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Assessing Human-Wildlife Conflict in the Periphery of Loango National Park in Gabon

Mbani Cynthia Axelle Eugénie N'Safou, Abubakar Ali Shidiki*, Ngankam Martin Tchamba

Department of Forestry, The University of Dschang, Dschang, Cameroon
Email: *shidikia@gmail.com, axellensa@yahoo.fr, mtchamba@yahoo.fr

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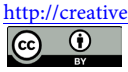

Abstract

Human-Wildlife Conflict in Gabon is a reality occurring in almost all protected areas in the country. These conflicts create real threats both for the survival of wildlife species and of human beings. This study was carried out at the periphery of Loango National Park in Gabon. This area is particular of seeing elephants wandering around villages. Respondents for the study were drawn from a wide range of stakeholders (State administrators, farmers and NGOs). Data was collected through administration of structured questionnaires and interview guide on the; socio-economic activities. Crops produced/destroyed. Animals are involved and economic loss is incurred due to conflicts. Data was analysed using SPSS version 16 and Kobo tool box. For qualitative data chi-square, descriptive statistic and linear regression model were also used. The results of the study showed that the elephants account for (60.1%) of crop destroyed followed by Ungulates (30.4%) and lastly by rodents (0.9%). The economic damage caused by the wildlife to crops valued at 72,084 USD in the zone in 2022. An urgent solution to this conflict is needed because the consequences are visible as well as the illegal repression by communities that have led to poisoning and killing of wildlife in the study area.

Keywords

Human-Wildlife Conflict, Protected Areas, Crop Damage, Crop Losses, Loango National Park

1. Introduction

Human Wildlife Conflict (HWC) is a problem that has been identified wherever there is coexistence between humans and wildlife. 37 countries in Africa have experienced HWC as a result of competition for spaces and resources (Tchamba & Hatungimana, 2006; Parker et al., 2007). Demographic pressure, agricultural

activities and infrastructural development have helped fuel human-wildlife conflicts (Poulsen et al., 2018). Indeed, the transformation of forests lands to savannah through agricultural leaves few resources for wildlife (Maisels et al., 2013) hence farms closer to protected areas become wildlife targets (Boukoulou et al., 2012; Ngama, 2018). The consequences of these conflicts are negative to populations who rely on agriculture as their only livelihood source. Recent studies have proven that these conflicts have reduced household incomes by 35.1% in the Baringo District in Kenya in 2014, likewise the studies of Amwata and Maganga (2014) in the Democratic Republic of Congo (DRC) revealed that Elephants destroyed cassava which represented 65% of the most traded products with annual economic losses estimated per farmer at 77% per year (Inogwabini et al., 2014). Elephants therefore jeopardize the efforts of local communities to achieve food security and compromise local livelihoods (Amwata & Maganga, 2014).

Gabon is not an exception; human-wildlife conflicts are known to be widespread throughout the country (Space for Giant, 2023). The elephant population for example increased from 61.000 to 95.000 between 1992 and 2019 representing more than 60% of the forest elephants in Central Africa with a density in rural areas of 0.24 to 2.9 elephants/km^2 (Blanc et al., 2007; Space for Giant, 2023). The population density in the study area is 0.6 persons per km^2 (EDF, 2006). It's observed that elephant overpopulation compared to rural human populations leads them to encroach into farms and this has increased conflicts. Depending on communities and the extent of the damages reprisals by populations has led to the killing of these animals irrespective of these animals are been threatened to extinction (Breuer & Ngama, 2020).

The damage caused by wildlife in Gabon is not sufficiently documented compared to other parts of the continent. Studies have recorded damage in the North West of Gabon in the area of the Crystal Mountains National Park reaching up to 75% of the total areas cultivated (Ngama, 2018; Walker, 2010) in the Loango National Park in southern Gabon. It was also found that annual damage to crops could be estimated on average at 45% of total crops planted in the area. It remains important to seek to better understand all the aspects linked to human-wildlife conflicts to guarantee better cohabitation and the protection of wildlife species in the country.

2. Material and Method

2.1. Description of the Study Area

Loango National Park is located in the South-western coastal basin of Gabon in the province of Ogooué-Maritime (**Figure 1**). It is located at latitudes 9˚17' and 9˚47' East and between longitudes 1˚52' and 2˚29' South. This park has a surface area of 155.224 ha. The park is part of the Gamba complex of protected areas (Le-Duc Yeno et al., 2006; Eyenbiang Ndong, 2011). The climate is tropical with an annual rainfall of 1.985 mm and the average annual temperature is 26˚C. The town of Gamba which has a population of 15.000 persons is close to the National Park (Nzamba, 2013; ANPN, 2016; Vanthomme & Nzamba, 2018).

