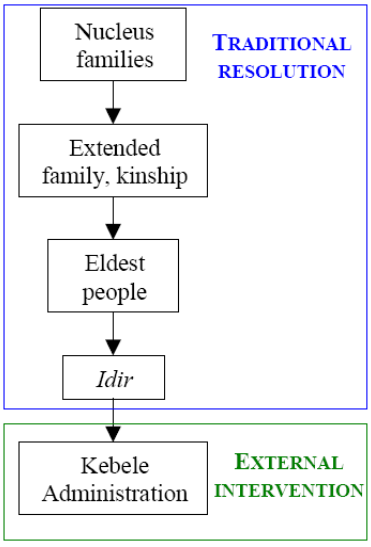
In addition to it there are two informal mechanism which rule the access to the forest in Kafa region namely Wejoo and Gogoo. Under Wejoo can be understood a system parents grant their sons trees when they found a family. This mechanism wants to support and introduce young people into forest activity (Zewdie, Y., 1998).

The other mechanism, Gogoo, is a sharecropping arrangement for forest goods. Young people getting an assured access to the forest even without the existence of peasants association. Gogoo has already helped poor farmers including women to generate cash. There is an advantage towards the Wejoo what base on a land owning family (Zewdie, Y., 1998).

5.3) Role of the Ethiopian Government

After the nationalisation of land holdings forest resources is a governmental matter. Ever since forest use and conservation has a low importance in the governmental framework of Ethiopia because of financial and personal shortage. So it is not amazing that the workforce responsibility for natural resource conservation in SNNPR consists of only two persons (Stellmacher, T., 2005).

In the early 1980ies the Ethiopian government tried to implement different forest conservation efforts. In this context the Government started to conserve with the incorporation of primary high forest areas as "National Forest Priority Areas" (NFPA). In 1986 they demarcated **Bonga** Forest as "**Bonga** National Forest Priority Area". But in reality the execution was not satisfying because of incompetences and not respecting the local communities. There is a miscommunication between the partners. Until today the governments meaning is: "Peasants destroy the forest […]". On the other hand the traditional forest owners statement is: "The forest belongs to us, the government tries to take it over" (Stellmacher, T., 2005). That illustrate that forest conservation has stagnated and seems successless.



Philippe, L. (2003) gives an overview on the land/tree tenure arrangement and user-rights is explained on the basis of state forest in Boginda and on the lands individually owned (in both villages).

Fig 3: Hierarchy in the process of resolving tenure disputes

The situation in the state forest in Boginda is that customary and statutory laws are admistrated by the government. The NTFP are in an open access what includes that nobody has the right to own or inherit the coffee trees. Exceptional people who used/owned coffee before the transfer to state ownership. The law gives them the admission to use the coffee (Philippe, L., 2003).
If a person collects coffee without permission of the owner the customary law intends that this person could get a problem to be part of the Idir (leaders of the traditional social organisation). In addition to it this persons risks to loose his membership of the organisation (Philippe, L., 2003).
Source: Philippe, L., 2003

Landowners have the right to own, to use, to dispose of and to inherit the tree and the right to collect coffee cherries. If a person owns land at the same time he owns the coffee shrub and has the user rights. This right is guarenteed by the Kebele administration (Philippe, L., 2003).
Since the middle of the 20th century the land tenure systems changed and the people adapted their own systems to the actual user right.
More information on user rights and land tenure in Mankira and Boginda is available in Philippe, L., 2003

6) Legal regulation of forests

In Ethiopia the Proclamation No. 94/1994 manages the forests and the treat with them. This manifestation gives information on conservation, development and utilization of forests. It is described shortly for what national issues the "Ministry of Natural Resources Development and Environmental Protection" is responsible. Issues in the international context are not described.
In the Proclamation is written that the Ministry "shall designate, demarcate and register state and protected forests" (PADELIA, s.a.).
"The Ministry [...] may designate any forest at "protected forest" so that any tree species, bushes and other plants are developed and protected with the object to" (PADELIA, s.a.):

- "protect rare or endangered endemic plant, animal and bird species, and genetic resources in general"
- "conserve unique and representative habitats or natural resources"

In general the Proclamation No. 94/1994 says that any interventions in the forest has to sign up by the Ministry of Natural Resources Development and Environmental Protection.
In the paper "annexes to project brief" is a table "The mandates of the concerned biodiversity conservation and protected area management organizations at a federal level", which shows the distribution of responsibility of the different institutions. The Ministry of agriculture and the Prime Minister's Office are the supervisory institutions. After that the Wildlife Conservation Department, the Forestry, Land use & Conservation Department, the Institute for Biodiversity Conservation and the Environmental Protection Authority as the mandates as legally stated
Information on the mandates of the concerned biodiversity conservation and protected area management organisations at a federal level gives page 44 of the annex of project brief byGEF (2006). There is explained, which department or office is responsible. The information status of this annex contains questions and answers to biodiversity and protected areas in Ethiopia.

7) Forest products

In the Kafa zone there is the so-called "Kafa Forest Coffee Farmers Cooperative Union" (KFCFCU, s.a.) which let produce coffee, in addition spices, honey and other non-timber products for local consumption. The union is working to begin exporting cardamom, long pepper, dried red pepper, and forest honey. The KFCFCU includes 26 coffee-cooperatives and 4,166 farmers. In the 26 coffee-warehouses they store the harvest of 164,059 ha. (KFCFCU, s.a.)
"Non-timber forest products (NTFPs) such as honey, false cardamom (*Afromomum corrorima*) and wild pepper (*Piper capense*) are important means of income, in particular for the indigenous **Kafa** population. Furthermore, the forests are a source for fuel wood, charcoal, and timber [...]. Coffee collected and managed inside the forest and planted in home gardens is the most important cash crop [...]. In 2003/04, the **Kafa** Forest Coffee Farmers Cooperative Union marketed 131 tons of coffee from forest coffee and semi-forest coffee systems with Gimbo and Decha wereda contributing 50 % and 30 % [...]" (Schmitt, Ch. B., 2006).
The long-term average of the annual coffee production ranges from 500 – 900 tons, the average of honey production is estimated to be 1,318 tons while that of cardamom and black pepper ranges from 250 – 800 and 150 – 450 tons respectively (Bekele, T., 2003).
The Ethiopian Coffee offers 90 % of Ethiopian export and 80 % of total employment. That means that coffee production gives employment in the rural areas and livelihood for more than 15 million people (van der Beek, J. et al., 2006).

Besides coffee spices like korerima and long pepper are the major crops that play a role. “Korerima, a potential substitute for the Indian cardamom, is endemic to the rainforests of the Southwest region. Long pepper (*Piper capense*) can also be a substitute for black pepper” (van der Beek, J. et al., 2006).
Due to deficient data, only the annual export of spices in general are known. Nevertheless, they show the economic value of spices for Ethiopia.

