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Research Article

Natural Resource Use Conflict and Its Management in Babile Elephant Sanctuary, Eastern Ethiopia

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ABSTRACT

Babile Elephant Sanctuary (BES) is located in the semi-arid ecosystem between Oromia and Somali regions of Ethiopia. Natural resource use conflict is one of the major problems of the sanctuary. This study aimed to assess the root causes of conflicts and their impacts on the sanctuary. Data was collected using satellite imagery and household survey, focus group discussions and key informat interviews. One hundred fifty two households were used to carry out socio-economic surveys from three kebeles. Land use/land cover change analyses were made for a period of three decades (1989-2019). The study indicated that there is insignificant changes on the drivers of resource use conflict among respondents ($p<0.05$). 67 (44.1%) respondents believe that the main driving factor of resource use conflict to be resource scarcity; 64 (42.1%) poverty and 61 (40.1%) drought. The satellite image analyses revealed forest and grassland have been decreased whereas bare land, settlement, cultivated and bush lands have increased.

Furthermore, human population increase has been found to be a prime cause for unsustainable resource use and decline of forests cover and size of grazing land.

The current resource use conflict and change in the land use can be mitigated through boundary re-demarcation of the sanctuary and creation of alternative means of community livelihoods in collaboration with the concerned stakeholders. At the same time, law enforcement and community engagements are equally important.

Keywords: Land cover; Natural resources; Satellite images; Socio economic survey

INTRODUCTION

Conflicts over of the use of natural resources exist to some degree in every society. This may emerge over ownership, access to use, decision making and distribution of resource revenues as well as other benefits and burdens. Poverty, climate change, population pressure, governance of land resource, competition over scarce resource and awareness on environmental conservation are major drivers of the conflict.

Natural resource use conflict has an adverse impact and leads to land and environmental degradation and loss of biodiversity. Hence, managing conflict for sustainable management is mandatory. Communities use different ways of resolving the resource use conflict. However, effective prevention and management of conflict require skill and tools [1-3].

Across Africa, national conservation policies have limited the local use of PAs, which triggered local grievances and ultimately constrained the achievement of conservation goals.

The interest of the local community over the resource use in PAs does not match with that of the PAs managers. The difference in interest over natural resource use creates conflicts. Particularly exclusion of the communities from the protected areas using trained rangers causes dissatisfaction.

Like other countries, Ethiopia has established more than 74 protected areas, which comprises national parks, wildlife sanctuaries, wildlife reserves, biosphere reserves, community conservation and controlled hunting areas. In most of the protected areas, conflict over resource use is common.

Babile Elephant Sanctuary (BES) is administered by Ethiopian Wildlife Conservation Authority (EWCA). The sanctuary was

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mainly established to protect the only known ecologically distinct isolated Elephant population of subspecies *Loxodonta Africana,* Orleans.

Although this unique mammal species needs special conservation, its range has absurdly declining due to agricultural, grazing and settlement encroachments. As a result the home range of elephants has been shrunk by 65.5% since 1976.

However, considering the size, BES is still the largest sanctuary in Ethiopia with a total area of 6984 km^2. Regardless of the shrinking home range of large mammals such as elephants due to human encroachment limited scientific information is available on the resource use conflicts. Thus, this study was conducted to examine and propose appropriate long lasting solutions of the resource use conflict [4,5].

MATERIALS AND METHODS

Description of the study area

Babile elephant sanctuary is located between Oromia and Somali regional states (Figure 1), about 560 km from Addis Ababa. It is situated between latitudes of 8022'300" N-90 00'300"N and longitudes 42°01'100"E-43°05'500"E and elevations range between 850 and 1,785 m.a.s.l. The climate zone of BES encompasses two main categories, upper "Kola" (characteristic arid climate) and "Woina dega" (mid altitude climate). The mean monthly maximum and minimum temperatures were 25.30°C and 9.700°C respectively.

The highest temperatures recorded were in the dry season in late February, March and April. December and January remained the coldest month during the night. The mean monthly rainfall ranges from zero to 112.6 mm. Rainfall is bimodal *i.e.* it is characterized by two peaks, occurring from March to May (short rain season) and July to September (long rain season).

The sanctuary and its boundaries were highly dominated by human activities including settlement, farming and livestock grazing. High encroachment patterns observed on the Northern and Northwestern borders of the sanctuary where there are permanent farming plots are used over the year (Figure 1).

