Title

“Assessment on the level of Human-Elephant Conflict and Possible mitigation measures in and Around Chebra Churchura National Park, Ethiopia.”

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ABSTRACT

An investigation on human-elephant conflict was carried out in Chebra Churchura National Park Ethiopia (CCNP) between March, 202021 to March 2022. Data were collected from a total of 20 Park adjacent villages during the first survey and additional detailed survey in three purposely selected park adjacent villages (Chebra, Seri and Yora). A total of 800 household samples 15% from 20 park adjacent villages were identified for interview. The purpose of this investigation was to identify the spatial patterns of human-elephant conflict in the area. Concerning the existence of human-elephant conflict (84.06%) of the total respondents of which (95%) of them were from 17 Park adjacent villages confirmed that they have never had any kind conflict with the elephants while (15.94%) of the respondents of which (96%) of them were from 3 Park adjacent villages (Chebra, Seri and Yora) reported that they had Sevier human-elephant conflicts. A total of 378 respondents from the three villages (Chebra, Seri and Yora) were purposely selected for interview, focal group discussion, actual measurements of the damages and estimation of the monetary value of the damage were carried out. Among the respondents (85.9%) reported crop damage as the main cause of human-elephant conflict, while (4.8%) reported loss of livestock and least (4.6%) reported effect on human life. Crop damages reported were mainly on three crop types of bananas, maize and yam. Actual measurements of the damages and estimation of the monetary value of the damage at local market was made. A total of 61 crop raid and 20 elephant attacks on humans and domestic animals were recorded with 7 human deaths. The majority of elephant attack (65%) was against humans followed by cattle (35%). The total annual economic loss due to crop raid and death of domestic animals by the elephants were estimated at 5875017ETB/127717 USD of which 11697534 ETB or 111545USD was from crop loss while only 26250 ETB or 1141 USD was due to loss of domestic animals. Most respondents (38%) reported firing warning gun by park scouts as an effective method of crop prevention followed by Chilly fencing (19.7%) sound noise including the sound of barking dog and hammering materials made of metal (13.3%) guarding (11.3%) fire smoking (9%) and smoking chilly and elephant dung (8.7%).

Key Words: Human-elephant conflict, Chebra- Churchura, Conservation, Ethiopia

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1. Introduction

There is no well-known historical information about elephants for Ethiopia before the 1960s. However, elephants were mentioned in early explorers' reports and hunting became fashionable amongst the earlier rulers of the 19th century (Demeke, 2009). As hunting for ivory escalated in the mid to late 19th century elephant numbers dwindled until Emperor Menelik banned elephant hunting around 1900 by his special permission (EWCA, 2015). A detailed account of the historical ivory trade and elephants in Ethiopia is available (Demeke, 2009). Unsystematic reports of elephant sightings around the turn of the 19thc from visiting hunters and naturalists indicated that elephants had a more widespread range in Ethiopia than that of today. With reports from Borana (the Italian Prince Ruspoli was killed by an elephant close to the place where the endemic Prince Ruspoli Turaco is found today. Elephant sightings were also reported from areas in the central Rift Valley, including Awash and northern areas including Bahir Dar and the Axum area (Demeke, 2010). However, these populations were extirpated by the1940s with the last records from Awash around 1942. In the early 1960s a UNESCO mission requested by Emperor Haile Selassie identified potential protected areas. The only specific elephant protected area established in Ethiopia was Babille that thought by John Blower to be holding not more than 100 elephants' remnants of the once numerous Somali race.

In the 1970s the status of elephants in Ethiopia became clearer and it emerged that most of Ethiopian elephants actually occurred in areas not previously described including the southwest part of the country from Mizan Teferi and Gura Ferda to the lowlands of Gambella (EWCA, 2015). Numbers estimated in the 1970/80s vary from 6000 to 10,000 with trophy hunting yielding excellent tusks up to 160 pounds until the early 1990s. During the fall of Derg a country wide wave of slaughtering of wildlife caused a huge decline of most of the wild animal populations including elephants.

The large herds of elephants in Gambella have also been decimated by the South Sudan Liberation Army for wildlife meat and ivory. This condition continued into the new millennium and was only brought to an end by the peace in South Sudan in 2003-2004. At the time of writing the instability in this area is again a serious threat to Gambella elephants. Overall, it is estimated that Ethiopia has lost about 90% of its elephants since the 1980s with elephants being extirpated from at least 6 of 16 sites reported in the early 1990s (EWCO, 1991).

The total Ethiopian population is currently estimated at between ~1850-1900 animals occurring in 6 main populations of Omo, Mago, Gambella, Kafta-Sheraro, Chebera Churchura National Parks and the Babille Elephant Sanctuary. In addition, elephant signs (footprints and dung) have been reported by conservation managers in the Alatish/Bejimez NPs and Mizan Teferi in southwest Ethiopia. Communities have reported observing elephants in the Geralle National Park area in southern Ethiopia and in the Dabus valley, at the confluence of the Abay and Dabus rivers in the northwestern regional state of Benishangul-Gumuz. Formal estimates of the size of these 4 small populations are not available. Key information on elephant status and threats in the major populations is detailed below and was obtained by site level staff or from published or internal reports after consultation with key partners (EWCA, 2015). Several populations move

across international boundaries Gambella, Kafta-Sheraro, Alatish, Omo and probably Geralle (EWCA, 2015).

According to (Maitima *et al.,* 2009) developmental activities in developing countries often involve alteration of natural wildlife habitats into agricultural farmlands, human settlements and industries areas. Altering natural lands for such developmental activities often leads to fragmentation and loss of natural habitats. Such activities finally end up in resulting humans and wildlife living in closer proximity and escalating human–wildlife conflict (Parker and Osborn, 2006). Loss of natural habitats to expand the developmental activities such as agricultural farmlands, industrializations, settlements and urbanizations to meet the ever-growing demand of the growing human populations has become one of the top conservation challenges especially for the megafauna such as elephants. Human-wildlife conflict imposes huge cost on local people and their livelihoods (Madhusudan, 2003). Moreover, the expansion these activities resulted in widespread habitat loss, fragmentations and loss of landscape connectives across Asia and Africa followed by huge decline in the elephant populations from most of their previous natural habitats and ranges (Thouless *et al.,* 2016; Calabrese *et al.,* 2017). Now a days most of the elephant populations in Asia and Africa are forced to live in close proximity with human due to a significant loss of their habitats resulting competitions for space and resources with people and Sevier conflicts with human beings including crop raid, injury and death of domestic animals and human beings (Western *et al.,* 2009; White and Ward, 2011; Liu *et al.,* 2017). According to (AfESG, 1997; WWF, 1997) human-elephant conflict has been identified as one of the five issues having equal priority that needs attention regarding the African elephant conservation. Negative interaction between human and elephants have become known as human- elephant conflict. In Africa at present only 20 percent of the species range has any form of protection, but conflicts occur at almost any interface (AfESG, 1997; WWF, 1997). Moreover, the issue is becoming increasingly politicized locally, even if actual incidents are sporadic or limited impact (AfESG, 1997; WWF, 1997). Thus, understanding of the elephant's ecology, behavior, spatial and temporal patterns of the habitat use, human-elephant conflict, local livelihoods and household production are valuable and timely to identify the principal driving causes of the conflicts and investigate and develop different effective conflict prevention and mitigation measures (Hoare, 2015). The population of African elephant in Chebra Churchura National Park is in a state of increase and there is a huge concern for escalating conflict with the local community. This study aimed to determine the spatial and temporal patterns of the elephant habitats, human-elephant conflict, local livelihoods, household productions and proper conflict prevention and mitigation measures. It also provides an important baseline data for developing appropriate conservation management plan to resolve the Elephant-human conflict.