Tab 10: Export of Spices Through official Route

Year	Spices (in tons)	Value (in US$)
1998	201,715,6	146,492
1999	268,787,9	2,827,397
2000	328,496,6	3,406,020
2001	268,206,5	3,307,060
2002	316,835,0	3,801,457
2003	489,902,6	5,284,462
Total	1,873,944,2	20,091,187

Source: van der Beek, J. et al., 2006

Another product out of the forest is bamboo. Mainly the local community uses bamboo for house construction, fencing, making beehives etc. Another use is making some households utensils like cups, cups, local pipes, jugs and jerry cans to carry water. The handicraft sector is poorly developed and mainly in family based enterprises (van der Beek, J. et al., 2006).
Another important function of bees is the pollination of plants. Bee colonies can increase the pollination rate and therefore the production of for example coffee plants (van der Beek, J. et al., 2006).
Honey is very important for the own consumption (100 g honey = 280 kcal). On average a household has 20 - 30 beehives. With good conditions one beehive produces 5 - 6 kg of honey. It is possible that the yield is about 100 – 200 kg/year. Around 20 % of the total domestic production is used as table honey in rural areas, 55 - 60 % is used in the production of tej (a local beverage), and just a small portion of the product is marketed on a larger scale (van der Beek, J. et al., 2006).
In 2003 Ethiopia exported 402 tons of beeswax (1.2 % share in world market) to different countries (USA, Japan, Greece, Great Britain and the Netherlands), generating 936 US dollars […]. Among 16 beeswax export companies in the country only four are active working. The lack of requirement is mentioned as one of the reasons for many of them to remain inactive, not the absence of an international market (van der Beek, J. et al., 2006).

8) Threats and disturbance of the forest

As already mentioned Boginda forest is heavily exploited. The main impacts are logging, agricultural use and honey production. Honey production affects the existence of trees because of fire they need during honey production (IBCR & GTZ, s.a.).

During the in 1999 conducted "Woody plant inventory survey", part of Forest Genetic Resources Conservation Project by the German Technical Cooperation (GTZ) and the Institute of Biodiversity Conservation and Research (IBCR) 29 quadrates had been analysed. "7 % were very lightly, 14 % lightly and 3 % moderately disturbed by Logging; 3 % lightly and 3 % moderately disturbed by agricultural encroachment; and 3 % lightly and 10 % moderately disturbed by honey production. In overall 69 % of the assessed quadrates were undisturbed and 31 % were disturbed by logging, agricultural encroachment and honey production" (IBCR & GTZ, s.a.).

Tab 11: Disturbance types and scales of disturbance observed in Boginda forest

Types of disturbance	Scale of disturbance					**Percent of total**
	1	**2**	**3**	**4**	**5**	
Agricultural encroachment	**1**	**1***	**1***	**-**	**-**	**7 %**
Honey production	**-**	**1***	**3***	**-**	**-**	**14 %**
Logging	**2***	**4***	**1**			**24 %**
*Number of quadrates encountered in each disturbance scale						

Source: IBCR & GTZ, s.a.

In addition to it, the coffee exploitation was found to show as very destructive. During the woody plant inventory survey many stands had been noticed as dry. As a result of illegal coffee harvest many coffee shrubs had been destroyed in a careless manner (IBCR & GTZ, s.a.)

The "Conservation and use of wild populations of *Coffea arabica* in the montane rainforests of Ethiopia" (CoCE) project carries out on how much wild coffee can actually be harvested from the forest and what the influences of wild coffee management on the floristic diversity and structure of the forest are. The fragments contain afromontane forest with wild coffee in the undergrowth. The number of study plots is according to the size of forest fragments (Schmitt, Ch. B. et al., 2005). In the following table are the four surveyed fragments listed.

Tab 12: Studied forest fragments in the Bonga region

Forest fragment	Total size (ha)	Disturbed forest (in %)	Altitude (in m asl)	Distance from Bonga	Number of study plots
Koma	2,100	25	1,800 - 2,300	20 km NWW	34
Meligawa	500	60	1,700 - 1,950	4 km NE	12
Mankira	900	70	1,550 - 1,800	10 km SO	17
Kayakela	1,200	70	1,600 - 1,750	7 km N	22

Source: Schmitt, Ch. B. et al., 2005

The result of the research is that they had found four different types of management systems. But it is not described in which forest fragment which management system is dominating. The four types are no management (NM), forest coffee system (FC), semi-forest coffee systems 1 and 2 (SFC) (Schmitt, Ch. B. et al., 2005).

“In […] the FC the wild coffee trees are thin and spindly and carry only few fruits. The percentage of coffee plants is low, because other shrub and tree species that are apparently more competitive than coffee grow in the shaded understorey. Management activities, i.e., the removal of canopy trees and competing undergrowth, lead to better growth conditions for the coffee. With increasing management intensity, the coffee yield rises due to the increasing population density of the coffee and to the fact that the individual trees carry more fruits. While in the FC system the forest structure remains undisturbed, in the SFC systems the original vegetation build-up is severely disturbed. In SFC 1, the density of the coffee trees and seedlings is very high, whereas in SFC 2 the coffee plants are thinned out and there are only few but large coffee trees. The trees become bushier and reach diameters at breast height of up to 15 cm. Some farmers transplant seedlings from adjacent forest areas or add seedlings of improved coffee cultivars distributed by government extension workers and non-governmental organizations “ (Schmitt, Ch. B. et al., 2005).

8.1) Social and Environmental impacts due to upgrading the Jima-Mizan Road

As part of the Ethiopian Government’s 10 Years Road Sector Development Programme – (1997 - 2007) the upgrading of the road between Jima and Mizan is one of the main projects. The project´s aim is to improve and expand the country´s road network. Because of transportation is an essential feature of agriculture it is important to improve the roads to develop and to push that region. The length of the to be upgraded road is about 224 km. It's starting from Jima, passing Bonga town and is ending in Miza. The upgrading

includes to modernise the existing road as well as to construct new bypasses to Bonga town (African Development Fund, 2006).

The positive social impacts could be better job opportunities, better health situation. Also local people get employed for the time of upgrading. In the long term the region experiences an economic growth and an advance of the general situation (African Development Fund, 2006).

The negative impacts could be the bad influence of the water resources. Because of culverst and bridges the natural run of water will be disturbed. Also the water within the culverts and new pits could become breeding places for vectors of malaria and bilharzias. Further it is espected that the water supply in Bonga will be bad affected (African Development Fund, 2006).

Soil erosion can be expected in areas where the soil is disturbed and the on growing vegetation is removed, too (African Development Fund, 2006).

As negative social-economic impacts can be mentioned the loss of property. A total of 2,566 households in the 30 m zone (alongside the road), which is needed to construct the road, are endangered to lose their property. Also 218 ha farmland within the 30 m zone would be lost (African Development Fund, 2006).

Further in ADF, 2006 is listed a "code of behaviour" related to types of potential impacts.

8.2) Deforestation

Around 1900 almost the entire Southwestern Ethiopian highlands were covered by montane rainforest. The enormous loss of forest was not due to shifting cultivation, but the migration and the following new farming system was blameable (Reusing, M., 2000).

According to the recent estimated rate of loss of forest of 80,000 - 200,000 ha by now, the area covered with natural forest will be disappeared in 10 years. As a result of the migration and the new farming systems the deforestation is stepping forward. The cutting for energy/fire as well as for constructing huts and houses is the cause. Also the population growth of 2.9 % has its impact to the natural resources like wood. Almost the whole economy bases on agriculture. 88 % of the population are engaged. The low growth of the agricultural sector of less than 0,3 % per year is correlated to its development. To produce enough food for the people in combination with the high population growth, agriculture needs to expanse horizontal, which leads then to an increase of deforestation (IBCR & GTZ, s.a.).

