Participatory Spatial Decision Making Using Participatory 3Dimensional Modeling(P3DM) for Babille Elephant Sanctuary Conservation and Local Livelihood improvement.

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Acronyms

ARD - Agriculture and Rural Development

BES - Babile Elephant Sanctuary

EIA - Environmental Impact Assessment

EWCA - Ethiopian Wildlife Conservation Authority

EWCD - Ethiopian Wildlife Conservation Department

EWCO - Ethiopian Wildlife Conservation Organization

EWNHS - Ethiopian Wildlife and Natural History Society

FAO - Food and Agriculture Organization

FfE - Forum for Environment

GPS - Global Positioning System

IBC - Institute of Biodiversity Conservation

MoARD - Ministry of Agriculture and Rural Development

OARD - Oromia Agriculture and Rural Development Bureau

P3DM-Participatory three Dimensional Modeling

WSD - Wildlife for Sustainable Development

UTM - Universal Transverse Merkator

1) ## Project Title: *Participatory Spatial Decision Making Using Participatory 3Dimensional Modeling (P3DM) for Babille Elephant Sanctuary Conservation & Local Livelihood Improvement.*

2) ## Abstract

Notwithstanding the renewable nature of most natural resources, it is universally understood that resources with particular reference to land, water, plants and wildlife are limited. We live in a world which puts increasing demand on the land and its resources for unlimited economic growth. Within this contradiction, all protected areas serve as grounds for potential or actual conflict. They are seen by most as impediments to growth and by others as opportunities for sustained growth. It's believed that Babille Elephant sanctuary (BES) provides and has provided opportunities for the growth of its human lives, wildlife and domestic animals for ages. We also see that it cannot provide these elements for sustenance indefinitely. There will come a time when its capacity is surpassed by greed or need and someone expected to pay the consequences. Ultimately, we see that the essence of conservation is not protecting unique wildlife or particular habitats but in fact our struggle to give earthly life a meaning and to strive for a higher quality of livelihoods. These multifaceted challenges are result from the less participation of various stakeholders to take proper decision for the timeless coexistence of nature in harmony with human interventions.

This project major emphasis is to develop a better decisions tool to enable all stakeholder participation and understand the situation at various levels thus to devise a strategy for the conservation and local livelihood improvement success. The methodologies devised have been tested to address those challenges using feasible geospatial technologies such as P3DM as a tool to experiment human-elephant conflict management and incorporate ancillary data from stakeholder analysis workshop, previous research, field survey, Elephant collar GPS tracks, Land use map, Socioeconomic survey and various discussions including the various community talks. Thus Conservation, then, cannot come about by haphazard paths that entail trials and errors. One of the best ways of conserving and making best use of BES's vast resources is to know important aspects of Actions of who, what, where and when considering all biophysical issues with social factors and understand the spatiotemporal phenomena and identify the key elements for a participatory decision that bring a sustainable solution so as to ensure the peaceful co-existence of human & wildlife.

This project have experimented the P3DM technology as a feasible geospatial technology that helps to organize people's knowledge to better discuss on the local environment and facilitate the participatory decision for better visual communication, open discussion and spatial planning. The information's have been organized as an attribute to the unknown spatial details during map development and have been fully exercised for model based information delivery to facilitate participatory local decision. The Stakeholder workshop discussion, socioeconomic review and previous researches are the important elements to build the final model and further develop alternatives for viable livelihood and conservation activities.

Key words: *Protected area, Participatory decision, livelihood, Spatial Modeling, P3DM*

3. Introduction

3.1. Background Information

In Ethiopia, where agriculture consists mainly of subsistence farming and plays a central role in income generation, the rapidly growing human population consistently seeks additional land. This ultimately threatens the conservation areas through progressive extension of settlements, farms and grazing land. In recent years, the situation in Babile ES has become severe (Yirmed and Negusu, 2008). Due to the multifaceted significance of the Sanctuary mentioned in one hand and huge anthropogenic pressures on it on the other hand made the current research findings important for lasting and sustainable conservation by virtue of recommendations forwarded based on findings of the degree of dependence of the community on the Sanctuary that considers participation of various stakeholders to understand the severity of the situation and consult them in the decision.

Protected area management in Ethiopia has got less emphasis as the conservation of protected areas such as the existence of the Babille Elephant sanctuary have been nominal when we consider the existing human elephant conflicts for decades. Since BES inception, the sanctuary has not been free from human interference and efforts to resettle people elsewhere from the sanctuary have not been attempted as the growing competition between human beings and wildlife has become an issue of conflict between survival and demise. The inhabitant's resource dependency has projected with the pressure on land for grazing, farming, and the forest degradation for fuel. Moreover, poaching and other illegal activities are also the major issues on which the sanctuary scouts have little control over.

Babile Elephant Sanctuary, which is known to support over 340 Elephants, is believed to be the only protected area in eastern Ethiopia, farthest horn of African remnants with a viable number of Elephants (Yirmed Demeke, 2009). Babile Elephant Sanctuary occupies an area of nearly 7000 sq.km and is undeniably one of the largest protected areas (PAs) in the country. It is located within the extensive Somali-Masai Biome which extends all throughout the Horn of Africa and most of Eastern Africa. Deciduous small-leaved vegetation, *Acacia* and *Commiphora* are the most dominant flora of this area. This part of the country is in general known for high endemicity of various plants. Scrub and grasslands are also form major habitats throughout the region. The

Elephant is the most unique wildlife of the area but in total the area has 30species of mammals and not less than 191species of birds(Mihret Ewnetu *et al*., 2006; Yirmed Demeke and Mihret Ewnetu, 2008).

Conservation, then, cannot come about by haphazard paths that entail trials and errors. One of the best ways of conserving and making best use of BES's vast resources is to know important aspects of actions of who, what, where and when considering all social factors and spatiotemporal elements for a participatory decision that could bring a win-win solution so as to ensure the sustainable co-existence of human & wildlife. This can be achieved by a process of integrated planning that show us the past, present and future scenario model as an efficient and a better participatory decision option. This project has been developed to provide guidance on actions required for conserving and making best use of BES's rich resources. However the Sanctuary and its adjacent areas have continually been under sever threats from growing human populations and the associated uncontrolled use of resources. People living inside and in the vicinity of this conservation area are involved in aggravating the problem and directly affected. In general, the surrounding community is mainly agro pastoralist, the level of agricultural productivity is very low throughout the cultivated lands in this area; hence increasing food production has dependent on cultivatable and grazing lands expansion. Such persistent expansions of settlements and livestock have been at the expense of the wildlife conservation areas near the rural people. Hence, the Sanctuary is at a risk of losing its prized magnet for ecotourism development which grants the site name of wildlife sanctuary, and in particular, its iconic elephants.

Experimenting the development of spatial decision support systems is one of major focus this research project so as to come together in developing integrative approaches in addressing sustainable biodiversity and livelihood coexistence as a strategy to challenge poverty, inequitably and scarcity by filling the technical gaps of Environmental Education, Finding viable conservation based livelihood strategies that harmonize the major human elephant conflict. The project also recommends community oriented conservation activities such as planting locally adapted fast growing tree species and productive crops outside the protected area to complement the surrounding energy crises, encouraging communities to grow trees nearby their villages as

alternative fuel wood and construction sources, assist farmers traditional working culture to minimize conflicts, raise awareness about the value of protected areas and alternative uses like developing ecotourism local business, engage in Environmental Education taking the site potential as an outdoor class for surrounding schools and higher institutions to practice on various topics such as how to tackle climate change challenges, Ecotourism business to resolve conflicts between people and wildlife, promoting non-farm activities nearby the Sanctuary, fauna and flora assessment, and generate useful information from satellite imagery and other data sources combined with participatory GIS models using sketch mapping.

The project also experimented the local knowledge diffusion with the help of Geographic Information Systems(GIS) and Remote Sensing based image analysis and application of Global Positioning System(GPS) that revolutionized real time data captured from collared elephants which integrates the state of the art data capture and mapping technology for community wisdom sharing for better understanding of the situation of their surroundings so as to make them active citizens in the overall decision making process, as a local researchers and local land resource administrator taking the role of scientific community and decision makers to facilitate the process. There for the project has met the concept of Participatory Geographic Information Systems (PGIS) emerged where the geo-spatial technologies were used for the community knowledge development for the empowerment of less privileged communities. The project successfully combines as a methodology using geo-spatial information management tools and methods of Participatory 3-Dimentisonal Modeling (P3DM) as one such method which can be used to represent peoples' knowledge in the Physical 3 Dimensional Models. This model used as an interactive vehicle for spatial learning, livelihood discussion, information exchange, decision making and advocacy.

P3DM were developed by the local high school students, Community scouts and result in a physical 3D representation of an area of the Babille Elephant Sanctuary covering the major valley of Erere and Gobelle that covers 1000sqkm which is approximately 1/7th of the BES coverage touching the major districts both inside and outside the sanctuary. This in turn has increased the understanding of the situation and qualities and strength of the decision-making process of the communities for better planning of sustainable livelihood alternatives and

biodiversity conservation. Also the model became a useful means of information communications for visitors from local and international tourists for the ecotourism activities that could create a live planning for the tourist motivation to explore BES during their entire stay and discover more adventures than a traditional point destination.