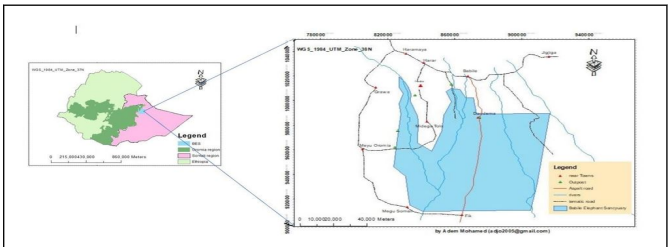

Figure 1: Location map of Babile elephant sanctuary.

Sampling design and size of households determination

Purposive sampling was employed to select representative Woredas and kebeles to obtain targeted information on the number of households, land use issues and security. Based on this, three woredas and three kebeles were selected, one kebele from each woredas. Hence, Erer Bada kebele from Babile woreda, Agdora kebele from Fedis woreda and Dendema kebele from Babile Dendema woreda were selected [6,7].

The number of households in each kebeles was obtained from Central Statistical Agency (CSA, 2014). The total household's size was determined by using the formula developed.

$n=Z^2pqN/e^2(N-1)+z^2pq$

Where;

N=The total no. of households in the three kebeles.

n=The sample size.

e=Margin of error / sampling error, which is considered as 95% or 5%.

z=The value that specifies the level of confidence at 0.05 is 1.96.

The total sample size was 152 households from which 72 household from Erer Bada; 36 household from Agdora and 44 households from Dendema kebele were selected and calculated based on their proportion out of the total households the kebeles have. The data was analyzed using R software version 23.

Data collection

Questionaire: 152 households were selected randomly to carry out socio-economic surveys from three kebeles of three woredas (Babile Dendema, Fedis and Babile) based on their proximity to the sanctuary. Both open and closed-ended questions were distributed to the questionnaire to acquire the necessary data.

Interview: Group discussions and informant interviews were directly conducted in the study areas to collect primary data. One focus group discussion was conducted in each three kebeles with six individuals. Correspondingly, key informant interviews with five individuals in each kebeles were carried out.

Remote sensed data and maps: Satellite imagery was taken from the period of the year (1989-2019) (end January and beginning February) to minimize discrepancies in reflectance caused by seasonal vegetation fluxes and sun angle differences, moisture content and cloud cover. The 30 m spatial resolutions were used for boundary delineation, navigation purpose and supported ground truthing and training site establishment (Table 1) [8].

Table 1: Satellite images acquired.

Sensors/satellite image	Landsat/no. of band	Resolution (pixel size)	Acquisition date	Path/row
Enhanced Thematic Mapper (ETM)	5	30 m × 30 m	Jan/25/1988	166/54 165/54

ETM	5	30 m × 30 m	Feb/13/1998	166/54 165/54
ETM+	7 gab filling)	30 m × 30 m	Jan/19/2008	166/54 165/54
ETM	8	30 m × 30 m	Jan/23/2018	166/54 165/54

Data analysis techniques

Both the quantitative and qualitative data analysis was employed. The household survey data were analyzed using SPSS version 23. A statistical method such as descriptive statistics and *chi* test were employed [9]. Whereas data acquired from satellite image analyzed using ENVI 5.0 software; GPS data collected in the field analyzed and processed using ArcGIS 10.3

RESULTS AND DISCUSSION

Community awareness, resource use interest and dependency

There was a significant difference between the respondents of the study area in their awareness about the sanctuary ($p<0.05$). 100% of the respondents in both Dendema and Agdora and 91.7% Erer Ebada kebele have the knowledge of boundary of the sanctuary. Whereas, 89 (58.6%) HHs did not understand the wildlife laws (Table 2).

Table 2: Community awareness about the sanctuary boundary and wildlife laws.

Variable		No. of HHs in the Kebeles			Total HHs	p-value
		Dendema	Agdora	Erer Ebada		
		44	36	72	152	
Knowhow about the boundary	Yes	44 (100.0%)[a]	36 (100.0%)[ab]	66 (91.7%)[b]	146 (96.0%)	0.031
	No	0 (0.0%)[a]	0 (0.0%)[ab]	6 (8.3%)[b]	6 (3.9%)	
Knowledge of the wildlife laws and regulation	Yes	19 (43.2%)	16 (44.4%)	28 (38.9%)	63 (41.4%)	0.826
	No	25 (56.8%)	20 (55.6%)	44 (61.1%)	89 (58.6%)	

Note: The figures outside and inside parenthesis of each tables represent respondent frequency and percentage, respectively; Different superscripts letter denote in Kebele categories indicate significant difference between each other.