8.3) Deforestation in Boginda

The deforestation in Boginda is empowered by the construction of the Diri-Masha road. The rate of loss of forest in Boginda is very high. Reasons for deforestation are as follows (IBCR & GTZ, s.a.):

- Clearing/burning of natural forest for cultivation of other crops and planting coffee
- Settlement and chasing the wildlife
- Cutting trees/shrubs for fuel wood
- Cutting trees for construction materials
- Cutting big trees to harvest honey

Especially the big tree species *Cordia africana* and *Pouteria adolfi-friederici* are highly endangered because of exploitation (IBCR & GTZ, s.a.).

Fig 4: Initial stage of land degradation in settlement areas in Bonga

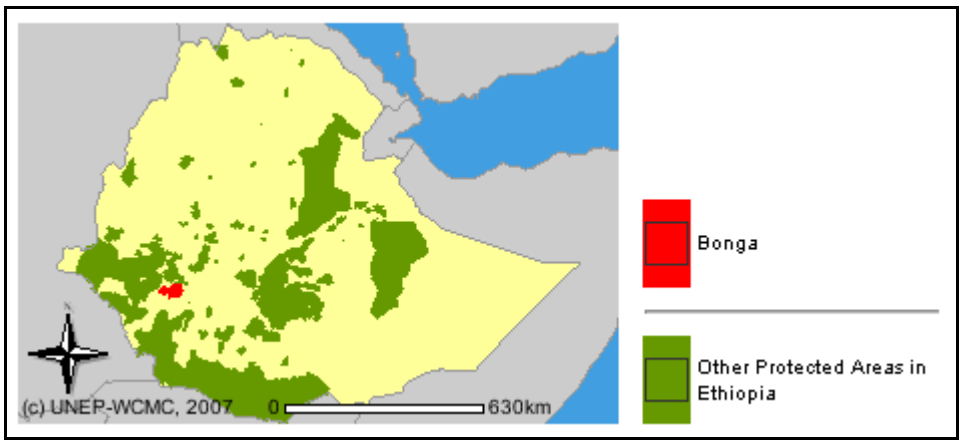
Source: Farm Africa & Sahel International, 2004a

9) Conservation Activities

Ethiopia's forest is highly disturbed and fragmented. Just 2,000 km² are remained as highly fragmented forest. In Ethiopia are 40 protected areas with an area surface of 186,198,40 km². That means that 16,86 % of the state surface is protected area. There are some National Forest Priority Areas in Ethiopia. In **Bonga** exist one proposed with an area of 161,423 hectares (UNEP & WCPA, s.a.). **Bonga** (Site Code: 29094) is situated at a latitude of 7° 12' 35"N (7,210°) and a longitude of 36° 17' 24"E (36,290°), for details please refer to Map 4 below and Map 8 in the appendix.

Category II means that the area is marked as National Park. For detailed information refer the Appendix.

Map 4: National Forest Priority Area in Bonga



Source: UNEP & WCPA, s.a.

The project “Conservation and use of wild populations of *Coffea arabica* in the montane rainforests of Ethiopia” (CoCE) has conducted in the vicinity of **Bonga** a study for the sustainable management of wild coffee. In four forest fragments, which contain wild coffee growth, there had been conducted vegetation surveys. The four areas are Koma, Meligawa, Mankira and Kayakela. During the surveys the area was parted into 85 plots in which all plant species had been listed (Schmitt, Ch. B. et al. 2005).

In the zone existing 84 service cooperatives out of which 12 are forest coffee cooperatives. (Bekele, T., 2003) Detailed information about the need of conservation gives Jacobs, M.J. & C. A. Schloeder, 2001 in their "Impacts of Conflict on Biodiversity and Protected Areas in Ethiopia" with the aid of different Ethiopian National Parks.

9.1) Conservation efforts

According to Stellmacher, T., (2005) the Forest Proclamation 9/1994 of Ethiopia assigned five forest administration categories

- State forests; protect genetic resources and conserve the ecosystem in a programme that is interregional
- State protected forest; free from human or animal interference for the protection of the environment and genetic resources
- Regional forests; not a state or state-protected forest
- Regional protected forests; free from human or animal interference for the protection of the environment and genetic resources

- Private forests; developed by any legal person including, administered by the regions

Detailed information about the Forest Proclamation 9/1994 is written in Stellmacher, T., (2005).

There are various efforts to conserve the forest coffee plants-gene pool in **Kafa** Region. 15 years ago an ex-situ conservation activity has been initiated in Jima zone. Since that time over 2,000 coffee accessions has been collected and researched in the National Coffee Research Centre at Jima.

The conservation had following goals:

- Collect and research the diversely coffee-plants to develop plants with high yield, better quality, resistance to diseases, pests and abiotic stress.
- Conserve flora and fauna, microorganisms, soil, water in about 50 ha of the forest coffee ecosystem (FCE) in western and Southwestern parts of Ethiopia.
- Conserve and preserve the coffee genepool (in-situ & ex-situ) to know the genetic value of this area and of Ethiopia, too. Moreover for future breeding programmes

The current conservation status is that the Institute of Biodiversity Conservation and Research (IBCR) maintains more than 4,000 accessions at the Chochie Biodiversity Unit in Jima on 115 ha. Additionally the Jima Branch of the Institute of Agricultural Research maintains now about 600 coffee types and 700 random selections that show varying resistance to CBD. The In-situ conservation is not developed as well. In 1998 the

Coffee Improvement Project of Ethiopia suggested the establishment of three in situ reserves known as the Kontir-Behan (20,000 ha), **Boginda-Yeba** (5,500 ha) and Geba-Dogi River (18,600 ha). Until today the assigned Coffee and Tea Authority did not started because of the financial lack (Gole, T.W., 2002b).

Before establish a conservation area it must be planed. The Forest Coffee Ecosystem is not only important for genetic conservation; also there are millions of people who live in this region who depend of it. The construction of a conservation area must respect the people who live there and also the must be a maximum use of it. The Man and Biosphere (MAB) Programme of UNESCO is considering this need (Gole, T.W., 2002b). To become a biosphere reserve by MAB the proposed area has to be:

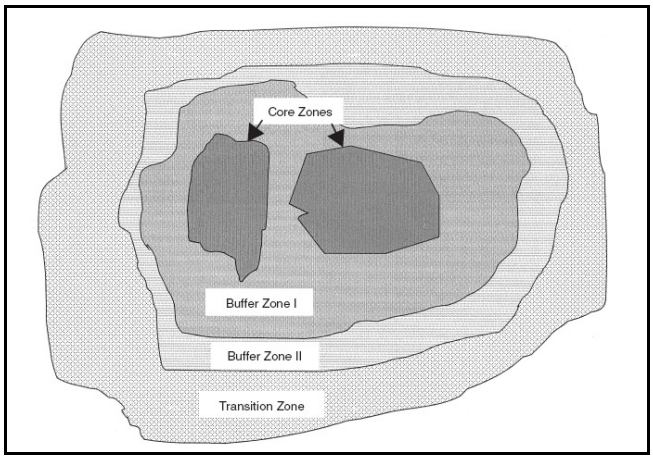
- representative in their biogeography
- contains animals, plants etc. which need to be conserved
- possibility for a sustainable development
- the size must be big enough to serve the three functions (explained below!)
- must have a zoning structure (core-, buffer, transition zone)

For the three functions a biosphere reserve must fulfil refer the appendix.