2. The Study Area and Methods

2.1. The study area

Chebera Churchura National Park (CCNP) is located in the southwestern part of Ethiopia, in the SNNPR Administrative Region. The Park is located between Dawro Zone and Konta Special Woreda, about 427 km and 475 km southwest of Hawassa and Addis Ababa, respectively. It covers an area of 1410 km^2 and lies between the coordinates 36^0 27'00''- 36^0 57'14''E and 6^{0}56'05''-7^0 08'02''N, bordered by Konta Special Woreda to the north, Omo River to the south, Dawro Zone to the east and southeast, and Agare High Mountains and Ouma River to the west(Fig. 1).

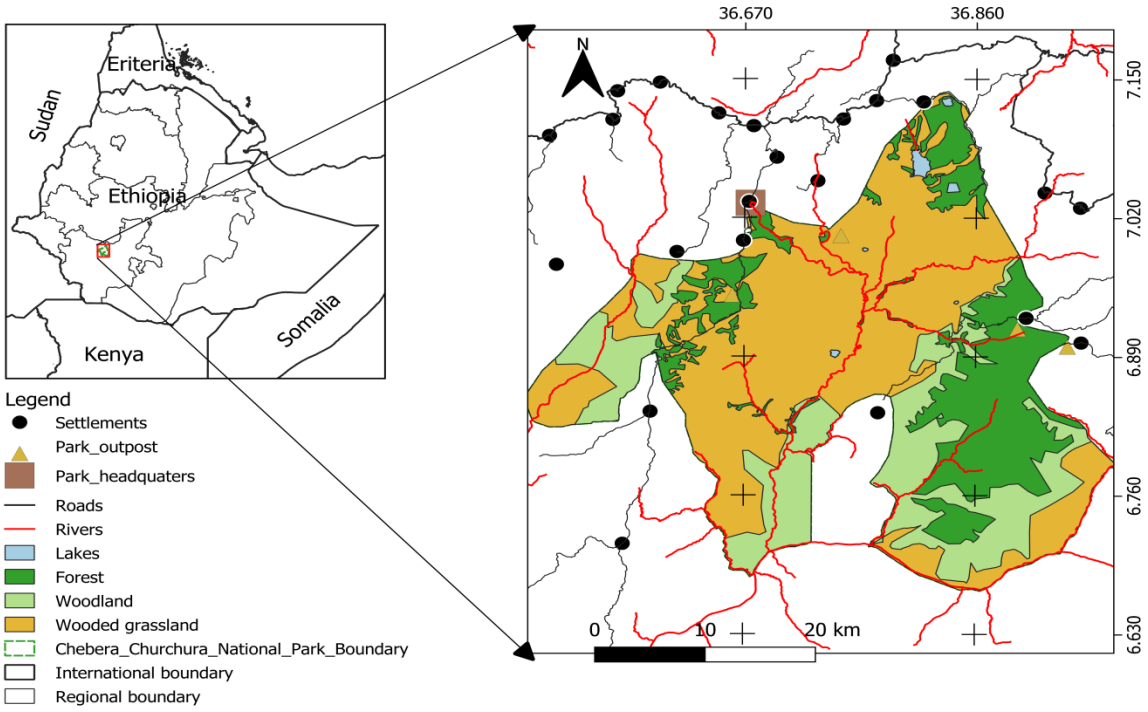

Figure 1. Map showing the location of Chebera Churchura National Park (Source EWCA, 21016).

Chebera Churchura National Park is known to possess almost one third of the country's total elephant population and high diversity of flora and fauna. So far, 40 large and medium sized mammals including four of the five big game animals, 18 species of small mammals of which one is endemic to Ethiopia and 138 species of bird of which 6 are endemic to Ethiopia are recorded in this National Park. Two mammalian species, Weyns' duiker (Cephalophu sweynsi) and Harvey's duiker (C. harveyi) were also recently recorded in this National Park which was not officially recorded in Ethiopia before. The Park is also the only home in the world for an endemic species of fish "Gara chebra" which is named by Chebera Kebele of the National Park. 106 woody plant species were identified by a single survey, of which 6 (Millitiaferugeni, Vepris daneli, Solanecio gigas, Cussonia ostini, Erythrina brucei, Rhusglutinosa) are endemic to Ethiopia (Girma, 2014).

Chebera Churchura is characterized by a relatively hot climatic condition. The rainfall distribution is unimodal. The average amount of annual rainfall in the area varies from 1000 to 3500 mm. The area has uniform and long rainfall season (between March and September and with a peak in July). The dry season of the study area is from November to February, with mean maximum temperature varying between 27 and 29oC. The hottest months are January and February while, the coldest months are July and August with the mean maximum and minimum temperatures of 280C and 120C, respectively (Weldeyohanes, 2006).

2.2. Methods

The present study was carried out in 20 Park adjacent villages in general and in three Park adjacent villages that had human-elephant conflict in particular (Fig. 1). Questionnaire and focus group discussion were conducted by modifying the methods of Newmark, *et al.* (1994) and Demeke Datiko (2013). Actual measurement of the damage caused by elephants was carried out following the method of Hore (2001) a standardized system developed by IUCN African Elephant Specialist Group's Human-Elephant Conflict Working Group. The study was aimed to assess the level, temporal and spatial patterns of human-elephant conflicts and the possible prevention and mitigation measures in CCNP between 2021 and 2022. Before the actual data collection reconnaissance survey was carried out during May 2019. Necessary information about the park, livelihoods of the local communities, spatial and temporal patterns of the elephant habitats and human-elephant conflict was collected.

Figure 2. Focal group discussion in Delba Village CCNP

Data about the attitude of local communities towards the park elephants and human-elephant conflict particularly was also collected. The questionnaires mainly focused on six main areas. (1) Crop commonly grown and palatable for the elephants (2) Types of conflicts they had (3) Specific elephant groups responsible for the damage (4) Trends in population of elephants and the level of conflicts (5) Possible prevention and mitigation measures and the level of effectiveness (6) Attitude of people towards the Park and elephants (7) Seasonal, spatial and temporal patterns of elephant habitats and human-elephant conflicts.