Interest of the communities on the sanctuary resources

The result indicated that the respondents had high interest of utilizing the sanctuary resources ($p<0.050$) in each kebeles. Among the total respondents 108 (71.1%) of the households have an interest to get sustainable income from the sanctuary [10]. On the other hand, from the total respondents 53 (35%) and 11 (7.2%) were interested in getting pasture land for their livestock and exploiting forest resources for different purposes respectively (Table 3).

Table 3: Communities interest on the resource use and engagement of BES management.

Variable	No. of HHs in the Kebeles				P-value
	Dendema	Agdora	Erer Ebada	Total HHs	

Communities interest		44	36	72	152	
	Sustainable income	38 (86.4%)	36 (100.0%)	34 (47.2%)	108 (71.1%)	0
	Getting grazing land	24 (54.5%)	14 (39%)	15 (20.8%)	53 (35%)	0.01
	Extraction of forest	2 (4.5%)	0 (0.0%)	9 (12.5%)	11 (7.2%)	0.013
	Protecting wildlife	43 (97.7%)	33 (91.7%)	24 (33.3%)	100 (65.8%)	0

Causes of resource use conflict between communities and the sanctuary

The result in the Table 4 showed that there was no significant difference ($p>0.05$). Wildlife risks and lack of community participation on the conservation of the sanctuary in each kebeles. Whereas, the results showed restricted resources use access and illegal harvest of forest products indicated significant differences among kebeles (Table 4).

Table 4: Causes of resource use conflict in the study area.

Variable		No. of HHs in the Kebeles				P-value
		Dendema	Agdora	Erer Ebada	Total HHs	
Cause of conflict b/n community and BES		44	36	72	152	
	Restricted resource use	24 (54.5%)	31 (86.1%)	14 (19.4%)	69 (45.4%)	0
	Wildlife risks	2 (4.5%)	0 (0.0%)	3 (4.2%)	5 (3.3%)	0.446
	Lack of benefits	4 (9.1%)	1 (2.8%)	31 (43.1) %	36 (23.7%)	0
	Lack of participation	12 (27.3%)	9 (25.0%)	14 (19. 4%)	35 (23.0%)	0.592
	Competition over natural l resources	39 (88.6%)	33 (91.7) %	27 (37.5%)	99 (65.1%)	0
	lack of awareness	20 (45.5%)	8 (22.2%)	11 (15.3%)	39 (25.7%)	0.001
	Poaching	13 (29.5%)	11 (30.6%)	5 (6.9%)	29 (19.1%)	0.001

The driving forces for resource use conflict

As shown in the Table 5 below, drought, population pressure, poverty and scarcity of resource are among the most driving factors. From the total households, the most top driving forces of resources use conflict in the sanctuary were scarcity of resources (44.1%) followed by poverty.

Table 5: Drivers of conflict around BES area (Multiple responses).

Variable		No. of HHs in the Kebeles				p-value
		Dendema	Agdora	Erer Ebada	Total HHs	
Drivers of conflict around BES		44	36	72	152	
	Drought	35 (79.5%)	20 (55.6%)	6 (8.3%)	61 (40.1%)	0
	Population pressure	35 (79.5%)	21 (58.3%)	4 (5.6%)	60 (39.5%)	0

	Poverty	38 (86.4%)	19 (52.8%)	7 (9.7%)	64 (42.1%)	0
	Scarcity of resource	32 (72.7%)	24 (66.7%)	11 (15.3%)	67 (44.1%)	0

Problems of management practice and resource trends

Regarding the management problems of the sanctuary, 7.2% of the respondents replied less responsiveness given to the sanctuary and to the community, the other (7.2%) of the respondents replied there was weak law enforcement, and 17 (11.2%) of respondents replied there was less concern of the community to the sanctuary, 8.6% replied lack of awareness [11-13]. While, a few respondents (1.3%) with no significance difference ($p>0.05$) replied human encroachment (farming and expansion of settlement) in the sanctuary, 3.3% of the respondents replied the sanctuary is highly impacted due to poor/weak law enforcement however, 7.9% of the respondents didn't know the problems (Table 6).

Table 6: Respondents perceptions on problems of management practice in BES.