A Biosphere reserve has different departments with their own specific functions. In general a reserve is divided in three sections/areas. The core zone, the buffer zone and the transition zone. A theoretical reserve is to see in Map 5.

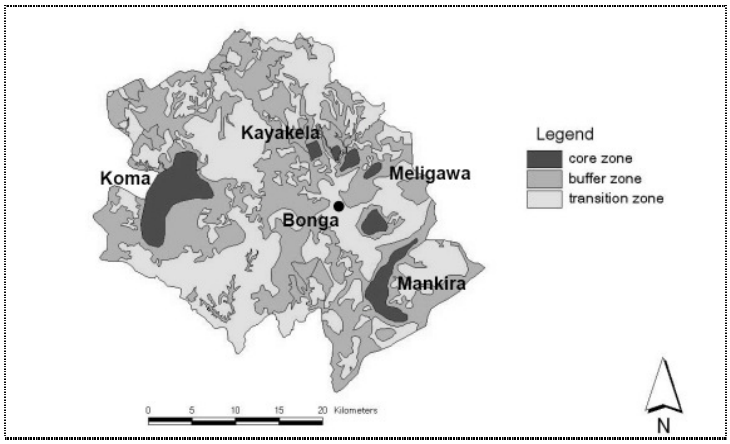
In a real case like the Biosphere Reserve **Bonga** the departments are more structured. For instance the core zone is not surrounded by a buffer zone, as shown in Map 6.

Map 5: Conceptional reserve design for C. arabica



Source: Gole, T.W., 2002

Map 6: Biosphere Reserve Bonga



Source: Schmitt, Ch. B., 2006

The underneath table shows how a potential biosphere reserve could look like. According to Taestensen, there could be 7 core zones, 36 buffer zones and 36 transition zones. A detailed illustration on the study area Kayakela gives Map 11 in the appendix.

Tab 13: Area of the Biosphere Reserve Bonga

Classification	Number	Area in km²	%
Core Zone	7	71,92	6,91
Buffer Zone	36	488,36	46,90
Transition Zone	36	481,12	46,20
		1041,40	

Source: Taestensen, F. et al., 2007

The different zones have their different functions. The Core zone is only for the (in-situ) conservation of wild coffee. Any human intervention is prohibited except project research or visits for public/education (Gole, T.W., 2003). But there also can be a of the core zone. For instance the collection of wild coffee, medicine plants, vegetable and mushrooms, hunting, production of honey and use of wood can be allowed under specific conditions (Schmitt, Ch. B., 2006).

The Buffer zone I is similar to the core zone and means an extension of the core zone. Just non-destructible interventions like picking fruits or collect honey are allowed (Gole,

T.W., 2003a). Also semi wild coffee management is allowed except the cultivation of coffee varieties (Schmitt, Ch. B., 2006).

In the Buffer zone II, also called socio-buffer, is the traditional semi-forest production allowed. In the understorey small trees and plants which "disturbes" the coffee grow will be eliminated. Besides coffee there is also a spice, which has a high value. One kilogram of *Aframomum corrorima* brings more than 10 US$ on the local markets. This spice is endemic for Ethiopia and depends to the wild coffee area. To ensure the success of the core zone, the rules of the Buffer zones must be realised (Gole, T.W., 2003a).

Tab 14: Biological and social benefits of using buffer zones

Biological benefits	Social benefits
- Provides extra protection from human activities for the core zone - Protects the core zone of the reserve from biological change - Provides a large forest unit for conservation, with less species loss through edge effects - Extends habitat and thus population size for large trees requiring more space - Provides a replenishment zone for core area species	- Gives local people access to use the forest by traditional practices without depleting the core zone - Compensates people for loss of access to the strictly protected core zone - Permits local people to participate in Conservation - Safeguards traditional land use rights and conservation practices

Source: Gole, T.W.**, 2003a**

In the Transition zone all cultural and productive activities including animal husbandry are allowed. Also introducing new plants and new techniques are allowed in case the people have a benefit of it. If the production in the Transition zone is working and brings enough benefit to the people, the danger of affect the core zone will be minimal (Gole, T.W., 2003a).

As a sample for more detailed distribution of the different zones, refer map of the study area Kayakela in the appendix.

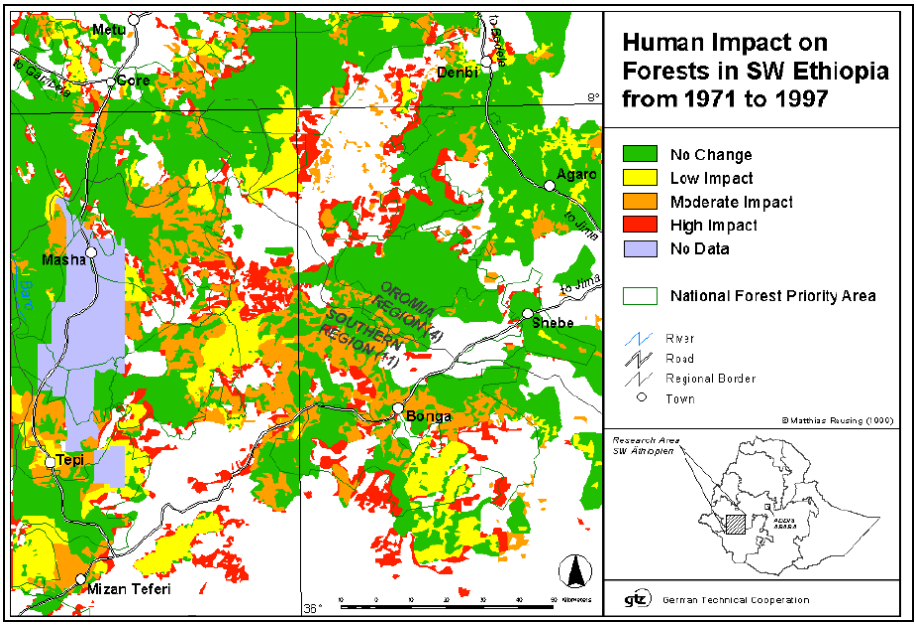
10) GIS data and maps

In this chapter all available GIS data and maps on Kafa Region are listed. There is a deficient supply of GIS data for the potential biosphere area. Only Reusing, M., (2000) provides data on that area. He collected all available GIS data and assembled them.

In the 1970ies and 1980ies there had been some analogue satellite image interpretation based on Landsat Satellite.

From 1986 to 1989 as well as from 1986 to 1990 there had been digital satellite image interpretation based on Landsat. All data had been edited by ARC/INFO and IDRISI. As a result of the 71 analogue images and the LANDAST images from 1986 to 1990 Reusing got a declaration about the deforestation in Ethiopia. De facto the deforestation between 1986 and 1990 was 3,93 % or 45,055 km². That means an annual deforestation rate of 163,600 ha (Reusing, M., 2000).

Map 7: Human impact on Forests in SW Ethiopia from 1971 to 1997



Source: Reusing, M., 2000

Before the 1970ies the forest was completely covered by montane rainforests. The situation changed resulting from the already described resettlement program of the state. The new farmers brought a new farming system that was not adapted to the environment (Reusing, M., 2000).