A total of 800 household samples 15% from 20 Park adjacent villagers were identified for interview. The purpose of this investigation was to identify the spatial patterns of the elephant habitats and human-elephant conflict. A total of 378 respondents from the three villages (Chebra, Seri and Yora) were purposely selected for interview, focal group discussion, actual measurements of the damages and estimation of the monetary value of the damage were carried out.

The structured questionnaires were administered to the member of household at a random manner excluding household member age less than 18 based on first come first served biases (Demeke Datiko, 2013; Newmark*, et al.,* 1994). Focus group discussion was also conducted in the villages to discuss the experience of people in human elephant conflicts and the effectiveness of different possible mitigation and prevention measures implemented by the local communities (Fig 2). Moreover, since the issue of human elephant conflict is becoming increasingly politicized locally, even if actual incidents are sporadic or limited impact to avoid such bias actual measurements on the amount of crop damage, human and domestic animals' injury and death were made using the method of Hore (2001). Measurements including the area of damage by m^2, the proportion of damage and the growth stage of crops, the elephant group responsible for the damage, locations, the age, sex, and number of elephants that caused the damage and proximity to the park were made and recorded.

Based on the data collected on actual measurement of the damage total economic loss due to the elephants were estimated in terms of monetary value based on current price of each crop at the local market. Seasonal variations in the level of damage and the amount of crop loss/damage were compared for crop available both during both dry and wet seasons. During the study period crop damages reported were mainly on three crop type banana, maize and yam from the three villages and actual measurements of the damage and estimation of monetary value at local markets was calculated using different methods for each.

Banana

Each individual banana tree consumed by elephants was counted and recorded (Fig 3).

Figure 3. Crop damage caused by elephants in Chebra Village CCNP.

Sample from 12 banana trees from the three villages were taken 3 from each plant considered as good, medium and low productive. The average number of banana/individual plant was calculated. Data on the price of each banana at local market were also collected (Fig 4).

Figure 4. Banana fruits harvested from sample areas to estimate average productivity.

Monetary value of the total damage was calculated as total number of banana consumed by elephants x average number of banana/ individual tree x average unit price at the local market.

Maize

Loss of maize was calculated by recording the total size of damage in hectare (Fig 5). Number of individual plants from a total of 18 sample plot 2x2m size were counted from high, medium and low productive farms. 6 from each village 2 sample from each village. The average number of

maize counted from 2x2m sample area individual plants and an average dry weight from the sample areas were calculated (Fig 5).

Figure 5. Crop damage caused by elephants on maize farmland in Yora village CCNP.

The average price/kg at local market was estimated. Total loss was estimated by multiplying total size of farmlands consumed in ha x estimated product in kg x average unit price/kg at the local market (Fig 6).


Figure 6. Measuring maize collected from sample areas to estimate average product.

Yam

Yam as a root plant total loss due to human-elephant conflict was estimated by multiplying total size of farmlands consumed in ha x estimated product in Kg/ha x average unit price/kg at the local markets (Fig 7).

Figure 7. Damage on yam plantations caused by elephants in Chebra village CCNP.

The average price/kg at local market was estimated. Total loss was estimated by multiplying total size of farmlands consumed in ha x estimated product in kg x average unit price/kg at the local market (Fig 7).


Figure 8. Damage on yam plantations caused by elephants in Chebra village CCNP.

Footprint size as a measure of age structure

Determination of the age of elephants from indirect sign based on the hind foot lengths was first described by modifying the method of Yirmed Demeke (2008) and Western and Moss (1983). Data obtained were grouped into five age classes: yearling with lengths less than 21.8 cm, calves and juveniles from 21.8 cm to 30.2 cm, intermediates 30.3 cm to 38.5 cm, and 38.6 cm to 45.0 cm as sub-adult male or adult female. A footprint of >45.0 cm is a bull (Western and Moss 1983; Lee and Moss, 1995). Total loss per household was calculated as total annual loss/total number of households.

Faecal bolus circumference as a measure of age structure

The method of Jachmann and Bell (1984) and Yimed Demeke (2009) with slight modifications was used to assign elephants into different age classes. Reilly (2002) used only the maximum diameter of a bolus. Elephants were grouped into five classes: yearling with sizes of ≤20.0 cm, calves and juvenile from 20.1 cm to 27.0 cm, intermediates from 27.1 cm to 33.5 cm, sub adult males or adult females 33.6 cm to 43.0 cm and 43.0 cm or more an adult bull (Fig. 8). Because of similarities in the results from both footprints and droppings, similar ranges in age classes were used (Fig 8).

Figure 9. Measuring the size of footprint and circumference of the elephant dung to determine the age of crop raiding elephants.

3. Results

Out of the 800 respondents, 464 (58%) were males and 336 (42%) females. There was no significant difference in the attitude towards elephants and Park conservation between the sexes. The age of respondents ranged from 18 to 70 years. The majority 616 (77%) of the respondents age was ranged 20 to 59 years, while 11 % and 12 % of the respondents were less than 20 and older than 59 years respectively (Table 1). Young individuals (18 - 29) showed more positive attitude than other age groups. Around, 53.8% of the respondents should positively attitude and 42.4 % showed negative attitude while 3.8% were neutral towards the park and elephant conservation. However, this was not significant ($\chi 2$= 8.136, df= 5, P > 0.05).

Table 1. Age category and attitude of the local people towards the park and elephants.

Age category	Number	Positive	Negative	Neutral
18-20	88	57.9	38.0	4.1
20-29	112	55.3	42.5	2.2
30-39	184	51.0	42.6	6.4
40-49	200	52.4	46.3	1.3
50-59	120	52.2	43.6	4.2
>59	96	53.9	41.1	5.0
Total	800	53.8	42.4	3.8

Educational level and attitude of the local people towards the park and elephant conservation are given in (Table 2). 28% of the interviewed respondents were illiterate, 37.62% had primary education 10% had high school and 24.37% had informal education. The majority of respondents (51.1%) had a positive attitude towards the conservation area and elephants. However, 45.0% had negative attitude. Relatively, better educated groups (primary and secondary education) had more positive attitude than the non-educated groups. However, this was not significant ($\chi 2$= 17.878, df= 3, P > 0.05).

Table 2. Educational level and attitude of the local people towards the park and elephants

Educational level	Percentage	Positive	Negative	Neutral
Illiterate	28.0	41.0	51.9	7.1
Elementary	37.62	54.3	39.1	6.6
High school	10.0	62.1	37.9	0
Other/Informal	24.37	46.7	51.2	2.1
Average	100	51.1	45.0	3.9

Source of income

Mixed farming (crop cultivation and livestock rearing) was the main means of livelihood (80.35%) of the respondents in CCNP and few (14.53%) depended only on the livestock rearing. About 5.11% of the respondents claimed to have been involved in other occupation such as laborer and others claim to be students and jobless (Table 3).