To understand the BES conservation challenges and livelihood gaps of the community a one day Stakeholder Analysis workshop were conducted following a socio-economic survey and preliminary field survey. The Stakeholder analysis workshop has covered major topics based on the BES Biophysical preliminary inventory, socioeconomic field survey, and secondary information of the desk research results for the existing situation analysis. The workshop stressed the discussion on improving the conservation status of BES and find out alternative solutions for the major livelihood challenges taking Participatory GIS of P3DM as a decision making tool that integrates socioeconomic survey, promote site specialization development, Environmental Education and spatial communication. Various papers have been presented from *Haromaya University, Wildlife for Sustainable Development, Ethiopian Institute of Agriculture Research/NARF project and Ethiopian Wildlife Conservation Authority/BES office* and participants have discussed on the project for experimenting participatory decisions that come up integrating local people knowledge in to GIS model and the stakeholder analysis workshop principally includes the participants from Oromia region districts relevant offices including Babille, Fedis, Midegatola, Haromaya, Kurefachele districts and various offices which have interest and relevant for the forum that includes *GO's of East Harargae Land Administration Bureau, Harere regional state culture and tourism bureau, NGO's such as Mension fur Mension, Academic institutions of Haromaya University, Babille KarlHynz preparatory school, Tourism business sectors and BES surrounding investors*.

3.2 Project Objective(s)

3. 2.1. General Objective

The general objective of the project is to assess the sustainable coexistence of people and wildlife particularly the Elephants at Babille Elephant Sanctuary(BES) using Participatory 3-Dimensional Modeling(P3DM) as an alternative spatial planning and management tool, besides the project investigates feasible alternative livelihood strategies for BES resource dependent community based on the existing opportunities and assets.

3.2.2. Specific Objectives

- Introduce Spatial Planning P3DM Model and P3DM methodology to support the decision for social livelihood support Vs conserve BES biodiversity particularly the Elephants habitat,
- P3DM as a method to bring about cohesion and consensus among communities to resolve resource conflicts,
- To identify project demand amongst stakeholders and formulate outlines of projects that would enable people to engage in viable economic livelihood strategies,
- Involving local people in the management and sharing tourism revenue to enhance their livelihood, educating local people on the value of BES as a national global resource,
- Study the existing land use patterns using input data from Spot-5 satellite imagery integrated with the data from Elephants GPS satellite collars track with P3DM input information,
- To gather data on the socio-economic conditions of Districts in and around the protected area to come up with some important recommendations that serve future adjustments in the conservation and management strategies,
- To figure out the exact sources of human-wildlife conflicts and come up with possible lasting solutions,
- To clearly understand community dependence & attitude towards the sanctuary and propose recommendations that ensures sustainable conservation and livelihood alternatives,
- The study will try to analyze possible linkage that will be made between conservation and livelihood based on the findings possible recommendations will be forwarded.

4. Materials and Methods

4.1. Existing situation Analysis, Materials organization & Preparatory Work

4.1.1. BES establishment overview

Before the establishment of Babile Elephant Sanctuary, the vast area surrounding the present Sanctuary was known as a game-hunting site, called Harar-Wabi Shebelle Hunting Area. The area extended as south as the Wabi Shebele River. The most notable large game animals hunted in the region were lions and other mammals. Later on, concerns grew over the small elephant population that had long been known to inhabit this semi-arid eastern region of the country. The "stress" situation of the elephants in the area, mainly due to crop raiding conflicts with the local farmers, was reported to the then Emperor Haileselssie-I during his visit to Fafum, eastern Ethiopia (Stephenson, 1976). In 1970, based on the report, the Emperor issued an order for the designation of the present conservation area as a Sanctuary. The vast controlled hunting area was reduced in order to establish the Babile Sanctuary with an area of 6,982 km2.

Babile Elephant Sanctuary (BES) was established to conserve a significant population of Elephants in Eastern Ethiopia. It happens that the population at BES is also the last remaining eastern most population in the Horn of Africa. Besides its relic Elephant population, this site also harbors other significant fauna and flora. Together with Gara-Muleta Mountain, BES also forms a significant section of the watershed for the Wabi-Shebele River Basin. The sanctuary has diversified attributes associated to biodiversity, economy and socio-politics such as climate stability, wildlife and cultural diversity, tourism (wildlife and historical sites), and sustenance of livelihoods. In view of the sanctuary's sustainable development program, these attributes are interlinked and should be treated holistically (Babile Elephant Sanctuary Management Plan, 2010).

According to Yirmed (2008) Babile Elephant Sanctuary (BES) supports the last survivors of the world elephant population in the farthest Horn of Africa with more than 27 percent of the country's elephant populations.

When the Sanctuary was proposed the degree of human influence was minimal. The major interference was only crop cultivation and charcoal making near the main road from Babile to

Jijiga(Stephenson, 1976). The situation has been changed through time that many illegal activities such as poaching, charcoal making, uncontrolled expansion of crop fields by burning a huge tract of virgin forests and aimless burning of forests are carried out in the Sanctuary ((Mihret Ewnetu *et al.*, 2006). As a result, regardless of efforts to manage the Sanctuary and to protect its diverse biological resources, this conservation area has been severely threatened from progressive expansions of settlements, encroachment of farms and grazing land. In a recent study by Yirmed(2008). Villagers residing inside and in the vicinity from Somali region side are commonly pastoralists, where as almost all villages (inside & outside) in districts from Oromia region side are agriculturists with the exceptions of two villages.

Babile Elephant Sanctuary was established primarily to conserve the existing Elephant population in this part of the country. The history of establishment of protected areas in the past used to rely more on the presence of mega fauna or charismatic species such as the Elephant. This trend has been the impetus for the initiation of the establishment of most national parks (NPs), sanctuaries and wildlife reserves in Ethiopia. While the setting up of protected areas had a fallacy of conserving for a particular reason i.e. conservation of an endangered species or the aim of generating revenues through tourism, it also brought along with it resentment which in most cases culminated in an all-out conflict between local people who have to bear the costs of conserving a protected area and conservationists who had a mindset that they were carrying out conservation for the good of generations to come. One way of avoiding conflict is to create awareness and co-manage protected areas with local constituents living in or around the protected area. Protected areas like BES continue to provide numerous ecological services and products that are priceless but have been taken for granted. Without these ecological services and products the present human population inside and adjacent to BES would not have been able to survive and grow.

4.1.2. BES and Investment

One of the recent phenomena was the issuance of an investment license for a German company called Flora Eco-Power P.L.C. to plant Castor beans (*Ricinus communis*) in Erer Valley as well as in Fedis and Midega Tola Districts as source of bio-diesel on 12,000ha of land(Fedlu and Wodwosen,2007). The bottom of the valley has relatively fertile soils (WSD and EWCA, 2010)

and lies within the Wabi-Shebelle River Basin, which might attract investors for agricultural investment to this area. However, according to the report by Fedlu and Wodwosen 2007, it was found out that 87percent of the granted land lies within BES. In March 2007, the company started to clear the natural vegetation in the northern and northeastern part of the sanctuary in the district of Midega Tola without any environmental impact assessment (EIA) (Yirmed Demeke and Negusu Aklilu, 2008).

According to the EIA report later conducted by Lisanework Nigatu *et al*. (2007), the portion of the granted area which was cultivated by the company is a seasonal pass route for Elephants in search of food and water. This is also approved during the model development and information organization of P3DM to conduct a participatory decision that reflects the existing land use as a continuous farm land created which totally blocks and aggravated the human-elephant conflict as described on the spatial model and left a fragmented Green patches that keeps the landscape for land degradation.

4.1.3. Conservation Status of BES

BES had never owned management plan excepting the recent Management Plan drafted by senior wildlife experts drawn from EWCA, EWHNS and wildCODE in 2010 and sponsored by WSD, but not yet reviewed and endorsed for implementation.

The BES has conservation significance for many reasons. In the first instance BES presents a conservation concern since it has lost and is still losing its Elephants and other wildlife resources. The protection of the few remaining wildlife population has become increasingly difficult as the rural human population continues to double every 25 years. The area is extremely important for Black-manned Lion (*Panthera leo*), Cheetah (*Acinonyx jubatus),* Leopard *(Panthera pardus),* and African Elephant *(Loxodonta africana)*. The site also affords protection to several antelope species, notably Lesser Kudu and Greater Kudu. Generally, BES protects a representative ecosystem within the Somali-Masai Biome and still has pockets of relatively intact ecosystem. The area is known for its riverine vegetation, Acacia scrub/bushland and open plains. Moreover, the spiritual and educational value of such a place is incalculable as its wilderness and resources potential could contribute its part towards the economic development of the country. The local people can also benefit from these resources as it can be a means of generating and improving its livelihood. Besides its ecological values, the area provides diverse economic

benefit from tourism in the years to come since it is situated close to the tourist destination areas in eastern Ethiopia.

In spite of being an outstanding part of the country in terms of its floristic and faunal composition, sound surveillance is inadequate and it lacks a management plan. With the exception of some sites at Gobelle and Erere, the sanctuary has not received effective protected area management directives in the past. Recovery of the ecosystems at BES is a possibility but requires a coordinated effort. However, human Elephant conflict, investment, repeated droughts, grazing pressure and other adverse human activities have aggravated the resource depletion in the sanctuary. It is, therefore, time to develop this Management Plan for sound conservation and development activities.

4.2. Socioeconomic Analysis

Data were collected on various socioeconomic dimensions like, income from BES and other allied activities, production from both pastoral and agricultural activities and its significance on the improvement of general livelihood of the population. Descriptive statistics techniques will be deployed to analyze the possible relationship between these variables and its significance on the livelihood of the population and as well BES conservation allied activities will be conducted. Whenever necessary, econometric techniques will also be deployed to analyze the casual relationship between pertinent variables depending on data availability and some other related issues. Comparison will also be made on the income earning potential of the population from BES tied activities and those who are not beneficiaries of such activities will be employed. For this purpose, the study will use the statistical package like Statistical Package for Social Sciences (SPSS) for Windows, version 17. More on that, to capture relevant attribute variables that are tied to the livelihood of the society which as well are tied to conservation activities, participatory discussions will be conducted.