Based on black and white photographs of the years 1971 to 1975 it had been shown that only 38,4 % of the original forest had been remained. The reason of the enourmous loss of forest lies in the resettlement programme of the 1970ies and the attached higher need of fuelwood and constructing timber (Reusing, M., 2000). There are two satellite images of Bonga region available but without theme.

On the website of the UN Office for Coordination of Humanitarian Affairs (OCHA) there is following map:

- Administrative Regions of Ethiopia

In "Reflections on environmental change and sustainable agriculture in areas of autonomous trypanosomosis control" by Bourn, D. (2002) there are some graphics and maps showing:

- Human Population Growth and Distribution in Ethiopia
- Forests and Deforestation in Ethiopia: 1973 – 1990
- Deforestation in South-Western Ethiopia: 1971-1997

In Conservation areas for wild coffee in Ethiopia: an exemplary planning concept based on land use" by F. Taestensen et al. (2006) there are maps showing biosphere reserves in Bonga:

- Biosphere reserve Bonga
- Zoning of the study area (Kayakela)

In "Genetic diversity of wild *Coffea arabica* populations in Ethiopia as a contribution to conservation and use planning" by Kassahun Tesfaye Geletu there is a map that shows the forest areas, the CoCE project sites.
In Christine B. Schmitt´s "Montane rainforest with wild *Coffea Arabica* in the Bonga region (SW Ethiopia): plant diversity, wild coffee management and implications for conservation" there are some maps:

- Forest cover in south-western and south-eastern Ethiopia with ecologically suitable areas for wild coffee growth (potential coffee forest) and the borders of the kingdom of Kafa in 1820 (GIS)
- Location of the studied forest fragments in south-western Ethiopia; potential coffee forest: ecologically suitable areas for wild coffee growth; other forest: forests above 2,000 m asl too high for wild coffee (GIS)
- Location and coffee management system of study plots in the forest fragments Koma, Mankira, Meligawa and Kayakela

In the National Biodiversity Strategy and Action Plan by the Institute of Biodiversity Conservation of Ethiopia 2005, there are maps:

- Agro Ecological Zone (AEZ) in Ethiopia
- Protected Areas in Ethiopia

In Conservation and use of coffee genetic resources in Ethiopia: challenges and opportunities in the context current global situations by Gole, T.W. (2003a) there are two graphics:

- Annual average ICO composite indicator price of green coffee on the world market
- Average annual retail price in three major coffee importing countries (ICO database)

The Sustainable Poverty Alleviation in Kafa (SUPAKS, 2002) has three maps of the Kafa region:

- Potential Areas with (Semi-) Forest Coffee Occurrence (Scale 1:500,000)
- Kafa Zone, Topographic Map (Scale 1:550,000)
- Kafa Zone, Land Cover / Use Map (Scale 1:550,000)

In the case study of Muys, B. (2003) "Forest Rehabilitation through Natural Regeneration in Tigray, Ethiopia: From Fragments to Forests" there is one map showing the population of Ethiopia:

- Total population density of Ethiopia

Stellmacher's "Governing the Ethiopian Coffee Forests: A Local Level Institutional Analysis in Kaffa and Bale mountains" (2006) gives following maps:

- Forest cover in SW Ethiopia and contours of Bonga and Mena Angetu NFPA (MODIS Vegetation Continuous Fields Satellite Image 2000)
- Forest cover and Bonga NFPA in Kaffa Zone
- The broad vicinity of Koma Forest
- GPS-confirmed boundaries of traditional forest property rights in Koma Forest

There existing two maps unknown made in the context of the Woody Biomass Project:

- Forest and potential coffee forest of Bonga, Yayu & Sheko
- Population density of Bonga, Yayu & Sheko

Matthias Reusing´s Change detection of natural high forests in Ethiopia using remote sensing and GIS techniques includes two maps made in cooperation with the GTZ:

- Human impact on forest in Ethiopia from 1973 to 1990
- Human impact on forest in SW Ethiopia from 1971 to 1997

In the World Bank, 2004 there are about 50 maps showing the distribution of for instance electricity, water access etc.

In World Bank, 2005 there is a map with two side maps:

- Energy Access Project

- Target Weredas for Sustainable Community Forestry Schemes
- Target Weredas for Farm Agro-forestry

In Surendra Kotecha's "Arabicas from the Garden of Eden: Coffea Aethiopica" (2007) there are two maps:

- Map of Ethiopia: main forest areas in green and forest areas with coffee in light green
- Detailed Map of Ethiopian forest areas in green and forest areas with coffee in light green

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Appendix

A) Conceptions

Alternate names for Kafa: KAFA, KEFA, KEFFA, KAFFA, CAFFINO, MANJO

Dialects: KAFA, BOSHA (GARO)

Alternate abreviations for Southern Nations, Nationalities, and People's Region (SNNPR): SNNPS, SNNP's, SNNPR's.

Alternate names for Gimbo: Ginbo

Kebele: It's the smallest administrative unit in Ethiopia. It can be a neighbourhood or a small group of organised people. The Kebele is part of a wereda.

Wereda: It's an administrative ward or local government equivalent to a district

B) Coffee

B.1) Introduction

"Wild Arabica coffee (*Coffea arabica*) has recently become a buzzword on the international coffee specialty market (Watson 2004). Little is known, however, about the actual abundance and distribution of wild coffee in its indigenous habitat. Southard (1918) was impressed by “great forests of the wild coffee, which have not yet been touched”. Subsequently, researchers have questioned if wild coffee exists at all, because centuries of human activities in the forests of southwest Ethiopia might have strongly modified the natural occurrence of

so-called wild coffee populations [...]. Until today, an official and internationally recognized definition of wild coffee does not exist.

Reams of studies have been published on the ecological requirements of coffee, coffee growth performance and coffee yields in plantations worldwide, but wild coffee in its natural habitat has hardly received any attention [...]. Most descriptions of coffee phenology and growth patterns in Ethiopian rainforests stem from early coffee researchers [...]. Sketchy characterizations of wild coffee management systems exist, but systematic studies on performance and yield of coffee in these systems are lacking [...]. Furthermore, conservation planning for the last Ethiopian rainforests with wild coffee requires good knowledge on the actual impact of wild coffee management on coffee populations and forest vegetation." (Schmitt, Ch. B., 2006)

"Coffee collected and managed inside the forest and planted in home gardens is the most important cash crop [...]. In 2003/04, the **Kafa** Forest Coffee Farmers Cooperative Union marketed 131 tons of coffee from forest coffee and semi-forest coffee systems with Gimbo and Decha *wereda* contributing 50 % and 30 %". (Schmitt, Ch. B., 2006)

B.2) Ecological requirements of Coffea arabica

"*Coffea arabica* L. (Rubiaceae) grows naturally as bush or small tree in the shaded understorey of montane rainforests in southwest and southeast Ethiopia. It occurs at altitudes between 1,000 – 2,000 m asl with the most suitable range being 1,500 – 1,800 m asl. Coffee supports annual rainfall between 900 – 1,300 mm/yr, but most appropriate are conditions above 1,300 mm/yr with an optimum at 1,600 – 1,800 mm/yr [...]. The optimum average annual temperature for coffee is 18 – 24 °C with contrasting seasons.

Coffee grown in plantations tolerates much wider altitude and rainfall ranges than coffee grown in its original habitat. Coffee plantations occur from sea level up to 2,800 m asl.