Table 3. Source of income of the respondents

Village/Kebele	Number	Mixed farming	Livestock	Other
Chebra	43	75.1	13.2	12.7
Seri	45	75.4	14.3	10.3
Delba	38	79.5	15.7	4.8
Koyesha	36	60.1	12.9	27
Oshka	34	81.0	17.2	1.8
Agare	38	80.2	18.3	1.5
Kuta	44	82.1	14.3	3.6
Yora	46	83.0	15.1	1.9
Shita	41	78.5	14.9	6.6
Keribella	35	69.7	17.8	12.5
Menta	39	83.6	13.7	2.7
Maliga	38	87.0	11.1	1.9
Dameno	39	86.4	12.6	1.0
Neda	44	84.3	14.5	1.2
Churchura	43	83.5	14.7	1.8
Gudumu	42	79.7	16.1	4.2
Chawda	41	84.4	14.4	1.2
Adabacho	34	88.0	11.0	1
Boka	41	81.8	14.7	3.5
Gimba	39	84.7	14.2	1.5
Total	800	80.35	14.53	5.11

The spatial pattern of elephant habitats and human-elephant conflict

When asked about the existence of human-elephant conflict around their villages out of the total respondents from the 20 Park adjacent villages. (95%) of respondents from 17 Park adjacent villages confirmed that they have never had any conflict with the elephants while (96%) of respondents from 3 Park adjacent villages (Chebra, Seri and Yora) reported that the presence of severe human-elephant conflicts (Table 4).

Table 4. The spatial pattern of elephant habitats and human-elephant conflict

Village	Last time/month elephant seen				Season		Existence of conflict		
	Never	1<	1 >3	3>6	Wet	Dry	Both	Yes	No
Chebra	1	84.1	11	3.9	1.6	3.3	95.1	89.3	10.7
Seri	1	86.6	9.1	3.3	4.3	2.1	92.6	92.2	8.8
Delba	91.9	1	1	6.1	1.5	1.4	1	1.2	98.8
Koyesha	95.1	1	1	2.9	1	1.2	1	1.3	98.7
Oshka	96.9	1	1	1.1	1.2	1.1	1.3	1.8	98.2
Kuta	65.1	19	14.7	1.2	14	21	3	3.6	96.4
Yora	1.8	93.1	2	3.1	10.4	6.2	81.8	98.1	1.9
Shita	45.1	43.9	4.1	6.9	11.1	5.1	4.7	4.1	95.9
Keribella	75.6	10.1	5.2	9.1	8.1	2.4	1.1	2.5	97.5
Menta	83.6	7.1	7.1	2.2	7.4	3.1	1.2	2.7	97.3

Maliga	87	5.2	3.1	4.7	3	2.9	1.1	1.9	98.1
Dameno	7.5	14.3	11.8	66.4	32.6	27.3	13.1	2.1	97.9
Neda	84.3	6.4	3.7	5.6	4.5	3.7	2.1	1.2	98.8
Chuchura	23.5	20.1	23.5	32.9	14.7	11.1	21.2	1.8	98.2
Gudumu	92.7	3.7	1.5	2.1	6.1	3.1	1.2	2.2	97.8
Chawda	84.4	7.1	2.6	5.9	4.4	3.2	1.3	1.7	98.3
Adabacho	88	6.6	4.3	1.1	3	4.1	3.4	1	99
Boka	37.8	23.3	13.2	25.7	26.2	21.4	42.1	3,5	96.5
Gimba	24.7	26.2	21.3	27.8	30.3	34.1	14.7	5.1	94.9
Percent	59.4	23.0	7.1	10.5	9.3	7.4	19.2	15.94	84.06

The main causes of human-elephant conflict

Based on the above result 378 individuals from the 3 villages confirmed the presence of both elephants and severer human-elephant conflicts in their area. The threat included crop loss, human and livestock injuries and deaths. Most of the respondents reported that elephants caused damage on crops, livestock and humans. Among the respondents (85.9%) reported crop damage, (4.8%) reported loss of livestock and (4.6%) reported injury and death to human life (Table 5). However, the difference was statistically significant ($\chi 2 = 148.38$, df=3, $P<0.05$).

Table 5. The main causes of human-elephant conflict.

Kebeles	No. of Respondents	Crop raiding	Loss of livestock	Human injury	Loss of human
Chebra	126	85.8	4.7	5.5	4.3
Seri	126	85.9	4.8	4.8	4.5
Yora	126	86.0	5.0	4.0	5.0
Average	126	85.9	4.8	4.7	4.6

Trend in elephant population and human-wildlife conflict

Out of the total respondents (93.3%) reported that elephant population has been increasing while (6.7%) reported decreasing. When asked about the trend of human-elephant conflict most of the respondents (95%) confirmed that human elephant conflicts including crop damage, injury and death to domestic animal and human has been increasing from time to time (Table 6).

Table 6. Trends of elephant population and conflicts.

Village	Number of respondents	Crop Damage				Domestic animal attack		Human injury	Human death
		>	<	>	<	>	<	>	<
Chebra	126	89.1	10.9	92.3	7.7	91.5	8.5	98.4	1.6
Seri	126	93.4	6.6	97.3	2.7	93.1	6.9	98.8	1.6
Yora	126	97.3	2.7	98.2	1.8	94.5	5.5	98.1	1.9
Average	126	93.3	6.7	95.9	4.1	93.0	7.0	98.3	1.7

Commonly cultivated crops around the villages and palatability to the elephants

Most of the respondents (96%) on average confirmed that among the widely cultivated crops Teff, maize, banana, yam and sorghum were palatable and were preferred by the elephants. While spices such as Ginger, cardamon, and fruits such as papaya, mango, avocado, were confirmed to be unpalatable for the elephants (Table 7).

Table 7. Commonly cultivated crops and palatability to the elephant

Village	Chebra		Seri		Yora		Average	
Total Number	126		126		126		126	
Response in %	Yes	No	Yes	No	Yes	No	Yes	No
Tefee	92	8	90	10	92	8	91.3	8.7
Banana	98	2	97	3	98	2	97.6	2. 3
Yam	97	3	98	2	98	2	97.6	2.3
Sorghum	96	4	97	3	94	6	95.6	4.3
Ginger	4	96	5	95	3	97	4	96
Cardamon	3	97	2	98	1	99	2	98
Papaya	4	96	4	96	5	95	4.3	95.7
Mango	3	97	2	98	3	97	2.7	97.3
Avocado	3	97	2	98	2	98	2.3	97.6
Maize	97	3	96	4	99	1	98	2

Measurement of crop damage and injury and death

The issue of human-elephant conflict and the damage caused by elephants is usually highly politicized locally, even if actual incidents are sporadic or limited impact. To avoid such related biases actual measurement on the extent of damage on each crop type and death and injury on human and livestock were recorded using different appropriate measurements technique for each crop type and human and domestic animal injury and death. During the present study period crop damages were reported mainly on three crop types; banana, maize and yam from the three villages and actual measurements of the damage and the estimation of monetary value at local market was calculated using different methods for each.