The study will review and updates the existing sociological and anthropological data, with a major emphasis on local communities at district and village levels. The number and extent of village encroachments into the Sanctuary was previously not known. Efforts will also be made to quantify the extent of livestock encroachments and their seasonality in selected localities of the Sanctuary. **Annex I** contains the Livelihood survey Questionnaire

4.3. Stakeholder Analysis Workshop

In order to understand the social dynamics in the area a stakeholder analysis workshop were conducted to give an idea of different interested groups, conflicts in the area, stakeholder participation. The stakeholder workshop assessment were helping to guide us to define the composition and participation of all the groups, including the Ethiopian Wildlife Conservation Authority (EWCA), the office of BES, WSD, Haromaye University, East Harergae Land Administration bureau, Tourism and cultural bureau of East Harergae, the Agriculture offices of the Oromia and Somali Regions, Horn of Africa Regional Environment Center, all district and village administrations bordering the Sanctuary including Oromia districts of Babille, Haromaya, Kurefachele, Midegtloa and Fedis. **Annex II** Contains the workshop information.

4.4. Base Map processing

4.4.1. Map information development

 Satellite image of SPOT and Landsat ETM+ were interpreted using Remote sensing software of ERDAS imagine 9.1 and the past land cover dynamics were considered for the current Land use map development using the community land use defining skills using P3DM techiniques. Using ArcGIS 9.3 and Global-Mapper 10 software basic geospatial data (Basemap, Land use pattern, contour DEM…) were processed and organized for land information of BES that were further analyzed for various decision making process in the whole research process. The GPS collar track data of sampled elephant is a direct source of Geospatial information that could inform elephant movement range and support to check the conflict hotspots of elephant habitat with the frequency of elephant movement track for a seasonal spatio-temporal comparison. The GPS-track information could also directly confirm to plan the need to protect those sensitive buffers zone from any intervention and also to define the major routes for ecotourism activities planning such as tourists camping sites location and identifying important sightseeing positions.

In the creation of the blank model we make the activities easier as only locally available materials were very important such as trekking mat (2m*0.9mdimension & 2cm thick sponge matters material), glue, stand table colored yarn and pins are necessary for the of the blank model construction with the direct involvement of the community & local students. Before the actual

start of the P3DM process the blank model were prepared using basic data inputs from geospatial data sources such as DEM data of 1:50,000 scale top-sheet screen digitized contours, ASTER DEM 30m resolution satellite data, field survey for Land use pattern study, topographic Base map and other sources such as Google-earth and elephant GPS collar track data.

4.4.2. Area Selection for General Study & P3DM development

The selection of the area is done based on different factors which includes biophysical, administrative, environmental, cultural, and socio-economic and issues of disputes of Human-Elephant conflicts in the project area. Based on the above mentioned criteria and in consultation with different stakeholders, the study area were checked and identified on the topographic administrative maps.

The assumption for the general model development covered the selected area for the BES and its buffer zones. According to the old boundary description by stephenson(1976), the conservation area extends over an average length of 80 km from north to south, and a width of 98 km from east to west with elevations between 850m and 1500m. This conservation area needs complete re-demarcation based on existing land use strategy models and existing conflicts due to land encroachment.

The proposed revised boundary for BES starting 2010 also considered important criteria's and try to resolve the conflict zones excluding the land use such as the major farm encroached site which left the river segments of Gobelle and Erere. This decision doesn't consider the impact of the landscape fragmentation as it cuts out the major elephant seasonal movement corridors from Gobelle to Erere. Thus the redefined boundary has left the landscape so fragmented and that could aggravate the conflicts as the existing farmlands are still growing edible crops for the elephants including sorghum and corn. The discussion during P3DM boundary development also helps to extract important information including the major conflict zones inside and outside the sanctuary, delineate the boundary of farm encroachment impacts, rate the major source of conflict and the community actions and identify major natural & historical attractions.
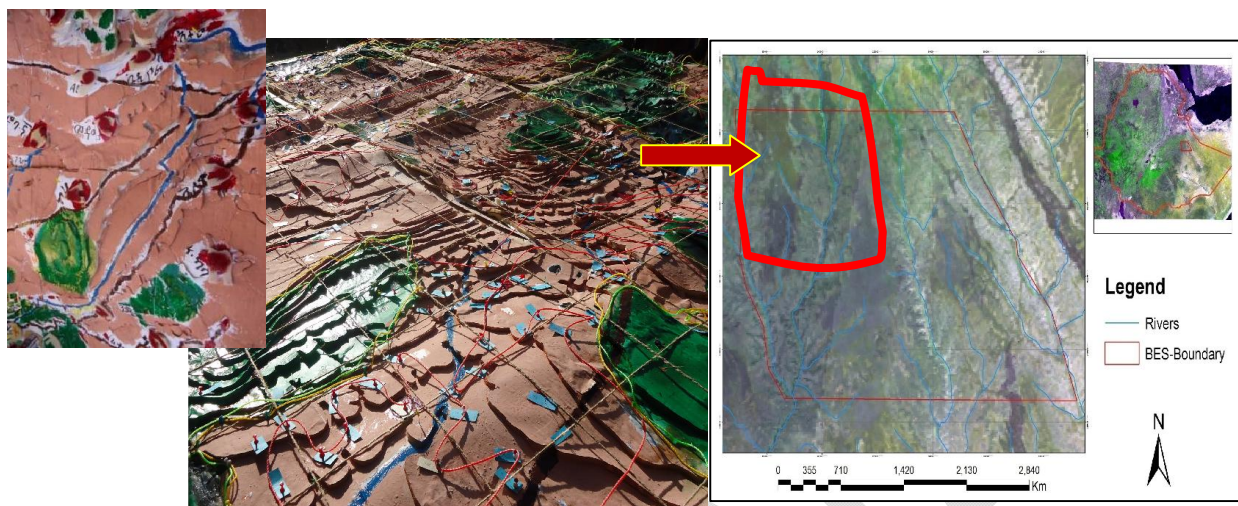
Fig.4.1. BES Site location for preliminary field inventory & P3DM Base map preparation

4.4.3. Ground Work at Community Level

This step in the preparatory work has introduced the concept of participatory 3-dimensional modeling to the various stakeholders and basic information for all participants was delivered. The primary preparation during P3DM development is **planning for the Logistics and a** venue sufficiently large enough to accommodate the community to prepare the model were arranged in the Babille town at the BES office mobilizing the participants from different site the BES existing outpost at **Erere** and **Agdora** with an organized Transportation, accommodation and catering for their entire stay. Thus all this preparation has been finalized and awareness to the participants was made with displaying documentary videos and photos of previous implementation from PPGIS archive.

4.4.4. P3DM Working Group Selection

It is considered that the first categories of participants were local people dwelling inside and adjacent to the Sanctuary as represented by the participation of the BES community scout and students from locally based academic institutions including Haromaya University and Babille KarlHynz preparatory and secondary school. The second categories of participants were included from those identified by stakeholders having vested interest in the area. These participants were

represented from indigenous groups, economic sectors, government and non-governmental organizations to provide their input in the final model and experiment the decision making process. To collect the general information as a spatial detail to represent the conservation and livelihood challenges of the local people the information from all participants of the selected villages at all level were harmonized for decision making process during P3DM information analysis and outcome development.

4.4.5. Gathering Secondary Information

A pre-requisite for P3DM is contour lines. We found it cost effective as contour lines are available in digital formats and we have extracted ASTER DEM 30m contour interval as an initial model development with extrapolation or diminishing the contour scale interval of ASTER DEM from 30m to 20m and have been checked superimposed with the existing toposheet(1:50000 scaled originaly extracted at 20m contour interval).this countour lines with 20m contour interval from the EMA topo-sheet are the major source of contour that are extracted with screen digitizing. The topographic maps were used to generate the contour lines including major spatial details for P3DM base map development. Apart from contour lines, additional information were gathered that includes demography, land use, vegetation cover, infrastructure and whatever information that may be relevant to better understand the physical, social and economic characteristic of the area during P3DM development.
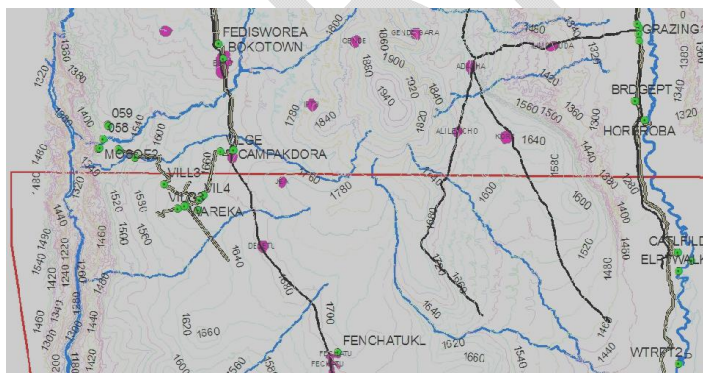
Fig.4.2. 1:50,000 Toposheet extracted contour at 20m interval for a basemap information.

4.5. Preparing Base Map for Landscape Model construction

4.5.1. Base map development for P3DM printing

Considering that Participatory 3-D Modeling aims at providing a visual aid capturing the details of the terrain, the larger the scale of the model the better would be its size. Therefore, when making the choice of the scale, size of the model were taken into account for enough space in which to physically construct and store the model properly which suit for presentation, environmental education and the need for accurate spatial decision making.