Annual rainfall can be as low as 500 mm/yr if coffee is irrigated as for example in Harar (east Ethiopia) [...].

Coffee grows on soils with varying acidity. Slightly acid soils, as present under montane forest in southwest Ethiopia, are most suitable [...]. Since coffee is evergreen, it requires sub-soil water at all times. Thus, deep soils with good water holding capacity are the most suitable environment for coffee growth. The soil structure must also allow good drainage because the surface feeding roots need a drier period for part of the year to slow down growth, ripen the wood and initiate flower buds [...]. In heavy rainfall areas such as Southwest Ethiopia coffee grows successfully in shallow clay soils with 15 – 20 cm depth. Years with excessive rainfall or unusually long dry season can reduce the yields (Schmitt, Ch. B., 2006).

Coffee is self-fertilizing, but fertilization by bees increases the yield substantially [...]. Monkeys, birds and rodents relish the sweet pulp of ripe coffee fruits and disseminate the coffee seeds inside the forest [...]" (Schmitt, Ch. B., 2006).

B.3) Traditional management and processing practices

"Forest coffee is traditionally managed in forest coffee (FC) and semi-forest coffee (SFC) systems [...]. They constitute 14 % and 54 % of the total coffee production area in Ethiopia, respectively. In FC systems, only some competing undergrowth is removed. In SFC systems, most undergrowth is removed and some emergent trees are cut. In semi forest coffee plantations (17 % of the total coffee production area) farmers keep only few shade trees and plant additional coffee seedlings collected in adjacent areas as well as improved coffee varieties distributed by government extension workers and nongovernmental organizations (NGOs). Home-garden coffee (9 %) and modern type plantations (6 %) constitute small parts of the total coffee production area.

Coffee fruits consist of endosperm (beans) coated by testa (silverskin) and endocarp (parchment), and surrounded by fleshy mesocarp (pulp). During wet coffee processing, the mesocarp is removed with water (pulping) and the remaining fruit is fermented and dried. Endocarp and testa are then removed mechanically (hulling) [...].

Traditionally, farmers harvest forest coffee by strip harvesting or by shaking trees and collecting fruits from the ground. They thus obtain a mixture of ripe and immature fruits. These are dried on the soil or sometimes on mats (dry processing). Thereafter, pulp, parchment and silverskin are removed manually.

The quality of traditionally processed coffee beans is good enough for home consumption, but does not meet export standards. Foreign coffee experts have long Wild *Coffea arabica* in southwest Ethiopia complained that forest coffee should be harvested

perfectly ripe, but not from the ground, should be mechanically pulped and hulled (wet processing), or dried on stools to avoid the smell of earth [...]." (Schmitt, Ch. B., 2006)
Further information about coffee systems gives Philippe, L.

B.4) Characterisation of wild coffee management systems

"The forest in **Bonga** region is classified into five management types according to degree of disturbance and abundance of coffee as observed in the respective study plots." (Schmitt, Ch. B., 2006)

No management/ undisturbed

"This forest type is unmanaged forest with undisturbed forest structure. The understorey is deeply shaded and consists mostly of shrub and small tree species, that are more competitive than coffee under these conditions. Coffee density is very low and the individuals are sparsely distributed in the undergrowth. They are spindly and produce few fruits. Due to the low number of mother trees and due to low productivity, there are only few seedlings. In some forest parts, there are no mature mother trees at all, and seedlings stem from seeds dispersed by birds or mammals. If the forest is extremely shaded and humid, no coffee individuals are observed.
Local farmers sometimes remove woody plants from these forest parts, but there are no regular coffee management activities. They collect green and red coffee fruits at the same time because the cherries ripen asynchronously in the shaded forest, yields are low, and the walking distance from the villages is usually large. Some remote coffee trees are not visited annually, but on a more arbitrary basis.
This management intensity is the very first step in the domestication process of wild trees. It is classified as “uncontrolled utilization” if the coffee fruits are only collected casually or as “controlled utilization” if the collection is more or less systematic. In both cases, though, there is no transformation of the natural vegetation composition and structure, and propagules are only incidentally dispersed (Wiersum 1997)." (Schmitt, Ch. B., 2006)

(2) No management/ disturbed

"This is forest with disturbed vegetation structure and low coffee density. The disturbance is caused by natural fall of trees or by people who removed poles and trunks to meet their needs for wood and timber, but there is no explicit coffee management. The coffee individuals have the same physiognomy as in unmanaged and undisturbed forest, and their yields are also low. The fruits are picked by farmers on a casual basis." (Schmitt, Ch. B., 2006)

(3) Forest coffee system

"This is forest with low coffee management intensity. Local farmers remove some shrubs and small trees that compete with coffee, but the overall vegetation structure remains undisturbed. As result of the management, coffee trees have more spatial space and are less shaded. The density of coffee individuals and the number of large coffee trees is therefore higher than in the unmanaged forest types. Coffee yields also increase." (Schmitt, Ch. B., 2006)

"Local farmers visit forest coffee (FC) systems at least once a year to remove competing undergrowth vegetation and systematically collect coffee fruits. FC systems are considered as "owned" by individual farmers according to traditional land use perceptions (Stellmacher in prep.). Thieving occurs, however, and therefore farmers prefer to harvest early, i.e. even green fruits, in order to be ahead of thieves. The production of coffee in FC systems is classified as "controlled utilization" involving systematic collection and the limited transformation of forest structure to reduce competing vegetation (Wiersum 1997)." (Schmitt, Ch. B., 2006)

C) Definition of category II National Park

The definition of category II National Park by the WORLD COMMISION ON PROTECTED AREAS: "Protected area managed mainly for ecosystem protection and recreation" is copied from http://www.unep-wcmc.org/wdpa/index.htm:

Definition
Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Objectives of Management

- to protect natural and scenic areas of national and international significance for spiritual, scientific, educational, recreational or tourist purposes;
- to perpetuate, in as natural a state as possible, representative examples of physiographic regions, biotic communities, genetic resources, and species, to provide ecological stability and diversity;
- to manage visitor use for inspirational, educational, cultural and recreational purposes at a level which will maintain the area in a natural or near natural state;
- to eliminate and thereafter prevent exploitation or occupation inimical to the purposes of designation;
- to maintain respect for the ecological, geomorphologic, sacred or aesthetic attributes which warranted designation; and
- to take into account the needs of indigenous people, including subsistence

resource use, in so far as these will not adversely affect the other objectives of management.

Guidance for Selection

- The area should contain a representative sample of major natural regions, features or scenery, where plant and animal species, habitats and geomorphological sites are of special spiritual, scientific, educational, recreational and tourist significance.

- The area should be large enough to contain one or more entire ecosystems not materially altered by current human occupation or exploitation.

Organizational Responsibility
Ownership and management should normally be by the highest competent authority of the nation having jurisdiction over it. However, they may also be vested in another level of government, council of indigenous people, foundation or other legally established body which has dedicated the area to long-term conservation."