Banana

On the average (175) bananas from the three villages Chebra, (171) Seri and (174) Yora were counted respectively from individual banana trees (Fig. On the average 173.3 bananas were counted from individual banana tree. The price of one banana fruit was 1ETB on the average at the local markets (Table 8).

Table 8. Average Number of banana fruit/individual plant and unit price at local market

Name of village	Number	Banana/individual Plant	Unit price in ETB/banana
Chebra	12	175	1
Serri	12	171	1.25
Yora	12	174	0.75
Average	12	173.3	1

Distance from the park and annual total amount of bananas damaged by the elephants and the monetary value.

A total of (32107) individual banana trees from the 3 villages were damaged by elephants The total estimated cost of the damage was estimated in terms of money at 5554580 ETB, of which 2,917, 126 ETB (52.51%) was from Yora village, 1,538, 316 ETB (27.69%) from Seri and 1,099,138 ETB (19.78 %) were from Chebra village (Table 9).

Based on developmental stage of trees most of the banana plants 22163 trees (69.02%) consumed were matured and with ripened banana fruit, 263.2 trees (16.39%) were intermediate and 4681.1 (14.57 %) were seedlings (Table 9).

Distance from the Park and trend in crop raid were presented in (Table 9). The result found from the three villages indicted that there was an inverse relationship between distance from the park and the quantity of crop damage. Out of the total 30614.4 banana trees consumed 9382.4. (30.64%) where from the farmlands less than 1km distance from the park boundary, 9385 (30.65%) were from distances between 1-3 km while, 8230 trees (26.88%) were from farmlands b/n 5-7 km, 3675(12.0%) non were consumed from farmlands more than 7km distance from the park boundary. (Table 9).

Table 9. Annual total amount of banana consumed by elephants and estimated cost

Number of Plant consumed/season and stage												
Chebra Village												
Stage	Seedlings			Intermediate			Mature			Total		
	Dry	Wet	Total	Dry	Wet	Total	Dry	Wet	Total	Dry	Wet	Total
Distance												
0-1	181	137	318	247	434	681	1120	827.4	1947.4	1548	1398	946.4
1-3	125	97.1	222.1	170.5	132.7	400.2	841.3	653.4	1494.7	1136.8	883.2	2020
3-5	86	66	152	125	97	222	570	443	1013	781	606	1387
5-7												
Above 7												
Average	392	300	692.1	542.5	663.7	1303	2531	1924	4454.7	3465.8	2887	6363.4

Yora Village												
Stage	Seedlings			Intermediate			Mature			Total		
	Dry	Wet	Total	Dry	Wet	Total	Dry	Wet	Total	Dry	Wet	Total
Distance												
0-1	147	153	300	209	291	500	873	1088	1961	1229	1532	2761
1-3	267	121	388	462	170	632	1714	1351	3065	2407	1642	4049
3-5	212	1667	1879	347	273	620	1368	1075	2443	1927	3015	4942
5-7	194	192	386	349	315	664	1399	1226	2625	1942	173	3675
Above 7												
Average	820	2133	2953	1367	1049	2416	5354	6139	10470	7541	9321	16862

Maize

The average number of maize counted from the plots 2x2m sample areas was 11.3 individual maize plants. The average dry weight of maize found from the sample areas was 0.76kg. The average dry maize production was estimated at 3800 kg/ha. The average price of the product/kg at local market was estimated at 19 ETB (Table 10).

A total of 31.5ha maize farm from the 3 villages were damaged by elephants. The total cost of the damage was estimated at 2274300 ETB of which 16.4 ha (52.0%) of the total damage with estimated cost 1184080 ETB was in Yora village, 10 ha (31.7%) with estimated cost 722000ETB were from Seri while, 5.1ha (16.3%) with estimated cost 368220 ETB were from Chebra village. Based on developmental stage most of the plant consumed 28.1ha (77.8%) were during maturity, 5.8ha (16.2%), were at intermediate stage while, 3.8ha (10.5%) were seedlings.

Distance from the Park, maize consumed and monetary value (Table 10).
The result found indicted an inverse relationship between distance from the park boundary and the quantity of crop damage/ha. Out of the total 31.5 ha maize damage in the three villages, 13.2 ha (41.90 %) were from farmlands located within less than 1km distance from the park boundary, 11.1 ha (35.23%) were from farmlands located within 1-3 km distance from the park boundary while, 9.2 (29. 2%) was from farmlands located within 3-5 km while the least 2.2ha (6.98%) was within 5-7 km distance from the park boundary and none was reported from the farmlands located at distance more than 7km far from Park boundary (Table 10).

Table 10. Annual total amount of maize consumed by elephants in ha and the estimated cost

Stage	**Seedlings**				**Intermediate**				**Mature**				
Village Distance	Chebra	Seri	Yora	Total	Chebra	Seri	Yora	Total	Chebra	Seri	Yora	Total	Total/ha
0-1	0.20	0.4	1.2	1.8	0.51	1.5	2.1	4.1	1.47	2.8	3.1	7.37	13.27
1-3	0.17	0.6	1.5	2.27	0.42	0.9	1.3	2.6	1.23	2.1	2.9	6.23	11.1
3-5	0.11	0.5	1.1	1.71	0.27	0.5	1.1	1.87	0.82	1.1	2.1	4.02	9.2
5-7							1.1				1.1	1.1	2.2
Above 7													
Total	0.48	1.5	3.8	5.78	1.2	2.9	5.5	8.57	3.52	6	9.2	18.72	31.5

Yam plant
The average amount of product/2m2 plots was 800kg. The average product/ha was estimated at 40,000 kg. The average price/Kg at the local markets was estimated at 3 ETB (Table 11).

Table 11. Average estimated cost of Yam plant/kg at local market in CCNP.

Village	Number of plots	Average product in KG	Average product /ha in 100 kg	Village
Chebra	6	7.7	385	3 ETB
Serri	6	8.3	415	
Yora	6	8.0	400	
Average	6	8	400	3 ETB

A total of 36 ha of damage on yam farmlands from the 3 villages were recorded. The total cost was of the damage was estimated at the local markets. 36 ha x 40,000kg/ha x 3 ETB = 4,320,000 ETB of which 16ha (44.5%) with estimated value 1920000ETB was recorded from Yora village, 11ha (30.5%) with estimated value of 1320000 ETB was from Seri while, 9 ha (25%) with estimated cost of 1080000 ETB were from Chebra village. Based on the developmental stage of the yam plant most of the plant 27ha (74%) of the damage were on the matured stage, 5.8ha (16.0%) of the damage were in intermediate stage while 3.8ha (10.0%) were seedlings (Table 12).

Distance from the Park and trend of the raids were presented in (Table 12). The result found from the villages indicted that an inverse relationship between distance from the park and the quantity of crop damage/ha. Out of the total 36 ha damage of yam farmland in the villages 14.65 ha (40.69%) were from the farmlands located within less than 1km distance from the park boundary, 12.75 (35.41%) were from farmlands located within 1-3km distances while, 8.55 ha (23.75 %) were from farmlands located between 5-7 km distance from the park boundary. while any damage was not reported from the farmlands located at more than 7km distance from Park boundary (Table 12).