Variable		No. of HHs in the Kebeles				p-value
		Dendema	Agdora	Erer Ebada	Total HHs	
		44	36	72	1 152	
Respondent believe	Less attention linkage	9 (20.5%)	0 (0.0%)	2 (2.8%)	11 (7.2%)	0
	Weak law enforcement	7 (15.9%)	4 (11.1%)	0 (0.0%)	11 (7.2%)	0.015
	Less community concern	11 (25.0%)	3 (8.3%)	3 (4.2%)	17 (11.2%)	0.002
	weak protection to BES	1 (2.3%)	0 (0.0%)	4 (5.6%)	5 (3.3%)	0.282
	Farming/ settlement in BES	0 (0.0%)	0 (0.0%)	2 (2.8%)	2 (1.3%)	0.324
	Poor coordination	3 (6.8%)	4 (11.1%)	2 (2.8%)	9 (5.9%)	0.214
	Lack of Awareness	11(25.0%)	1 (2.8%)	1 (1.4%)	13 (8.6%)	0
	Don't have the knowledge	7 (15.9%)	5 (13.9%)	0 (0.0%)	12 (7.9%)	0.003

Suggestion of the communities to solve the conflict (multiple responses)

Based on the results obtained from the respondents as shown below Table 7, community participation, stakeholder's attention and strong law enforcement were the most suggested to solve the conflicts in the sanctuary. However, the results for re-demarcation, sharing the benefit from the sanctuary and making a fence on boundary line were not significantly different in each kebeles as being viewed problem solving for resource use conflicts in the Babile Elephant sanctuary (Table 7).

Table 7: Communities' suggestion to solve conflict of the BES (Multiple responses).

Variable	No. of HHs in the Kebeles				p-value
	Dendema	Agdora	Erer Ebada	Total HHs	
Communities suggestion	44	36	72	152	

Community participation	25 (56.8%)	19 (52.8%)	25 (34.7%)	69 (45.4%)	0.04
Stakeholders attention	25 (56.8%)	17 (47.2%)	2 (2.8%)	44 (28.9%)	0
Water for the community	2 (4.5%)	0 (0.0%)	0 (0.0%)	2 (1.3%)	0.083
Strong law enforcement	16 (36.4%)	14 (38.9%)	10 (13.9%)	40 (26.3%)	0.004
Stop deforestation	4 (9.1%)	12 (33.3%)	5 (6.9%)	21 (13.8%)	0.001
Free from settlement	2 (4.5%)	5 (13.9%)	24(33.3%)	31 (20.4%)	0.001
Budget for rehabilitation	5 (11.4%)	1 (2.8%)	0 (0.0%)	6 (3.9%)	0.009
Re-demarcation	0 (0.0%)	0 (0.0%)	2 (2.8%)	2 (1.3%)	0.324
Making a fence	0 (0.0%)	0 (0.0%)	3 (4.2%)	3 (2.0%)	0.183
Sharing the benefit	0 (0.0%)	0 (0.0%)	2 (2.8%)	2 (1.3%)	0.324

Land use and land cover classification

The land use land cover of BES was classified into six categories based on the field survey and satellite imagery generated (Table 8).

Table 8: Land use and land cover category and description.

Land use land cover category	Description
Bush land	Trees and shrubs are common: Dominated by bushes, short grass is also available and ground cover is poor cover in %.
Natural forest	Areas covered with both natural indigenous tree and riverine vegetation species.
Grazing land	Land covered with grasses and used for grazing.
Bare land	Little or no vegetation cover at all mainly on areas with exposed rocks better to show in % of bare land.
Settlements	Those closely associated and settled inside and adjacent to the boundary of the BES.
Cultivated land	Plots for annual rain fed and irrigation especially following Gobelel and Erer rivers. Please review the categories to show clear distinction between. Review the criterion for each.

Land use and land cover of the BES

The satellite image below indicated the highest and the least land coverage in 1989 was forest and bush land which covers 62.37% and 5.6% respectively. Forest (38.95%), bare land (30.4%) and farmland (15.53%) were the largest coverage in 1999; bare land (41.96%), forest (26.26%) and farmland (16.66%) were the largest coverage in 2009; and finally the bare land (38.78%), farmland (17.14%) and forest (10.81%) were the relative land covering 2019 (Table 9 and Figures 2-5).

Table 9: Land use and land cover of the BES.