Equivalent Category in 1978 System
National Park

D) UNESCO Biosphere Reserve

Definition: Core Area

"The **core area** needs to be legally established and give long-term protection to the landscapes, ecosystems and species it contains. It should be sufficiently large to meet these conservation objectives. As nature is rarely uniform and as historical land use constraints exist in many parts of the world, there may be several core areas in a single biosphere reserve to ensure a representative coverage of the mosaic of ecological systems. Normally, the core area is not subject to human activity, except research and monitoring and, as the case may be, to traditional extractive uses by local communities." (UNESCO, 2006)

Source: Taestensen, F. et al., 2007

Definition: Buffer Zone

> "The ***buffer zone*** (or zones) is clearly delineated and surrounds or is contiguous to the core area. Activities are organized here so that they do not hinder the conservation objectives of the core area but rather help to protect it, hence the idea of "buffering". It can be an area for experimental research, for example to discover ways to manage natural vegetation, croplands, forests, fisheries, to enhance high quality production while conserving natural processes and biodiversity, including soil resources, to the maximum extent possible. In a similar manner, experiments can be carried out in the buffer zone to explore how to rehabilitate degraded areas. It may accommodate education, training, tourism and recreation facilities." (UNESCO, 2006)

Source: Taestensen, F. et al., 2007

Definition: Transition Area

> "An outer ***transition area*** or area of co-operation extends outwards, which may contain a variety of agricultural activities, human settlements and other uses. It is here that the local communities, conservation agencies, scientists, civil associations, cultural groups, private enterprises and other stakeholders must agree to work together to manage and sustainably develop the area's resources for the benefit of the people who live there. Given the role that biosphere reserves should play in promoting the sustainable management of the natural resources of the region in which they lie, the transition area is of great economic and social significance for regional development."
> (UNESCO, 2006)

Source: Taestensen, F. et al., 2007

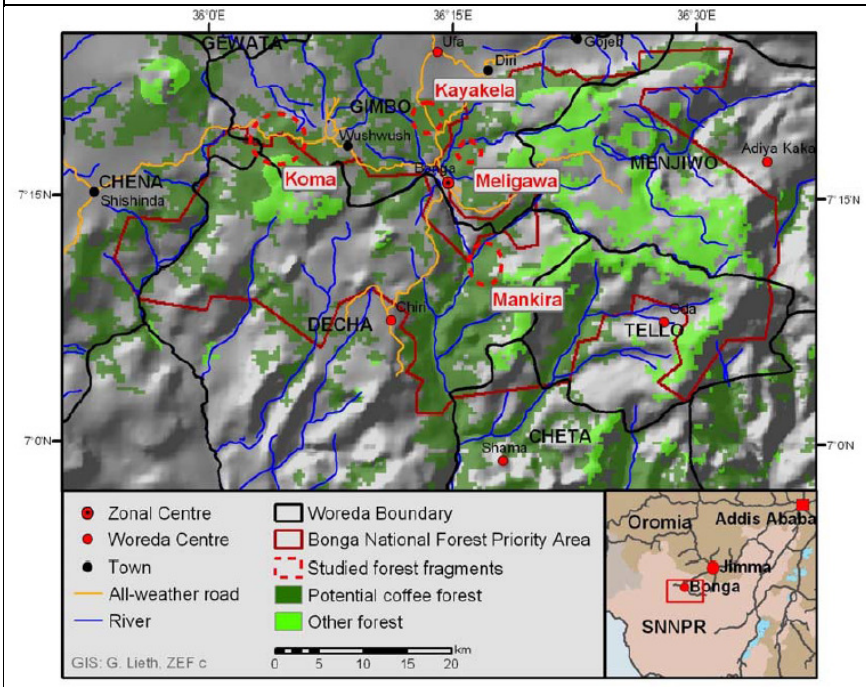
Tab 15: Functions of Biosphere Reserve by MAB/UNESCO

Conservation	contribute to the conservation of landscapes, ecosystems, species and genetic variation
Development	foster economic and human development which is sociocultural and ecologically sustainable
Logistic support	support for demonstration projects, environmental education and training, research and monitoring related to local, regional, national and global issues of conservation and sustainable development

Source: Taestensen, F. et al., 2007

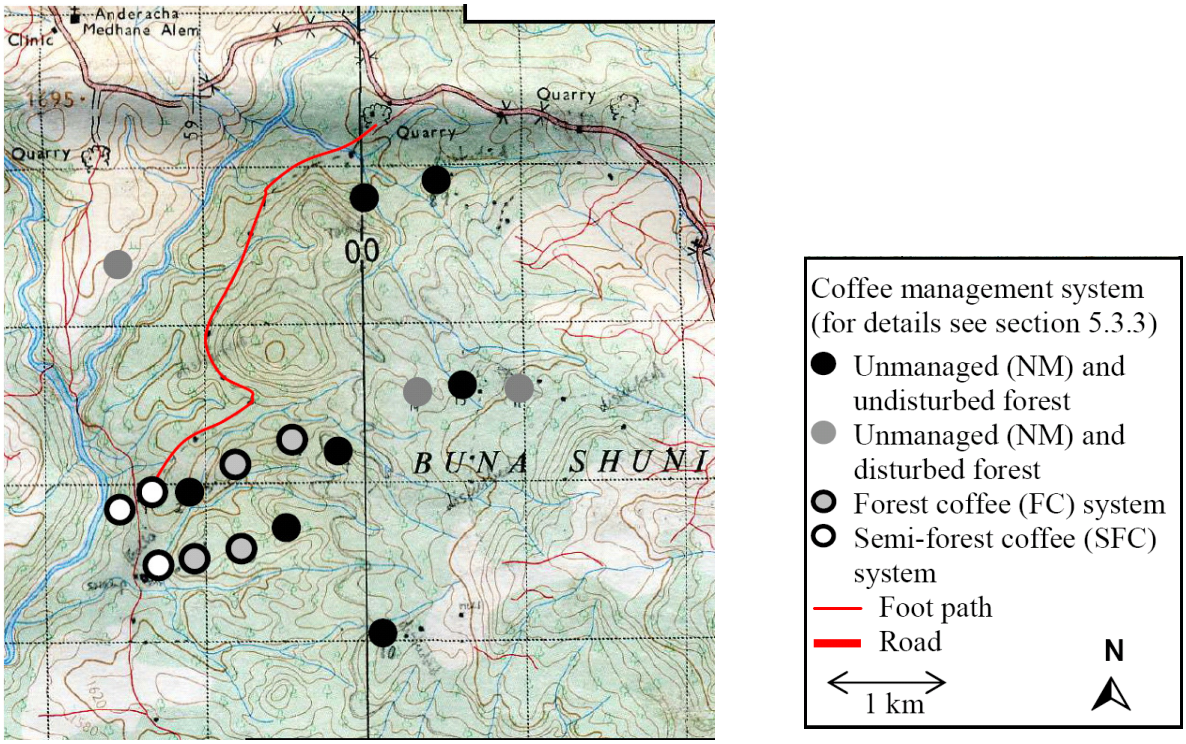
E) Maps & Tabs

Map 8: Bonga National Forest Priority Area



Source: Schmitt, Ch. B., 2006

Map 9: Location and coffee management system of study plots in Mankira forest



Source: Schmitt, Ch. B., 2006

Tab 16: Eight years average climatic data

	Monthly Period											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Rainfall (mm)	60.11	38.98	97.61	168.88	200.63	197.2	182.34	172.36	175.76	151.53	79.38	50.31
Mean max. T°	28.28	29.08	28.72	27.73	26.98	26.54	25.26	25.43	26.48	27.2	28.17	28.29
Mean min T°	10.16	10.86	11.99	11.78	12.13	11.63	11.66	11.89	12.05	11.3	10.49	9.75
Mean T°	19.2	20	20.4	19.8	19.6	19.1	18.5	18.7	19.3	19.3	19.3	19

Source: IBCR & GTZ, s.a.