Table 12. Annual total amount of yam plant in ha damaged and estimated monetary value

Total size of the farm consumed/ha													
Stage	Seedlings				Intermediate				Mature				Total loss/ha
Village	Chebra	Seri	Yora	Total	Chebra	Seri	Yora	Total	Chebra	Seri	Yora	Total	TOTAL
Distance													
0-1	0.40	0.45		0.85	0.6	0.70		1.3	2.7	3.7		6.4	8.55
1-3	0.35	0.30	0.6	1.25	0.6	0.5	1.25	2.35	2.2	3.1	4.5	9.8	13.4
3-5	0.25	0.25	0.5	1.0	0.4	0.5	1.0	1.9	1.5	1.5	4.1	7.5	10.4
5-7			0.34	0.34			0.25	0.25			3.4	3.4	3.99
Above 7													
Total	1	1	1	1.44	3.44	1.6	1.7	2.5	5.8	6.4	8.3	12	36.34

Hour and group structures of crop raiding elephants

A total of 61 crop-raiding incidents were recorded during the present study. All incidents of crop raid except five occurred during the night. The raids were most frequent (91.9%) during the night (4.9%) of the raid occurred in the evening, while the least frequent (1.6%) occurred during the morning. There were two daytime observations of a mixed group of elephants entering banana farmlands during January 2020 and three bull groups in the evening (Table 13). There was a strong relationship between crop raiding and the time of day ($df = (2,61)$, $F = 69.4$, $P = 0.00$).

Group compositions of elephant herds involved in crop raiding.

Group structures of crop raiding elephants were recorded from a total of 61 sightings and age estimation made from measurements of indirect signs found on the farmland such as measuring the size of footprints and circumference of dungs of the raiding elephants during the study period. Most of the groups (96. 8%) of the raid were made by bulls and the remaining (3.2 %) were made by mixed groups. Cow-young groups were reported entering into fields on only (3.2%) of occasions (Table 13).

Crop raiding elephants ranged from two to 39 individuals. Two bulls constituted 18% of the record and 3 bulls were (27 %). The maximum number of bulls was 7. The numbers in the cow-young groups involved in crop attack were in the range of 18 -39 and accounted only for (3.2%) of the total. Mixed groups contained the largest number of 18 -39 elephants (Table 13).

Table 13. Group compositions of elephant herd involved in crop raiding

Hours of the Day	Total Observation	Group structure	Average Number	Percent
Morning	1	Mixed heard	39	1.6
Afternoon	1	Mixed heard	18	1.6
Evening	3	Bull Group	4.5	4.9
Night	56	Bull Group	5	91.9
Total	61		5.7	100

Elephant attacks on people and livestock

A total of 20 elephant attacks on human and domestic animal were recorded, with 7 human deaths. During the study period the majority of elephant attack (65%) was against humans followed by cattle (35%). Out of the total 7 deaths 5 were on their farmlands and trying to protect their crops from the elephants during the mid-night and during the month of February 2020/2021. All the six human injuries were also recorded during the same month, year and villages. While two deaths were recorded from places located inside the park boundary during August 2020 and September 2021. They were killed inside the park boundary collecting wild honey and spices from the park. Cattles were the only domestic animals attacked by the elephants during the present study period (Table 14). All 100% of the attacks were occurred outside the park boundary in the 3 villages. During the present study 4 cows and 3 bulls were killed by elephants during year 2021/2022.

Table 14. Humans and domestic animals killed and injured by the elephants and estimated cost

Village	**Distance**	**Month/Year**	**Domestic Animals Killed**	**Human Injury**	**Human Killed**	**Average Estimate Cost**	**Total Loss**	**Elephant Killed by poachers**
Chebra	1.1km	February 2021	2 Cows	2	2	7000	14000	
Yora	6km	February 2021	2 cows and 1 bull	2	2	7500	22500	
	7km	September 2021			1			
Seri	1km	February 2021	2 bulls	2	2	8000	16000	
Inside the Park		August 2021						1
Total			7	6	7	15300	52500	1

Annual economic loss due to human-elephant conflicts

The total economic loss of years 2021 and 2022 due to human elephant conflict was estimated at 11,750,034 ETB or US$255,435 of which 11697534ETB or US$ 254294(99.5%) was from crop loss while only 52500ETB or US$1141 (0.5%) was due to loss of domestic animals (Table 15). The total number of households affected in the three Kebles during the study period = ETB 11,750,034/411 households = 28588 ETB or 621.5 USD.

Table 15. Summary of total loss due to the conflict

Total Value	Total estimated loss in ETB	Total estimated loss in USD ETB/46
Banana	5103234	79738
Yam	4320000	93913
Maize	2274300	49441
Cattle	52500	1141
Total	11750034	255,435

Mitigation techniques implemented by the local communities

Local communities used different techniques to control (minimize) the problems caused by elephants on cropland at night. Most respondents (38%) reported that elephants responded faster during gun fired by the park scouts, followed by chilly fencing (19.7%), sound noise including the sound of barking dog and hammering materials made of metal (13.3%), guarding (11.3%), fire smoking (9%) and smoking chilly and elephant dung (8.7%) (Table 25). Views of respondents among villages did not significantly differ ($\chi 2 = 48.82$, df = 6, $P>0.05$) in using the different techniques for protection of crop and livestock. No one used only one method alone but combined and integrated all the local methods to prevent crop raiding by elephants (Table 16).

Table 16. Different techniques to minimize problems caused by elephants on cropland at night

		Deterrent Techniques					
Village	Respondents	Guarding	Fire Smoking	Smoking Chilly& Elephant dung	Sound Noise	Chilly Fencing	Warning Gun fire
Cherbra	126	12	10	10	13	15	40
Seri	126	10	8	9	12	23	38
Yora	126	12	9	7	15	21	36
Percent	100	11.3	9	8.7	13.3	19.7	38

Among the respondents most of them (41.8%) suggested that barrier such as electric fence; ditch or concrete wall should be constructed in the area's corridors between the park boundary and the villages exist and used by the elephants to move into the villages. (25.6%) of the respondents wanted to be relocated to other areas that are far enough from the elephant habitats, (20.9%) of the respondents suggested compensation from the government for the crops damaged, (8.5%) suggested killing problem animals that are responsible for the conflict while, few of them (3.2%) suggested use of traditional methods of prevention. (Table 17). Respondents differed significantly ($\chi 2= 74.29$, df=4, $P<0.05$).