The ideal scale for 3-D modeling is 1:10,000 or larger. So in this ideal case the reference map is at 1:50,000-scale and it's re-scaled to 1:10,000 to make it suitable for the activity. At 1:10,000, one centimeter on the model corresponds to 100 meters on the ground and people easily to pinpoint salient features. Taking into consideration the size of the area and the location where the model is going to be stored, it is proposed that the P3DM model is constructed at a scale of 1:10,000. The vertical scale for exaggeration purposes were differ from horizontal scale and the vertical scale were exaggerated by nearly double the horizontal scale, say 1:10,000. Generally, 1:50,000-scale reference maps feature 20-m contours, which is convenient. This enhances the visual perception of the ruggedness of the landscape or highlights conflict issues such as water points or farm accessibility.

Once scale, size and contour interval were fixed then a base map is generated and has been plotted with the sequence of contour lines in different color and Elevation labels are placed close to the contour lines.
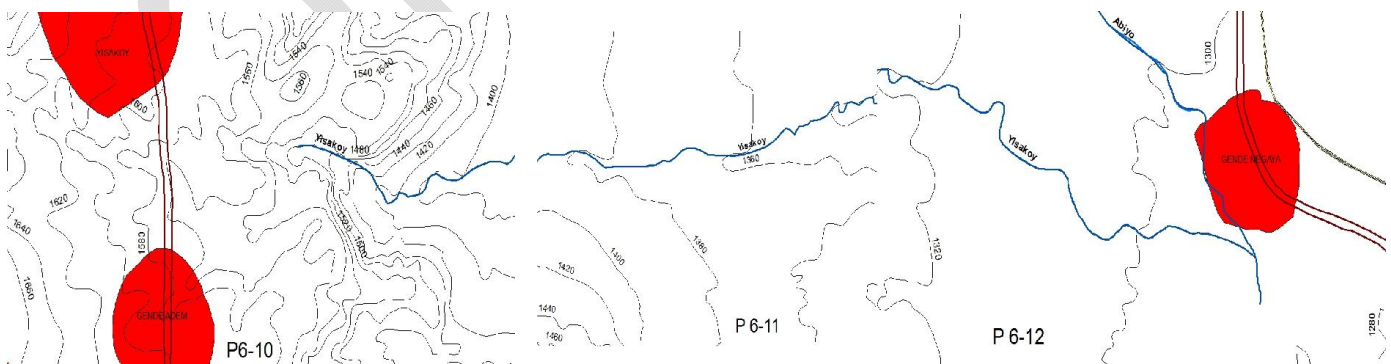
Fig.4.3.Basemap mosaic for P3DM tracing

4.5.2. Procurement of Materials

Various map symbols with a range of coding items were available in sufficient quantity to mark the many variables that people want to record in the model. Procurement is done after the first assessment of the features that may be encountered in the area. Map symbols should be chosen understanding the existence of different types of point, line and polygon features. Some guidelines to code and display the features are given in (table (Annex-1)).

4.6. Assembling the Model
4.6.1. Orientation for Participants

Participants were oriented on the mechanics of model construction and they have trained and introduced with the rudiments of map reading. It would be an added advantage if they know in advance what sort of material is being used, the scale of the model and the contour interval.

4.6.2. Building the Base Table

We have constructed a wooden 12 base table of each dimension 2m by 1m to rest the model. The table has match the base map and constructed to be assembled and strong enough to support the weight of the model. One side of the base table made narrow enough to permit easy access to all sections of the model.

4.6.3. Tracing, Cutting and Pasting

The contour lines are traced, cut and pasted on top of the trekking mat one maintaining proper Geo-references. The outcome is a scale relief model with base contours of the landscape

4.6.4. Transposing Information

Composing People's Knowledge community scouts and participants are well aware of the legends they are going to use before they mark the features on the model. Participants are then invited in groups to locate the water courses, mountain peaks, villages, roads, trails, wild animal distribution sites, vegetation types, farmlands, tourist potential sites, social infrastructures and

other landmarks they use to orient themselves when moving around within their domains. Pins, yarns and colour paints are used to mark point, line and polygons features respectively.

4.6.5. Secondary Information

After the informants have completed the transference of mental maps and cross checking, other secondary information are added to the model. Some secondary information like administrative boundaries, Sanctuary boundaries, encroached farm lands, elephant movement ranges, watering sites, and range and grazing lands were placed on the grids.

4.6.6. Handling over the Model for Decision

After the completion of the model, the ownership of the model has been formally transferred to the community scout through BES office. The model has been experimented for Environmental education, participatory decision, scouts patrol planning and the use of the model is flexible and it needs to be regularly updated with the latest information for various application including planning the conservation process and the model has been entrusted to BES office having the means and the commitment to safeguard and maintain it, and to make it accessible to those who would like to use it, update it with the latest information and correct previously entered information.

Fig.4.4.Model handover with description of land use/cover information

5. <u>Results and Discussions</u>

5.1. Socioeconomic Characteristics

According to the CSA report a total of 1,053,720 people live in these Districts (table.5.1.)

Table.5.1. Population Vs Area of the study Districts

Zone	Woreda	Population			Area in Sq. km.	Persons/Sq. km.
		Male	female	Total		
East Harerghe Zone	Babile Oromia	53,323	52,607	105,930	594.64	178.1
	Fedis	64,164	62,598	126,762	720.79	175.9
	Midga tola	43,525	40,997	84,522	1732.53	48.8
	Haramya	156,282	150,006	306,288	553.99	552.9
	Kufa Chale	33,377	32,631	66,008	243.44	271.1
	Meyu	26,273	25,601	51,874	1413.95	36.7
Total		376,944	364,440	741,384		

Source: CSA, 2011

Out of the surveyed 221 sample households that were interviewed in these seven Districts, 17.1 percent lives inside the protected area. The average family size of the sample respondents were 6 ranging between twenty and one. Of the total respondents, 98.2 percent are married 0.9 percent are single and 0.5 percent are divorced and 0.5 widowed. There is no significant difference in terms of family size and composition among residents who are living inside the protected area and those who are living outside.

According to the above data (CSA, 2011), the human population varies considerably from District to District and ranges from 552.9 persons /sq.km in Haremaya District in the north to 36.7 persons/sq.km in Meyu District in the south, which was 406.5 and 6.7 persons /sq.km , according to CSA,2004, for Haremaya and Meyu Districts respectively. This is an implication how fast the population increased in the years through 2004 to 2011.

5.2. Settlements

A total of twelve Districts are found either inside or adjoining the sanctuary. They are Haremaya, Babile-Oromia, Babile-Somali, Fedis, Girawa, Gursum-Oromia, Meyu Muluke, Kurfa Chelle, Dihun, Midega Tola, Fiq and Jijiga. Seven of these districts are found in the northern and western side of the BES within Oromia Regional State. Four are found in the west and south and

one in the east. A total of 63 villages in three Districts are found wholly in the BES (Mihret Ewnetu *et al.*, 2006). The most heavily settled areas are the Valleys of Gobele and Erer Rivers which are most frequently visited and important habitat by the elephants. Elephant contact with humans is encountered wherever there are heavily settled areas across Gobele river on the periphery of the sanctuary, the northern and north-western corner of the sanctuary, in the Erer Valley, and along the track that leads from Babile to Fiq.

The villages inside the Sanctuary were established between the mid 1970's and 1985(Helen, 1989). The outbreak of war between Ethiopia and Somalia in the mid- 1976 forced many farmers to leave their villages and settle as refugees at the edges of the Sanctuary (Henze, 2004). As a result, the original extensive bush and shrub cover around these villages was cleared, primarily for crops and settlements. Though other Districts have direct contact and tremendous influence on the Sanctuary in one or other way they are fully outside.

Despite the above facts the current survey targeted on the five very important Districts from Oromia Region side(Babile Oromia, Fedis, Midega Tola, Kurfachelle and Haremaya).The location of the Villages in reference to the Sanctuary is shown in the table below.

Table.5.2. Location of Villages in reference to BES

Districts	Villages Inside the sanctuary boundary	Outside the sanctuary boundary(Bordering)
Babille Oromia	–	Erer Ebada,Ebada Gemechu, Erer Guda,Gemechu, Berkele, Tulu Horo and Derer Arba
Fedis	Agdora,Riski,Aneni,Fechatu, Roba Bilisuma, Qufo Bobasa, Negaya Bobasa and BaliWeraba	Umer Kule
Midega Tola	Lencha Midega, Qufo Midega,Negeya Midega and Roba Bilisua	–
Girawa	–	Hufe, Juru Belina, Mudena Kurkura,Kufekas, Rasa Negaya and Biftu
Kurfa Chelle	–	Adu Ambate,Bili,Eje kecho,Dire Gudia and Afren Kelo
Haremaya	–	Akefila and Edo Belina

Fig.5.1. Existing Village Insides & Adjacent to BES

5.3. Occupational Status

As the occupational status survey shows 60percent of the respondents live on both farming and animal rearing, about 32% depends on farming and only 3percent are rely on animal rearing(see table.1. below). From this one can easily infer that almost all livelihoods in the area are dependent on the exsiting natural resource such as land,water and grazing. This in turn shows the degree of influence the livelihood of the community has on the conservation of the Sanctuary.

Table.5.3. Livelihood Observation Types

Principal Occupations	Respondents	
	Frequency/number	Percent
Farming	71	32.1
Animal Rearing	6	2.7
Both	132	59.7
Trading	1	0.5
Missing	11	5
Total	221	100

5.4. Educational Status

Educational status has its own impact on the conservation of natural resources. The more people are educated the more they are conscious on natural resources conservation and are too sensitive to Awareness creation programs.

In this respect, out of the 221 respondents about 132(60percent) are illiterate which implies that successive and concerted efforts on conservation education and awareness raising programs are crucial. It is also evident that there are also good opportunities for the conservation as about 20 percent of the respondents are at schools attending formal education. This may include formation of nature and environmental clubs in schools to make the young generation nature loving.