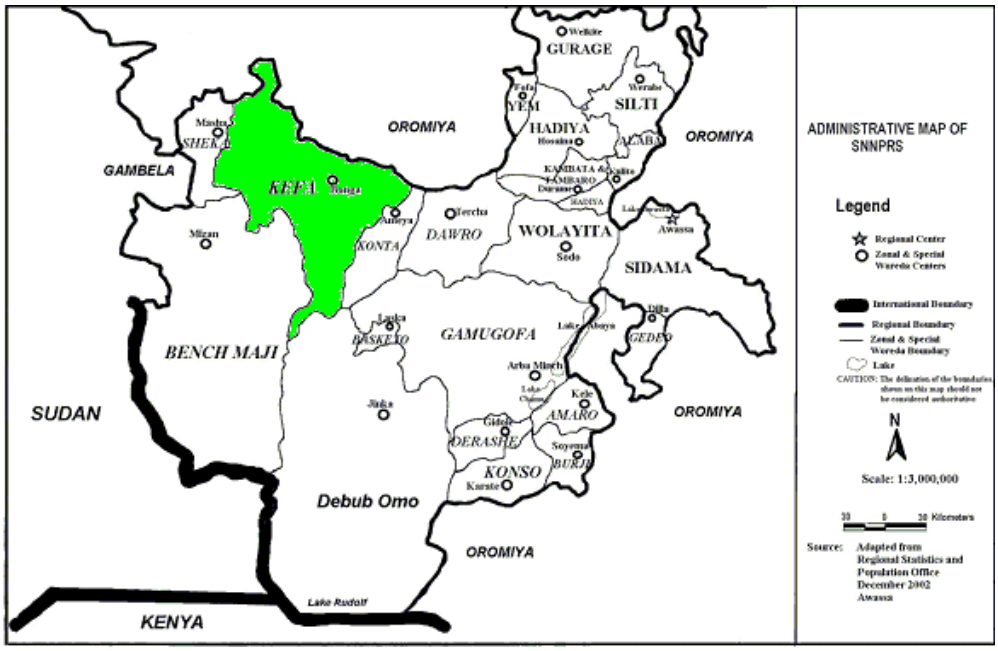
Tab 17: Differences in soil parameters between four forest fragments

	Koma (16 plots)			Kaya (6 plots)			Meli (5 plots)			Mank (10 plots)			Sign.
	Ave.	Min	Max	Ave.	Min	Max	Ave.	Min	Max	Ave.	Min	Max	diff.[1]
pH (H_2O)	5.1 low (low-medium)	4.21	5.91	5.4 low (low-medium)	5.02	5.74	5.3 low (low-medium)	4.08	5.89	5.5 medium (low-med.)	4.58	6.3	-
pH (KCl)	4.3	3.49	4.87	4.6	4.04	4.99	4.8	3.7	5.32	4.9	3.98	5.48	1<4
OM (%)	6.28 high (medium-high)	3.61	9.92	7.09 high (medium-high)	4.75	8.76	8.29 high (high-very high)	5.38	11.93	8.37 high (high-very high)	6.69	10.56	1<4
Total N (%)	0.42 medium (med.-high)	0.31	0.6	0.43 medium (med.-high)	0.3	051	0.45 medium (med.-high)	0.34	0.6	0.52 high (medium-high)	0.43	0.68	1<4
C/N	8.8	5.1	10.3	9.5	7.9	10.5	10.5	9.2	11.5	9.3	8.8	10.0	1<3
Avail. P (ppm)	1.08 low	0.31	2.22	2.91 low	0.95	5.38	4.97 low	1.5	8.44	1.63 low	0.54	3.18	1<2,3 3>4
Exch. K (meq/100g)	0.5 medium (low-high)	0.16	0.95	1.21 high (medium-high)	0.48	2.2	0.96 high (medium-high)	0.31	1.87	1.21 high (medium-high)	0.35	2.09	1<2,4

[1] *Significant difference at level 0.05 as determined by the Bonferroni test (one-way ANOVA):*
1 = Koma, 2 = Kayakela (Kaya), 3 = Meligawa (Meli), 4 = Mankira (Mank)
Classification of values (low to very high) (Landon 1984; AG Boden 1994)

Source: Schmitt, Ch. B., 2006

Map 10: Administration in SNNPR



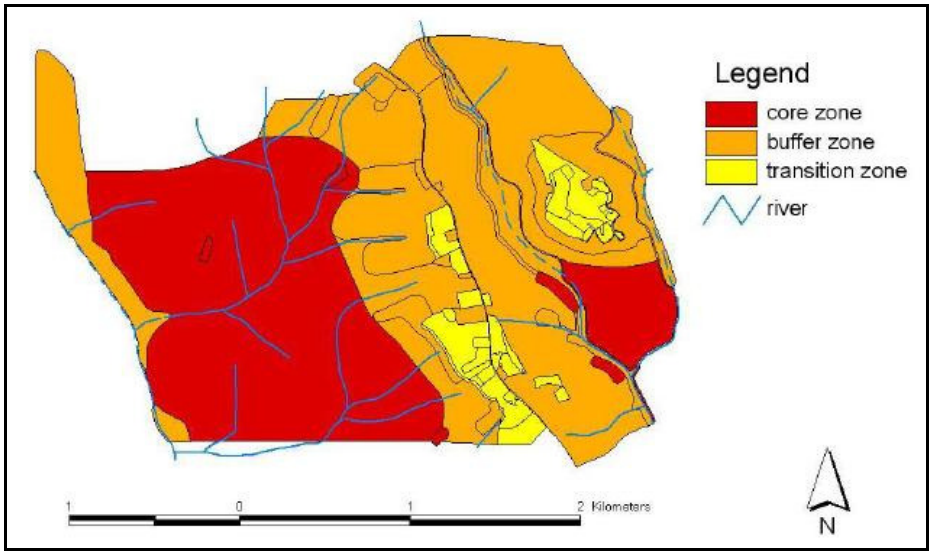
Source: Abbute, W.-S., 2003

Tab 18: Conservation status of major mammals and birds in Ethiopia

Type of species	Critically endangered	Endangered	Vulnerable	Near threatened
Mammals				
Gelada Baboon			3	3
Grevys Zebra		3		
Swaynes Hartebeest		3		
Speake's Gazelle			3	
Mountain Nyala		3		
Walia Ibex	3			
African Wild Ass	3			
Ethiopian Wolf	3			
Tora Hartebeest				
Dibatag		3		
		3		
Birds				
Ankober Sern		3		
White-winged Fluftail		3		
Prince Ruspoli's Turaco			3	
Sidamo Long-Clawed Lark			3	
Ferruginous Duck			3	
Great Spotted Eagle			3	
Imperial Eagle			3	
Lesser Kestrel			3	3
Taita Falcon				
Harwood's Francolin				3
Wattled Crane			3	
Corn Crake		3		
			3	

Source: EWCO (2001) as cited in Mohammed Abdi et al. (2003)

Map 11: Study Area Kayakela



Source: Taestensen, F. et al., 2007