Table 17. Recommended effective methods of human-elephant conflict mitigation measures

Activity	Frequency	Percentage
Using traditional method	12	3.2
Shoot them	32	8.5
Compensation	79	20.9
Barrier	158	41.8
Resettlement	97	25.6
Total	378	100

Focus group discussion with the local community

The discussions held with communities showed that they had negative attitude towards the existence of elephants and the Park. The discussants stated that the continued existence of elephants had a negative impact on their livelihoods. Few discussants recognized the value of the park and wildlife for the contribution to the regional economy through tourism and climate stability in the future. Some of the respondents noted that previously they used to hunt and kill elephants and minimize their threat. However, after the establishment of the National Park the

area was protected, and the population of elephants and their negative effects were increasing from time to time. As a result, some discussants were dissatisfied with the existence of the National Park. They considered the Park as a limiting factor in improving their livelihood.

Discussants also stated that the Park has restricted access to resources and forced relocations. Few discussants considered the Park as useless. They also felt that Park staff members do not like the communities around the park boundaries and never followed win-win approach. Their main focus was only conserving the wild animals using armed scouts and strong law enforcements. They never considered compensation or any support for families who had lost their family due to human-elephant conflict. They arrest and bring to courts for disrespecting rules and regulations of the park such as killing any wild animal or extraction of resources from the park. They also believed the situation is beyond their control. Support and government interventions are needed as a way to find a solution for the co-existence of wildlife and communities.

4. Discussion

In the study area human-elephant conflict was identified as the top conservation challenge both for the elephant population and local communities living around the park posing huge problem on the long-term co-existence of elephants with the local community. AfESG (1997) and WWF (1997) also noted that human-elephant conflict as one of the five big issues with equal priority that needs attention regarding the African elephant conservation.

During the present study injury and death of human and livestock and crop raid by elephants had been identified as the main causes of human-elephant conflict and the top conservation challenge increasing rapidly in adjacent boarder areas of the park. AfESG (1997) also mentioned that even though at present only 20% of the species range in Africa has some of protection conflict occurs at almost any interface.

During the present study, the incidence of human-elephant conflict was not found to be uniform throughout the entire park adjacent villages. Out of the total 20 Park adjacent villages almost all of the respondents from 17 villages confirmed that elephants were not commonly seen around their villages. This may be due to the villages were located far from the elephants' habitats, corridors and home ranges of the elephants. This finding also goes in line with the findings of Aemero Mekonne (2019) and Demeke Datiko (2013) who noted that human-hippopotamus and human-wildlife conflicts were not recorded around some adjacent villages of Chebra Churchura National Park due to large distance from the park boarder and the existence of topographic features that determine the movement of hippo and other wild animal in the area. While almost all of the people living in other three villages Chebra, Seri and Yora confirmed to have elephants commonly around their villages and had severe human-elephant conflict. In these three villages where both the presence of elephants and severer conflicts confirmed were found to be very close to the elephant habitats and coinciding with the previous home range of the elephants.

Elephants were frequently observed trying to cross the same places and areas in these villages that were proposed to be their previous corridor between the park and Kaffa Biosphere Reserve, which was their wet season home range, located at the western and southwestern parts of the National Park and currently encroached by those villagers.

During focus group discussion participants from these three villages strongly confirmed that the areas that were already inhabited by the villagers were the common habitats and corridors of the elephants before the human settlements. This may be due to the problem created during the demarcation process of the park boundary in 2005. Proper attention was not given to include the elephant natural habitats, corridors and home ranges into the park boundary and the demarcation process was carried out without adequate knowledge or information about the natural home range and corridors of the elephants. According to most informants participated both during the demarcation process and the focal group discussion the main focus of the demarcation process was making suitable farmlands available for local communities and finding natural features such as mountains and rivers to make clear and permanent boundaries of the park (CCNP office, 2019).

The result of this study clearly indicated that the main reason for the frequent conflict between elephants and local communities in these three villages may be due to elephants still trying to utilize resources and trying to cross their previous natural habitats, home range and corridors that was already encroached by the farmers and settlers without knowing and respecting man-made boundaries of the park. The farmers were also settled in these habitats without knowing the cost and consequences of settling in the elephant habitat and blocking their corridor. This agrees with the findings of Hoare and Du Toit (1999) in Zambia who also mentioned that since elephants are also ecosystem engineers that greatly influence their surrounding and landscapes their livelihood activities limit the elephant home range and population density through direct and indirect competition for water, food and spaces.

Elephant populations co-exist to varying degrees with human communities until a threshold is reached (Shaffer, 2010). Farmers and pastoralists alter biophysical dynamics and habitat patterns through subsistence agricultural production and management of key natural resources (Shaffer, 2010). Cutting trees and burning to clear land for agricultural expansion and improve livestock forage may draw elephants to patches of new vegetative growth (Shaffer, 2010; Babigumira, *et al.,* 2014). The study also showed that the majority of the people living around the park had a positive attitude towards the conservation area and the elephants. However, some of them (45%) showed negative attitude. The reason for the more positive attitude towards both the protected rea and the elephant's conflict was due to most local communities think that the presence a National Park and the elephants in their locality is a symbol and unique emblem to their area to attract both national and international tourists, scientists and higher officials to their area.

This study also showed that crop loss, injury and death of humans and domestic animals were the main causes of human-elephant conflicts. The present study showed that for most of the people living in the conflict areas Chebra, Seri and Yora villages crop damage was the most pressing problem followed by loss of livestock and injury and death of humans. This study also showed that all crop types commonly grown around the villages do not equally attract and palatable for elephants. The study showed that among the widely cultivated crops teff, maize, banana, yam, and sorghum were palatable and preferred by the elephants. While crop species spices such as ginger and cardamon, fruits such as papaya, mango, and avocado were found to be unpalatable for the elephants. The findings of Barnes (1996) also noted that among the crops planted outside the Kakum National Park (Ghana) maize and cassava attracted particularly elephants.

Both food preference and distance from the park were found to be the principal factors that determined the level of human-elephant conflict in these three villages. Distance from the Park and quantity of crop damaged showed an inverse relationship in two of the three villages Chebra and Seri. As distance from the park boundary increase the amount of crop damage, injury and death of human and livestock. In many parts of Africa, the conflict between local people and wildlife is the most serious problem if they are adjacent to nature reserves (Newmark *et al.,* 1994). This study also shows close proximity between farms and the Park resulting in high level of conflicts. Those who live close to the habitat of the pest animals encounter high problems. As a result, those who live near the park faced frequent crop damage. This indicated that conflicts are particularly common in reserve buffer zones where healthy wildlife populations stray from the protected areas into adjacent cultivated fields or grazing areas. This is an increasing

phenomenon because the expansion of the cultivated area is very high at the periphery of protected areas (Woodroffe *et al.,* 2005).