Land use class	Years							
	1988		1998		2008		2018	
	Ha	%	Ha	%	Ha	%	Ha	%
Bush land	39131.9	5.6	27898.3	3.99	27898.3	3.99	70209.2	10.05
Forest	435617	62.37	272028	38.95	183395.5	26.26	75513.1	10.81
Grassland	81416.2	11.66	20536.6	2.94	20536.6	2.94	56148.1	8.03
Bare land	58782.9	8.42	212332	30.4	293024.4	41.96	270814	38.78
Settlement	42782.6	6.13	57170.8	8.19	57170.9	8.19	106103	15.19
Farmland	40669.3	5.82	108435	15.53	116374.3	16.66	119613	17.14
Total	698,399. 9	100	698,400.7	100	6,98,400	100	698,400.4	100

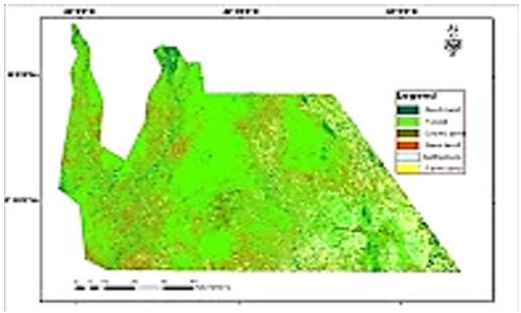

Figure 2: LULC map of 1989.

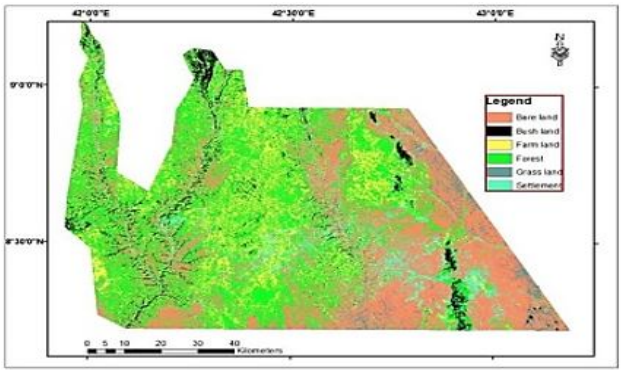

Figure 3: LULC map of 1999.

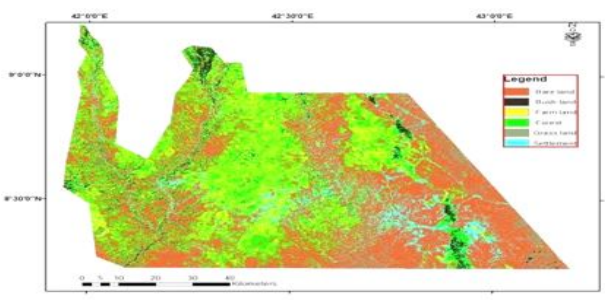

Figure 4: LULC map of 2009.

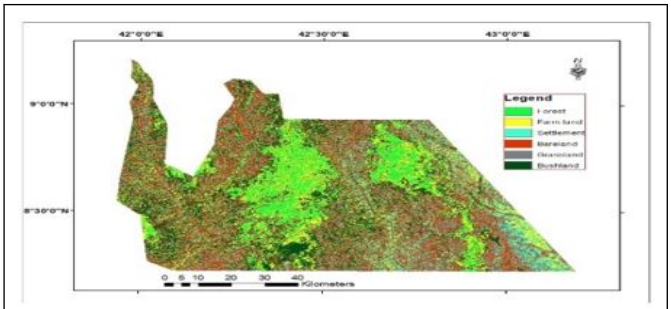

Figure 5: LULC map of 2019.

DISCUSSION

Community awareness and resource dependency

The findings of this study revealed that there was lack of community awareness with respect to rules and regulation of the sanctuary conservation. Balakrishnan and Ndhlovu, and Shibia, thought that lack of awareness towards conservation issues and involvement of the local community in the decision-making processes might be significant determinants of negative attitudes towards protected areas. The communities in and around the sanctuary were dependent on the resource of the sanctuary for grazing, water, farming, fuel wood collections, settlements and associated livelihoods whereas the sanctuary has been working towards protecting the wildlife and their natural habitat. The interest over the resource use by the community and protection for nature conservation caused serious conflict that has been intensified over time the conflict required integrated and community conservation strategies that could benefit both the wildlife and the locals. A local engagement in protected area management has a significant contribution as the management process considered problems of both.

Driving forces for resource use conflict

Human population increase in and around BES intensified expansion of human activity and encroachment of the sanctuary. In developing countries in general, there is an ever increasing exploitation of common resources, resulting from the rapidly expanding human population.