Table.5.4. Educational Status

Literacy Condition	Respondents	
	Frequency	Percent
Illiterate	132	59.7
Read and Write	30	13.6
Attend Formal Education	44	19.9
Religious Education	14	6.3
Missing	1	5
Total	221	100

5.5. Human- wildlife Conflicts

Babile Elephant Sanctuary is established to ensure the survival of the endangered elephants and other wildlife of the area. Since the area is inhabited by farmers and pastoralists for a long period of time there exists wide range of interaction between the two "communities". The residents encroach the PA for economic gains while the wildlife invade and destroy farms and livestock at hard times.

Out of the total respondents 84 percent have reported they have seen elephants in their life time. The number is significant not because the number of elephants in the sanctuary is abundant so

much so that this number of people have the opportunity to have a look at the beasts but either the residents have encroached deep in to the sanctuary or the elephants have started to appear in the residential areas in looking for feed and water because their natural habitat is invaded.

This fact is substantiated by the finding of the survey which indicates that 72.6 percent of the respondents have reported that the number of elephants, according to their assessment, is increasing. This close contact have resulted frequent attack by the wildlife on the residents and their property. Again 72.6 percent of the respondents have reported that they have been attacked or have seen someone else being attacked by wildlife in the last year. Of which 62.5 percent of them have reported there is more than one incidence per year.

The wildlife raid occurs both in cattle and farmland. However, the extent of the raid is more severe on farmlands than on cattle. About 75.9 percent of the respondents have reported that they have lost their crop due to wildlife attack in contrast to 65.9 percent who lost their cattle. The extent of crop damage ranges from total destruction to loss of quarter of the crop. Fig 1. indicates the extent of damage caused by the wildlife. About 58.7 percent of the respondents reported a crop damage once a year and 27.9 percent on daily basis.
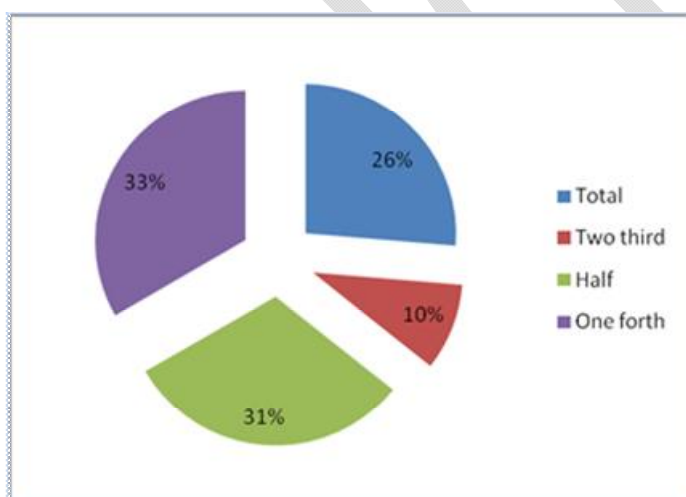
Fig.5.2. Extent of reported wildlife damage on crops

The damage occurs mainly during the rainy season and when the night falls. These frequent damages have made some of the residents to develop some hostile attitude to wildlife in particular to elephants.

5.6. Community Attitudes towards BES

The evidence from the survey has indicated very striking facts that about 56.2 and 27.9 percent of the respondents do recognize that the sanctuary is very important and important respectively as a wildlife habitat. This can be clear evidence about the existence of high level of awareness about the importance of wildlife among the community but the encroachment comes from lack of alternatives in supporting their livelihoods.

The respondents were also asked if they believe conserving the wildlife as an important activity. Surprisingly, 92.7 percent of the respondents do agree with the importance of conserving the wildlife. The major justification they gave for the conservation is the economic value they provide. Those who believe conservation of the wildlife is unimportant give the damage caused by the wild animals on their crop, livestock and home as a reason for their disapproval.

Most of the respondents also do approve the aesthetics and heritage value of the Sanctuary as 61 and 70 for aesthetics and 49 and 81 percent of them rated the Sanctuary to be very important and important in this respect respectively.

5.7. Economic Activities

The BES existing Land use can be classified in three categories. The major ones are cultivation, grazing, forest and/or bushland (Mihret Ewnetu *et al.*, 2006).

5.7.1. Cultivation

Stephenson (1976) noted that no cultivation existed up to three years after the establishment of the sanctuary. The sanctuary was established more than 40 years ago and arable agriculture is an activity that has grown with it. Cultivation now is a major activity for a number of farming communities both inside and on the periphery of the BES. Agriculture is basically subsistence with various cereals, fruits and cash crops. The major cereal grown in the valleys is maize while sorghum is sown on higher ground. Main fruits grown include mangos and bananas while cash crops are represented by chat, pepper and tobacco. Vegetables are also present and farmers grow tomatoes, sweet potato and pumpkin widely. Peanuts are particularly prolific in this region for which the soils and climate of the valleys appears to be very suitable. Though this sanctuary was established on the edict of the Emperor Haile Selassie I, there was little concern about the consequences of having farms and farming communities inside and around the protected area since its inception. In fact the large Erer-Wabi-Shebelle Haile Selassie I Foundation

Welfare farm was situated on the north-west corner of the sanctuary with little regard to future negative impacts (Mihret Ewnetu *et al*., 2006).

But today, the main economic activity is crop production being the major source of livelihood in the survey area. The major crops grown in the area include sorghum, maize, pulses, oil crops potato and vegetables.

The average land size of the study area is 1.7 hectares ranging from a maximum of 12 hectares to a quarter of a hectare. There exist a significant difference on income level and farm size among residents living inside the protected area and those living outside. Those who are living inside the protected area own an average of 2.8 hectares of while those who are living outside own an average of 1.5 hectares of land. This difference indicates how much the protected area is encroached. Accordingly, the total income of the residents who are living inside the protected area is much higher. Their annual income from farming, livestock and other activities is around Birr 17,614 while those who are living outside have a mean annual income of Birr 6,987 from similar activities. This critically shows that in many cases the Sanctuary is an important farming ground and income source for the adjoining Districts

Table.5.5 Land size and income level of respondents

Parameters	Residential site		
	Inside the protected area	Outside the protected area	t Value
Average Farm size	2.8	1.5	4.71*
Average annual income	17,614	6,987	5.1*

* Significant at 5 percent level

5.7.2. Grazing and livestock Pressure

Grazing is the oldest and one of the most important land use system in the area. Its effects are insidious regarding its impact on biodiversity. It dates back much earlier than the arable cultivation practiced by sedentary farming communities. In earlier years, Somali pastoralists made use of the area on a seasonal basis. This trend continues throughout the territory of the BES but is more pronounced in the south, western and northern parts of the area. In the earlier years of the establishment of BES, it was noticed that competition between pastoralists and Elephants was limited to the valleys (Stephenson, 1976). Stephenson (1976) noted that there was peaceful coexistence between cattle and Elephants during those early years. This situation has now changed with the growth of human population in the area, influx of refugees, establishment of state farms and vllagization campaigns during the Dergue Regime (Yirmed Demeke, 2009). Yirmed Demeke (2009) also pointed out that with the takeover of highland areas between the fertile Erer and Gobele Valleys, competition for grazing has increasingly become intense.

The Elephants, in the absence of alternative sources of food moved up the valleys to be confronted by human interest leading to serious conflict. Yirmed Demeke (2009) in his Doctoral Thesis records that a study carried out in October 2004 which found out that there were at least 2,200 and 3,350 mean daily numbers of cattle and camels respectively in the Upper Erer Valley in direct competition with Elephants. While competition for forage and cover is obviously the main threat, Elephants are known to be easily disturbed as the result of invasion by livestock making them nervous and likely to attack with little or no provocation.

These days, livestock keeping is also livelihood sources along with farming in the survey area as the survey result indicates about 60 percent of the respondents are engaged in both activities. One of the serious issues which call for attention is, therefore, the high dependence of the local inhabitants on the sanctuary for grazing their animals. The survey result indicates about 73 percent of the respondents have rated the protected area as a very important source of grazing land (see table 4.). The gravity of the problem is much clear when we learn that more than 60 percent of the respondents reported that they keep livestock along with their farming activity. The importance of livestock as a source of livelihood has a direct implication on the protected area. As the number of livestock kept in the area increases the dependence on the protected area as a source of grazing land will be higher.

The importance of the protected area as a grazing land is higher because there is no enough grazing area outside the sanctuary. This fact is substantiated by the response of 72.4 percent of the respondents who claim that there is shortage of grazing land in the area and viable alternative is the area within the sanctuary. Those who reported that they will go for the cultivation of forage crops and purchase of additional feed to supplement the grazing are only 10 percent. This is a clear evidence for the existence of high level of encroaching on the protected area in looking for animal feed.

Table. 5.6 Importance of the protected area for various purposes

Use of the PA	Rate of Importance			
	Very important	**Important**	**Less important**	**Not important**
Grazing land	73.3	15.8	1.8	9.1
Wildlife Habitat	56.2	27.9	2.3	13.6
Water source	44.3	27.6	14.9	13.2
Aesthetics value	27.9	32	7.3	32.8
Heritage value	22.3	36.8	20.5	20.4
Honey production	21.7	22.2	8.1	48
Food source	18.7	19.6	22.4	39.3
Charcoal production	17.6	33.9	16.3	32.2
Source of medicine	11.4	33.6	22.7	32.3
Farm land	10.9	10.9	11.3	9.1
Game animals	5	13.6	6.8	13.6

5.7.3. Source of Energy and Deforestation

Almost all dwellers; inside and in the vicinity of the Sanctuary; Rural and urban; depend on

wood as energy source either in the form of fuel wood or charcoal. There is a drastic tree felling for charcoal making,construction pole and fuel wood especially meant for sale (Mihret Ewnetu *et al*., 2006). This can be witnessed by the visual observation of charcoal displayed for sale alongside the Harar- Jigiga highway.