Cultivated farmlands and severe human-elephant conflicts were recorded in the areas that were located more than 5km distance from the park boundary. This finding clearly indicated that food preference and availability of palatable crop in the farmland were the main driving reason for human-elephant conflict rather than the mere distances measurements from the park boundary. This information agrees with the findings of Barnes (1996) who mentioned that some food items/crops might be found particularly palatable and attract wildlife. According to Barnes (1996) among the crops planted outside the Kakum National Park (Ghana) maize and cassava attracted particularly elephants. The present study also confirmed similar situations in the study area in which maize; banana and Yam were found to be highly preferred to the elephants. Some food items/crops were also found to be particularly palatable and attract wildlife. In the most common form of human-elephant conflict crop raiding elephants forage in agricultural fields to meet dietary requirements (Graham *et al.,* 2010; Sitienei *et al.,* 2014; Goswami *et al.,* 2015).

The result of this study also showed that the amount of crop damage showed variation between the different developmental stages of crops. Most of the crop damages caused by elephants were on the matured stage while seedlings were found to be the least consumed. This may be due to preference of elephants for food that are palatable and had good nutritive value. Similar findings were also mentioned by different researchers that crop raiding peaks were usually near harvest times resulting in high crop losses that threaten the survival of farming households (Graham *et al.,* 2010).

The issue of human-elephant conflict and the damage caused by elephants are usually highly politicized locally even if actual incidents are sporadic or show limited impact. To avoid such related biases actual measurement on the extent of damage for each crop type and death and injury on human and livestock using different appropriate measurements techniques should be practiced (Hore, 2001).

Out of the total 3 crop types being raided by elephants only banana was available during both dry and wet season. Thus, all damages recorded on maize and yam plant was only during the wet season. However, most of the injury and death of domestic animals and humans were recorded during the dry season. This may be due to foraging habitats and scarcity of diverse food sources until the beginning of a new growing grass. Studies in other localities also showed similar result where human-elephant conflict and crop raiding occur in agricultural fields to meet dietary requirements (Graham *et al.,* 2010; Goswami *et al.,* 2015). The findings of this study also agree with Adane Tsegaye *et al.* (20 15) who mentioned that during the dry season forest fires were common in CCNP until the onset of new growth of moist green grass.

The result of the study showed that human-elephant conflict resulted huge economic loss on the people living in those three villages where the existence of human-elephant is conflict confirmed. The present study also showed that almost all of the crop-raiding incidents on the farmlands of the local communities were during the night and most of the raid was made by the bulls' groups. Damage caused by the mixed groups was found to be the least and insignificant compared to damage caused by the bull groups. The maximum number of bulls found raiding crops was 7

while 2 was the least bull groups found raiding crop. This is similar to the finding of Yirmed Demeke (2009) who mentioned that out of the 52 crop-raiding incidents recorded in Babile Elephant Sanctuary, Ethiopia all incidents, except one, occurred during the nighttime and 58% of the raid was made by young bulls.

5. Conclusion

Even though CCNNP is a very well protected area and known for harboring diversified fauna and flora species, human-elephant conflict is an increasing concern that needs urgent solution in the area. As in many parts of the country, and all protected and unprotected areas all over Africa that harbor elephants the top priority problem for conservation is associated with human-elephant conflict. At present, the major causes of the conflict are crop damage, injury and death of human and livestock. Moreover, frequent fire, limited professionals and scouts, poor facility in the park and negative attitude of the local people towards the wildlife are major challenges that needs to be properly addressed. The respondents oppose the Park and elephant conservation in the area, which will have negative impact. There is a need to develop and implement effective human-elephant conflict mitigation measures in the identified high conflict areas to minimize the level of conflict and schemes where local people perceive tangible economic benefits to tolerate the conflict on the surroundings. It is important to monitor conflict situations over time. There is a need for carrying out intensive awareness programs. The data collected will provide valuable information on the ecology of elephants as well as the human-elephant conflict in and around CCNP.

6. Recommendations

- The CCNP has a great potential for the country's wildlife and tourism development. Therefore, it is necessary to take appropriate conservation measures (community-based conservation activities) to minimize the existing problems.

- Assessments and feasibility study should be conducted, and actions should be taken to open the elephant corridor between CCNP and Keffa Biosphere Reserve.

- Investigation and implementation of effective human-elephant conflict mitigation measures should be the top urgent conservation priority of the park to ensure long term co-existence between the park and local communities living around the park.

- There should be a strong controlling mechanism on wildfire set by illegals people and fire management plan should be developed and fire should be used as only an intentional ecological monitoring tool.

- Unmanageable spread of fire has adverse effects, especially on small mammals and others. Therefore, awareness creation should be practiced.

- Investigation must be carried out to identify alternative crops that do not attract wildlife.

- Awareness creation is important for the locals at different levels (on conservation, ecosystem functioning, the ethical, economic and recreational values of wildlife).

- Continuous monitoring and evaluation process of human–wildlife conflict are needed for future conservation measures.

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Appendix I. Household questionnaire for local people in and around Chebra Churchura National Park.

1. Name of respondent						
Sex						
Age category	<20	20-29	30-39	40-49	50-59	>59
Occupation						
2. Residence						
Village/Kebele						
Distance from the Park						
Dominant and common plants that occur in the area						
GPS location						
3. Education Level	illiterate	elementary	high school	others		
4. Household economy	pastoralist	farmer	both			
5. What type of crop do you grow?						
6. Do you own livestock?	yes	no				
	cattle	donkeys	sheep	goats	other, specify	
7. Are you dependent on the park resources for livelihood activities?	Yes	No				
If yes, how?						
8. Where do you collect firewood and use other resources (wood, grass non timber forest products)?	From the Park	Outside the Park				
9. What kind of wild animals are usually seen in this area list them						
10. When did you see elephants in this area for the last time	year	month				
11. Are they here throughout the year?	yes	no				
12. If the answer is no for question no 11, in which						

months/ season are elephants commonly seen in this area.		
13. Do you have conflict/ any problem caused by elephants	yes	no
14. If the answer is yes what kind of problem do you have?	crop raiding Types of crop	loss of livestock
	types of livestock/name	number
	human injury number of	individuals injured
	loss of human life number of individuals	other (specify)
15. Does the Park have any means of compensation for the damages caused by elephants and other animals?	wild animals?	
16. Is there any illegal killing of elephants (poaching)?		
17. If the answer for question no 16 is yes. What is the main reason of poachers/?	for ivory (Commercial)	in revenge/retaliatory killing for loss of human life, crop, and livestock
	other specify	

Appendix 2. Focus group discussion with local people inside and around Chebera Churchura, as well as with Park Staffs.

1. What advantage/disadvantage do you realize associated to the presence of elephants in the study area?

2. Do you think that illegal activities such as poaching are affecting the wildlife?

3. In what way and what benefits have been realized until now from the park?

4. Do you think that local people and livestock affect wildlife?

5. How do local people and wildlife/specially elephant in the National Park coexist in peace and harmoniously?

6. Were these areas currently inhabited by the elephants were the only known habitats of the elephant's long time before?

7. To avoid illegal activities such as elephant poaching what should be done?

    a. By the local people?

    b. By conservationist?

    c. By government?

8. In order to bring sustainable development for both to National Park and the local community, what do you suggest?