The findings of this study provided evidences and supplementary information on the derivers of the resource use conflict between the sanctuary and the community. As shown on the (Table 6), poverty (food insecurity, economic problems and famine), recurrent drought, human population pressure and scarcity of resources (land, water, forest), were identified as major causes (driving forces) of resource use conflicts between the local community and the sanctuary.

Population growth has a double effect, simultaneously expanding demand of the population and reducing supply of resources such as land, water and forest. Poor people often destroy their environment not because they are ignorant, but in order to survive. Likewise the result of this study revealed that the majority of the communities around the babile elephant sanctuary are living under poor and medium wealth status which leads to dependency on available limited resources and over exploitation.

Problems of management practice of the sanctuary and trends

This study investigated different views of the respondents regarding the management problems of the sanctuary. Insufficient government support, weak law enforcement, less concern of local community to the sanctuary, expansion of cultivation, poor coordination and lack of awareness among the local community are among the major management problems contributing to deterioration of the Sanctuary's status over time. Furthermore shortages of resource and budget allocations, lack of infrastructure development (road, water, t, out posts, power etc.), expansion of settlement and poaching are the main challenges of the sanctuary. The growing number of the community on the contrary of resource scarcity and degradations further increased demand for land in the district for food production. This brought an adverse impact on the protected area (BES) and threatened management of sanctuary in general and aggravated encroachment into the elephant home range in particular. The management approach along with the limited capacity of the sanctuary does not consider the needs and interest of the local communities living inside and around the sanctuary and thus conflict becomes imminent thereby undermines protection and management of the protected area. Due to the management problems of the sanctuary prevalence of illegal activities (livestock encroachment, expansion of cultivation and settlements, deforestation, etc.), and human-wildlife conflict increased overtime and this accompanied by lack of compensation for losses from conflict. Some animals of the sanctuary were killed and their habitat also encroached by farming. Gobelel and Erer valleys in BES are the core habitats for African Elephant but it is mostly in these locations illegal farming and Elephant killing were reported. According to Gebremicael and Gebretensae and Gebremicael, report 42 and 14, Elephants were killed in 2012 and 2013 respectively. Beside this, the sanctuary report indicated in the past 50 years poaching activities were extended and the population was declined by 60%. Poaching for ivory and human-wildlife conflict over critical habitats are the most noticeable anthropogenic challenges of the Sanctuary contributing to the critical decline of Elephant population.

According to the gap analysis reported on law enforcement in Babile elephant sanctuary by gebremicael, there are major limitations in the wildlife proclamation (no. 541/2007 and 575/2008) and regulation no. 163/2009 which are well addressed in the updated version of legal frameworks drafted.

Land use land cover change

Change analysis of the land features is essential for better understanding of interactions and relationships between human activities and natural phenomena. This understanding is necessary for improved resource management and decision making.

The land use land cover change of Babile Elephant Sanctuary of the last 3 decades (1989-2019) analyses indicated that forest and grassland coverage were declined. Whereas, farm lands, bush land, settlements and bare land coverage were increased. Deforestation for the purpose of charcoal productions, house construction and fuel wood, land for farming (irrigation) along the rivers and sever grazing of the livestock are the major activities in the sanctuary which led the land cover to change. Similar land use land cover changes were observed in the North Western low lands of Ethiopia related to high demand for wood and fodder which require significant clearance of forest/shrub resulted in huge habitat and deterioration of land cover.

CONCLUSION

Like the case of other protected areas of the country, conflicts over the use of natural resources (Forest, land, water) are commonly observed phenomena in the Babile elephant sanctuary and this has been a serious challenge that negatively influenced the integrity of the sanctuary. The existing threats and associated challenges are broadly linked to limited institutional capacity, poverty, and population growth, lack of alternative livelihoods, unsustainable resource use and lack of ineffective management of the sanctuary.

RECOMMENDATIONS

Based on the conclusions the following recommendations are suggested.

- Improve institutional capacity of the sanctuary.
- Support creation of alternative livelihood opportunities through improved livestock feed development, improved farming technologies and rangeland management activities in cooperation with district agriculture offices.
- Strengthen law enforcement to ensure effective management of the sanctuary.
- Establish collaborative mechanisms among all stakeholders to stop poaching of Elephants and deterioration of critical habitats.
- Strengthen relationships between the Sanctuary and the community through mutual collaborations in development and conservation jobs.
- Concluding the redemarcation of the sanctuary.

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