5.7.4. Water Sources

The other Major resource inside the protected area is water as 44.3 and 27.6 percent of the respondents have reported that they value the water inside the sanctuary as very important and important source respectively. The Sanctuary serves as a very important source of water for both human & livestock consumption.

The surrounding areas are known for their shortage of water. Water development works should be strengthened in most Villages as there is a drastic shortage of water for human and livestock consumption.

5.7.5. Others

According to the current survey, the protected area is also a direct income source for about 42.6 percent of the respondents through honey production, charcoal production, fire wood collection, selling wild animal products and traditional medicines.

5.7.6. Urban and Market centers

According to Mihret Ewnetu *et al*., 2006, Babile,Fedis, Garamuleta, Husae and kurfachelle are the nearest and the easily accessible towns and market centers either inside or in the vicinity of the Sanctuary. Harar city and Alemayatown are also the largest nearby market centers. There town are many small villages (small towns) along Alemaya-Husae road, Fedis-Negeya Midega feeder road that serve as local market for fuel wood selling (Mihret Ewnetu *et al*., 2006). It is common to observe fuel wood markets along in these small village markets along the above mentioned urban and market centers. According to the above source good proportion of it comes from the Sanctuary.

5.7.7. Tourism and Economic benefits of the Sanctuary

Despite its rich biodiversity and significance for eco-tourism, it contributed no meaningful economic benefit to date. However the Babile Elephant Sanctuary is close to a number of tourist attractions and a visitor will have the benefit of appreciating other historical, cultural and natural assets in the locality. Harar town, with its ancient history, its famous walls and hyenas form exceptional tourist attractions drawing thousands of visitors every year. The unique ethnicity of the Harari, Oromo and Somali people forms an exceptional mix of cultures imparting to this town a colorful and vibrant nature. The presence of the interesting geologic rock formations at Dakata's Rock Valley and the Prison House of Lij Eyasu in the Gara Muleta Mountains are other important tourism attractions. Thus the BES could be developed though ecotourism potentials considering the immense attractions of the surrounding and the unique nature services the sanctuary could provide for visitors and the community. Babile Elephant Sanctuary is found between two large towns of Harer and Jijiga. The towns of Babile, Boko, Lencha and Dendema are near the sanctuary providing centers for woredas administrative and other offices. Proximity to towns has its own negative implications but also with a positive side. Towns have a growing population which if supportive of a conservation area can bring benefits and income to the development of the conservation area. The proximity of the sanctuary to major towns and settlements can also provide a natural laboratory where countless scientists and students gain insight and knowledge on the workings of nature and ecosystems.

6. P3DM as a Participatory Decision Tool

6.1. Environmental Education using P3DM training

Local students at Babille Karl Henz Preparatory and Secondary school have been organized to establish a Nature club and have got the basic training on P3DM project have been collaborating to build their capacity in Environmental Education(EE) and have engaged the students to build the BES P3DM Blanc model. we provided P3DM development training for the selected students committed and hard working to show the quick results. We have also already contacted with school director and we have reached on consensus to start project on preparation of EE resource for teaching.

The Training content includes basic map making skills using contour lines and map making tools students are get familiar on how to build a 3D physical model using topographic contour data and P3DM materials so as to simulate their environment considering BES landscape.

Fig.6.1.Students participation on P3DM construction (R➔L: P3DM class orientation & practical landscape model construction)

6.2. P3DM Application for BES Scouts Activities

All scouts at Erere, Akdora and Babille outpost have attended the orientation on P3DM activities for community participation. The P3DM presentation also supported by Environmental Education topics imitated by BES staff (Tourism expert and Biologists) that builds the scout's capacity on the sanctuary information gathering, conservation, patrol planning and tourist serving activities. One of the most critical tasks in building the 3-dimensional model is to provide the skills to the scouts on how to use the P3DM development to manage the conflict issues. Various map symbols with a range of coding items were utilized to mark the many variables that people may want to record in the model. Map symbols were chosen understanding the existence of different types of point, line and polygon features in the model construction and all biophysical features identified materials are coded and displayed with features that exist at BES and surrounding during the field survey and community scouts previous observation.

Fig.6.2.Community Scouts practice P3DM technology for spatial planning decisions

The major advantages derived from the P3DM summarized below:

- P3DM Provides for a 'bottom-up' participatory planning, with integration of public and community groups, resource users etc., directly into management process.

- P3DM serves as tool to give a voice to the communities, allowing for contribution to and influence the development of policy and management form the local level.

- Transforms conventional mapping and GIS tools into information accessible to the community level.

- Potential to capture local spatial knowledge, human interaction with the environment, and relationships with livelihood challenges (including conflicts and overlaps)

- Can foster accountability, transparency, legitimacy and other dimensions of protected area management & surrounding people respect for bylaws.

- Can be used to strengthen spatial planning and use in spatial decision making.

- Fosters sense of community's ownership of a plan, serving as a commitment from which to plan implementation.

6.4. Human Elephant Conflict Management

6.4.1. Assessment of the status of the existing farmlands inside BES using P3DM

Field survey conducted to Erere and Gobele valleys to assess the status of the existing farmlands and other manmade activities that raise major conflicts. According to the survey it's discovered that following Ererer valley and tributaries all the illegal farm plots that existed inside BES have been closed starting 2009. A Community scout who also previously owns illegal farm inside the sanctuary reported the current status of those illegal plots at BES is resolved with a win-win negotiation with the community participation and he has proofed his current role as a community scout to the sanctuary as he have taken action and decision for conservation based employment. However he witnessed the majority of the community still requires alternative livelihood to shift from farming, grazing and fuel wood/charcoal selling. The figure below portrays a closed farm covered with Congress weed once the plot is closed from farming and nature restores through succession. This decision was reached with BES office negotiation with the community to start alternative livelihood activities in harmony with the conservation process and create awareness to the community through new development opportunities that this project rectify the participatory decision tool as a means to build human wildlife peaceful coexistence.

Farm plot owners reported that the livelihood challenge result from the population pressure and agricultural production decline which forced them to farm more plots inside the sanctuary where major production factor(water + land) are available to maximize production and supplement the recurrent food deficit.

Fig.6.3 Major Discussion on model utilization for scout field planning, reporting and information updating (Top: P3DM outcomes, Bottom: Field inventory**)**

6.3.2. P3DM to evaluate the conservation status of BES from investment impacts

The Eco-power project that has been discussed at Section 4.1.2 has been reported as closed investment. Though during P3DM mapping of the change in land use/cover the previous closed castor bean field has transformed to informal cultivated land the land encroachment impacts are shown as a major treat for the existing human elephant conflicts on the P3DM information delivery. During community land use mapping the GCP's taken during field inventory approved that the cultivated plots are the major corridor of elephant wet and dry season movement. The Brown colored information shows the encroachment of farm plots and the green patches are core green at Gobelle valley which still contained the illegally cultivated farms aggravates the risk of total encroachment.
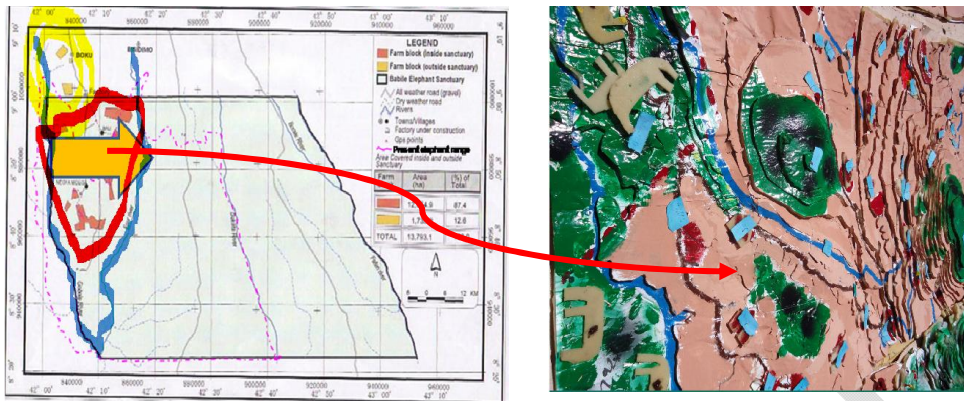
Fig.6.4.BES Encroachment by past eco-power investment & current illegal settlement

Source: EWCA archive (2007) & P3DM model information (2012)

6.3.4 Assessment of existing communities in the Sanctuary using field survey & P3DM

Field survey conducted to Erere and Gobele valleys to assess the status of the existing farmlands and other anthropogenic activities that raise major conflicts. According to the survey it's discovered that following Ererer valley and tributaries all the illegal farm plots that existed inside BES are closed starting 2009. A Community scout who also previously owns illegal farm inside the sanctuary reported the current status of those illegal plots at BES is resolved with a win-win negotiation with the community participation and he has proofed his current role as a community scout to the sanctuary as his current decision for conservation based employment. However he witnessed the majority of the community still requires alternative livelihood to shift from farming, grazing and fuel wood/charcoal selling. The figure below portrays existing farms colored with brown color by the community scout. The community also believed if alternative conservation based livelihood support mechanism established and once the plot is closed from farming nature will restore through succession and the land use conflict could be insignificant. This decision could be reached with BES office negotiation with the community to start alternative livelihood activities in harmony with the conservation process and create awareness to the community through new development opportunities that this project rectify the participatory decision tool as a means to build human wildlife peaceful coexistence.

Farm plot owners reported that the livelihood challenge result from the population pressure and agricultural production decline which forced them to farm more plots inside the sanctuary where major production factor (water + land) are available to maximize production and supplement the recurrent food deficit.

6.3.4. Consultation with local people knowledge for participatory project implementation

 Discussions that were held between the livelihoods dependent communities during field survey and the active participation from the community scouts during P3DM experimentation the verbal

information were merged with the visual communication of the spatial model and all the participants have agreed on the importance of working on model based spatial planning for conservation and conflict minimized livelihood support strategy in the overall project activities.

Fig.6.5. Communities participation using P3DM for decision on issues of conflict management

6.3.5. Decision tool of P3DM, Livelihood support project development

Capacity building with EE training using the P3DM model production was successfully accomplished with the participation of selected students of Babille Karl Henz Preparatory School and BES scouts. All stakeholders have take their decision roles on the conservation and livelihood conflicts management using spatial decision tools considering the various scenarios.

Local students are well equipped with manuals and technical skill on how to describe their local landscape in a scaled 3dimentional real world model.

Information dissemination from the various stakeholders were successfully transfer to the model so as to acquaint the citizens informed about the situation of BES besides as means for active participation in the overall conservation and local livelihood support as a means for nature and people peaceful coexistence. The project could be the best way to learn in the real world the

potential of Participatory spatial decision tools such as P3DM as an appropriate technology to gather a wider target group working on protected area management, Environmental Education, conservation based Project development such as Ecotourism. The project findings and working documents will be published for reference and further development of the project is required to keep the good outcomes to reach all stakeholders & create a culture of working together for better results.

Fig.6.6.Ecoturism Attractions around BES (☞ L: Lej Iyasu prison, 10 generation old mosque, welcoming pastoralist culture)

6.3.6. Organization of the Geospatial data's for Participatory spatial decision Support

All data from primary and secondary sources are organized and validated using information of field assessment. The base map for P3DM development is compiled and the extent of the blank model has covered $1/6^{th}$ of the total coverage of the sanctuary which contained the main elephant core zones of the Gobelle and Erere valley, other tributaries and the major elephant movement corridors. The major criteria to define the stated boundary include feasibility of site assessment, elephant GPS collar tracking, the revised proposed BES boundary, the status of natural resource pressure, human elephant conflict zone, the budget for P3DM implementation and villages involved during socioeconomic survey.
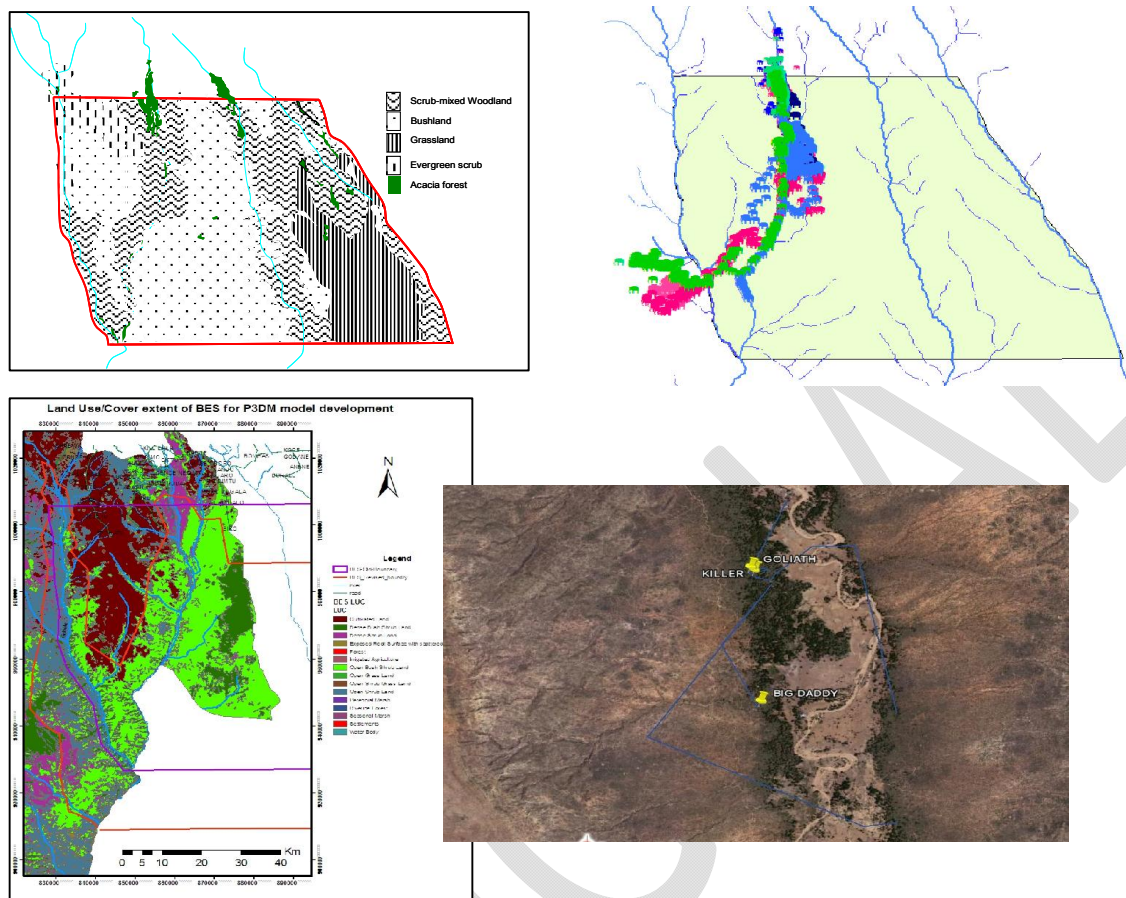
Fig.6.7.Varous P3DM spatial layers organised for decision experment(Source

7. Conclusions & Recommendations

7.1. Conclusions

- There are serious manmade pressures on the Sanctuary due to critical shortage of farmland, grazing ground (forage shortage) and water for livestock's and other purposes.

- Though there is high awareness and positive attitude towards the Sanctuary among the community, there is also serious livelihood problems as Socioeconomic and P3DM discussion relived.

- The dependence on the Sanctuary for various resources like land for crop production and other forms of income generation could be managed with better participatory spatial planning and sustainable intervention decisions.

- There is a grave human-elephant conflict due to habitat destruction that resulted damage of elephants on crop, human life and property and alternative actions are required for better participatory decisions to minimize the conflict.

- Previously there is no discussion, mutual understanding, and integration and co-planning among key stakeholders in development & conservation activities in the area, the elephant habitat is continually diminishing owing to various human factors like investment, Farming and other disturbances, thus the BES conservation requires urgent decisions at all level using Participatory spatial planning that could facilitate effective visual communication.

7.2. <u>Recommendations</u>

- Need of discussion, mutual understanding, integration and co-planning among key stakeholders in development & conservation activities could be modeled using P3DM.

- Spatial planning could help to design alternative livelihood mechanisms that can generate additional incomes through mapping Ecotourism Assets.

- Important to implement improved livestock, forage and water development strategies.

- Need of discussion, mutual understanding, integration and co-planning among key stakeholders in development & conservation activities.

- Participatory spatial decision making practice will create awareness and sense of ownership at all levels thus P3DM could be very essential as a bottom up working tool.

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Annex I Socioeconomic inventory questionnaire

II. ECONOMIC OCCUPATION			
1. What do you work for a living	1= Farming 2= Animal rearing 3= Both 4= Trading 5=other (specify)	|＿|	
2.What is your farm size	Record in hectares		
3.Major crop types you grow			
a. Maize	1=Yes 2=No	|＿|	
b. Sorghum	1=Yes 2=No	|＿|	
c. *Tef*	1=Yes 2=No	|＿|	
d. Wheat	1=Yes 2=No	|＿|	
e. Barley	1=Yes 2=No	|＿|	
f. other cereals	1=Yes 2=No	|＿|	
g. pulses	1=Yes 2=No	|＿|	
h. root crops	1=Yes 2=No	|＿|	
4. Do you own the following animals			Number of each animal
a. cattle	1=Yes 2=No	|＿|	
b. goats	1=Yes 2=No	|＿|	
c. sheep	1=Yes 2=No	|＿|	
d. camel	1=Yes 2=No	|＿|	
e. equine	1=Yes 2=No	|＿|	
f. poultry	1=Yes 2=No	|＿|	
5. how much per annum is your estimated income	1= from farming _____ 2=From animal rearing_____ 3= from trading _____ 4= from employment_____ 5.from other zctivities_____		
6. how do you rate the importance of the protected area in terms of the following	1=very important 2=important 3=less important 4=not Important		
a. As grazing land		|＿|	
b. Charcoaling & fire wood		|＿|	
c. As source of food		|＿|	
d. As sources of water		|＿|	
e. As source of honey		|＿|	
f. Source of farmland		|＿|	
g. As source of game animals		|＿|	
h. Source of medicinal plant		|＿|	
i. Aesthetic value		|＿|	

j. As a natural heritage		|__|	
k. Habitat for wild life		|__|	
7.Do you get any income from the resources of the protected area	1=Yes 2=No	|__|	If yes go to question No.8
8. from which activities	1=charcoal and fire wood selling 2=Honey collecting 3=hunting and selling animal products 4=collecting and selling medicinal plants 5=Other (specify)_____		
9. How much per year do you get t from this activities	_____		Indicate in Birr
10. Do you have enough grazing area for your livestock in your area	1=Yes 2=No	|__|	If no go to question No.8
11.What alternative do you use	1=use the grazing area inside the protected area 2=cultivate forage crops 3=purchase additional feed 4= 0ther (specify)_____	|__|	
III. Wildlife Conservation and Management Issues			
1. Do you believe conserving the wild life is necessary	1=Yes 2=No	|__|	If yes go to question no2. If no go to question no 3
2. What benefits do they have	1=they have the right to exist 2=they have economical value 3=they help to maintain the ecosystem balance 4=they have sacred value 5= 0ther (specify)_____	|__|	
3. Why conserving the wild life is not important	1=they compete for resource 2=they damage property and life 3=they have no use 4=they transmit disease 4= 0ther (specify)_____		
4. Can you list the wildlife you observe in the protected area	1._____ 2._____ 3._____ 4._____ 5._____ 6._____ 7._____ 8._____		
5. What is the dynamics in their number	1=it is increasing 2=it is decreasing	|__|	If 2 go to question no 6
6. What do you think the reasons are	1=illegal pouching 2=decline in their grazing and breeding area	|__|	

|				
		3=spread of disease 4=other (specify)_____		
7.	Are there any species that were present in the past and believed to have been extinct these days in the sanctuary?	1=Yes 2=No	|__|	
8.	Do you know any species, which was previously not found in this area but is found there now?	1=Yes 2=No	|__|	If yes go to question number 9
9.	Can you list these species	1._____ 2._____ 3._____ 4._____ 5._____		
10.	Have you seen wild animals injuring people/domestic animal	1=Yes 2=No	|__|	If yes go to question number 11
11.	How many incidences you have observed for the past two years.	_____		
12.	Have you lost livestock to wildlife?	1=Yes 2=No	|__|	If yes go to question number 13
13.	To what species of wildlife?			
14.	Do you think the present management of this conservation area is effective?	1=Yes 2=No	|__|	If no go to question number 15
15.	What weaknesses you have observed	1=There is shortage of wardens 2=the area is too large to manage 3=it excludes the local community 4=other (specify)_____	|__|	
16.	What factor do you think have contributed for the poor management	Please rate 1-6		
	a. Lack of ownership		|__|	
	b. Population growth		|__|	
	c. Poor knowledge		|__|	
	d. Weak law enforcement		|__|	
	e. Free access to the resources		|__|	
	f. Ethnic conflict		|__|	
17.	What alternative management do you suggest	1._____ 2._____		
18.	Is there an incidence where by your crops are raided by the wildlife in the last two years	1=Yes 2=No	|__|	If yes go to question number 19
19.	What crops are raided by wild animals?			

20. What proportions of the farm was affected?	1=totally 2= about two third 3=about half 4=about one forth	|___|	
21. How much do you estimate the loss in Birr			Record in Birr
22. How often problem occurs?	1= about once in a year 2= more than 3= about once in a month 4= about once in a weak 5= on a daily basis	|___|	
23. Which season incidents most happen?	1= in the rainy season 2= in the dry season 3= any time of the year	|___|	
24. What time of the day damages occurred?	1=during day time 2=during night time 3= any time of the day	|___|	
25. Identify which species are responsible in crop raiding	1=Warthogs 2=Lions 3=Hyenas 4=Elephants 5=Hamadryads 6=porcupines 7=Leopards 8=caracals 8=Jackals 9=Monkeys 10= others (specify)_____	|___|	
26. Damages caused by elephants other than crop raiding	1= attack on livestock. 2=attack on human 3=Destruction of man-made watering sites. 10= others (specify)_____		

Annex II Stakeholder Analysis workshop program

Stakeholder Ananlysis Workshop for Babille Elephant Sanctuary Conservation and Local Livelihood Improvement			
Date Nov,29, 2010 Place: Harari Regional State Administration Conference Hall, Harare			
Time	Topic	Presenter/facilitator	Chair
8:00-8:30AM	Registration	BES office	EWCA
8:30-8:35AM	Welcome and introduction	Project Principal Investigator	EWCA
8:35-8:45AM	Opening remarks	Hariri regional State president /Representative	EWCA
8:45-9:00AM	**Offcial opening remarks/Keynote Adress**	Ato Cherie Enawgaw , EWCA	EWCA
Theme : Participatory Decision Making for Babille Elephant Sanctuary conservation and local livelihood improvement			
9:00-9:30AM	Achievements of WSD for the overall management of BES	Ato Fedelu Abdela, WSD	EWCA
9:30-10:00AM	Roles of EWCA for participatory Decison making of BES Conservation and surrounding livelihood improvement	Ato Cherie Enawgaw , EWCA	WSD
10-10:30AM	*C o f f e e/Tea B r e a k*		**BES OFFICE**
10:30-11:00AM	BES Flora/Vegetation diversity and cover status for Elephant habitat and livelihood benefit	Ato Anteneh Belayeneh, Haromaya Univiersity	EWCA
11:00-11:30AM	Stakeholder Analysis for BES conservation and local livelihood improvement using Participatory Decision tools	Asaye Nigussie, NARF Project Principal Investigator	EWCA
11:30-12:00AM	Discussion	BES office/PI/EWCA/WSD	EWCA
12:00-12:30PM	Discussion	Ato Asaye Nigussie,NARF PPI	EWCA
12:30-1:30PM	*L u n c h B r e a k*		Self
1:30-2:00PM	Stakeholders Participation roles for the Challenges of Implementing Tourism Research Outcomes at Grassroot Level , Video of BES Prevous reasearch activities & Documentry movie of PPGIS	**WSD/BES, NARF Project Principal Investigator**	WSD
2:00-2:30PM	Discussion		WSD
2:30-3:00PM	Discussion & presentation	**WSD,EWCA, NARF Project Principal Investigator**	WSD
3:00-3:30PM	*C o f f e e/Tea B r e a k*		**BES OFFICE**
3:30-4:00PM	Closing remarks	Head of East Hareregae Zone Administration	WSD

Annex III Spatial information from various sources for P3DM development

Extent of BES for P3DM model development
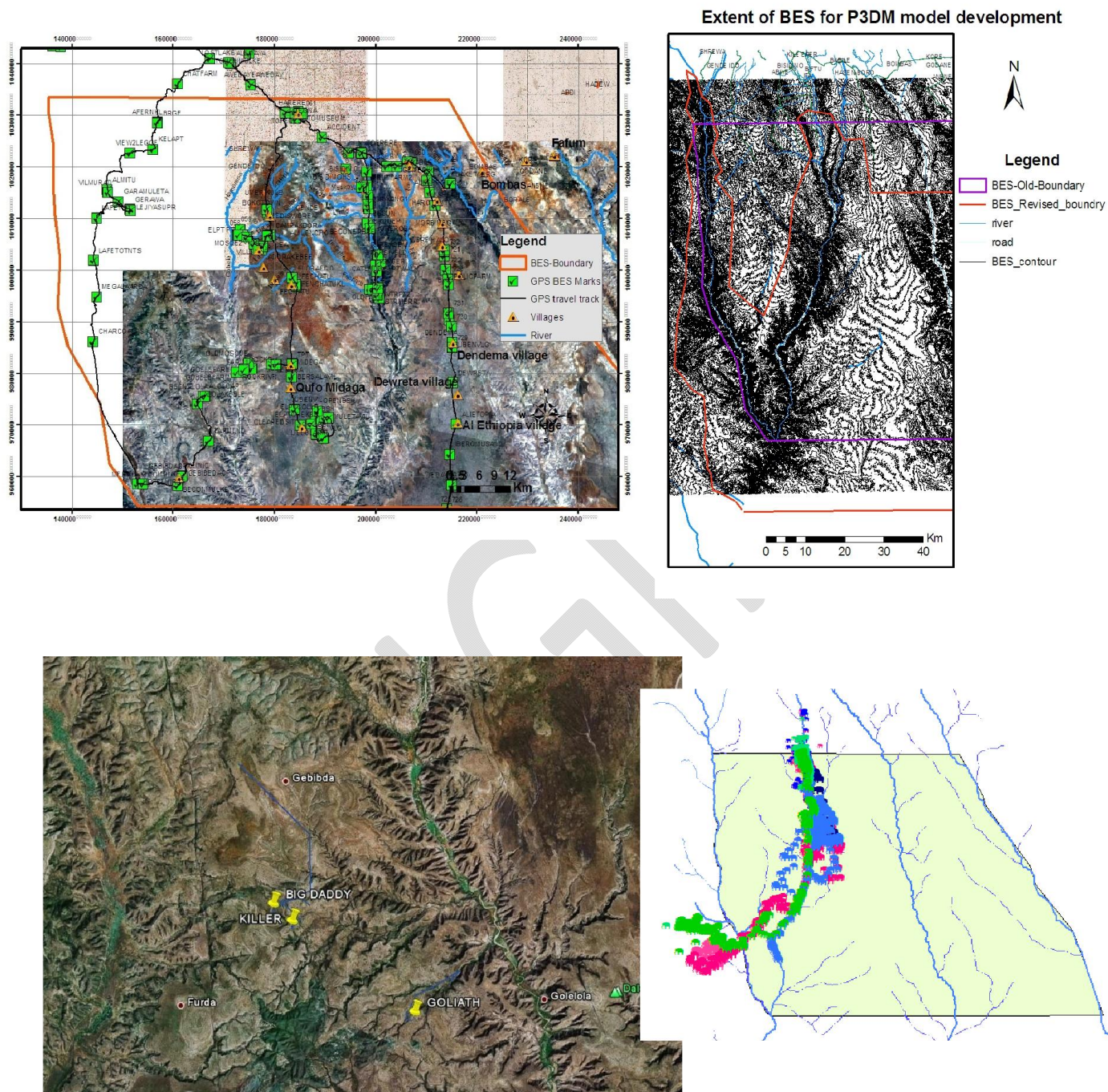
Annex IV Project activity photo snaps