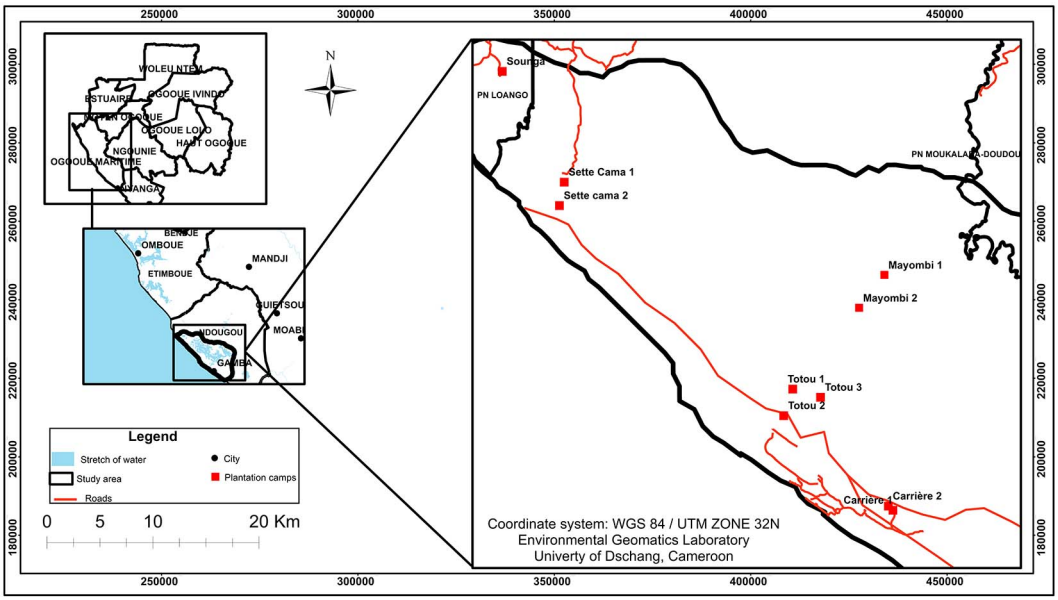

Figure 1. Map of the study area.

2.2. Sampling

The target population are farmers. The sampling technique used was non-probability convenience sampling by quota. The survey unites being the households and farms. This was done to ensure the objective of the study was made. The populations and their opinion on HWC was also recorded; but also due to the small number of farmer willing and available to participate in the study, resources and time available a total of 34 respondents were interviewed out of the 65 identified households during the reconnaissance survey with the Ministry of Forestry which accounted for 52% of farm owners in the study area. Amongst the villages surveyed were Carrière 1, Carrière 2, Mayombi 1, Mayombi 2, Sette Cama 1, Sette Cama 2, Sounga, Totou 1, Totou 2 and Totou 3.

2.3. Data Collection

Data was collected through interviews with farmers combined with direct field observations as described by Atta et al. (2016) and Boukoulou et al. (2012). The interviews were done using structured questionnaires which were design to achieve the study objectives. This questionnaire was test run before the actual data collection process. Interviews with farmers focused on social and economic aspects as well as their opinion on issues related to HWC Direct field observations focused on the occurrence of HWC in the area. Field assessments were carried out to ascertain the levels of crop destruction in the study area. The identified farms were visited at least twice between the periods of January and December 2022 to monitor and assess the damage. Using the economic models proposed by M'Kwa and Temple (2019), Vernier et al. (2018), and for crop damage; the assessments were done as follows: 1 ha of plantain farm produces 1000 bunches. 1 bunch is sold at 5.80 USD; 1ha of Cassava farm produces 8

tonnes of cassava tubers. 1 tonne of tuber is sold at 249.36 USD and 1 ha of sugarcane farm produces 30 tonnes; 1 tonne of sugar cane gives 700 litres of cane juice and 1 litre of sugar cane juice is sold at 1.64 USD.

2.4. Data Analysis

Data analysis was carried out using two approaches. For quantitative data, SPSS version 16 and Kobo tool box were used. For qualitative data content analysis techniques were used to as describe by Howell (2006). Chi-square, descriptive statistic and linear regression model were also used.

3. Results and Discussions

3.1. Activities and Characteristics of the Population Confronted with HWC in the Area

➢ **Social characteristics of the population**

The results in Table 1 revealed that more women 65% are involve in agricultural activities in the study area than their male folks who only accounts for 35% of the respondents interviewed. The women respondents with ages ranging between 30 and 60 years accounts for 35% of the work forces and they have an experience in farming which is between 10 to 30 years.

Chi-square proportion test showed that there is a significant difference between the sex of the respondents (p-value = 0.03959). As for the ages of respondents, the results showed no significant difference at (p-value = 0.06012). The results in Table 1 also showed that youths below the ages of 30 are not involve in agricultural activities in the study area. Their absence means they have alternative income generating activities in the nearby cite of Gamba and beyond. Majority of youths are getting more education and skills which gives opportunities to work in other income generating activities other than agriculture. This indicates their absences in the list of respondents.

Table 1. Cross-tabulation of respondents based on age, sex and year of experience.

Age by gender		Year of farming experience			Total
		Less than 10	10 to 30	Over 30	
Female	30 to 60	4	12	2	18
	over 60	0	0	4	4
Male	30 to 60	3	4	1	8
	over 60	0	0	4	4
Total		**7**	**16**	**11**	**34**

➢ **Type and cost of farming**

Majority of farmers 79.4% in the study area practiced individually farming while 21.6% cultivate in association (CIG) (see Figure 2). This trend is also observed with crops for commercial purposes that accounts for 50% of production

while subsistence agriculture for food is 50% of the production system. Chi-square proportion test showed that there is a significant difference between individual and association farm types with a p-value = 0.0006036 and between subsistence farming and commercial agricultural with p-value = 0.03959. The Chi-square double proportion test of the type of plantation (association and individual) in relation to the purpose of the products (commercial/subsistence) showed no significant difference (p-value = 0.2515) between these groups.

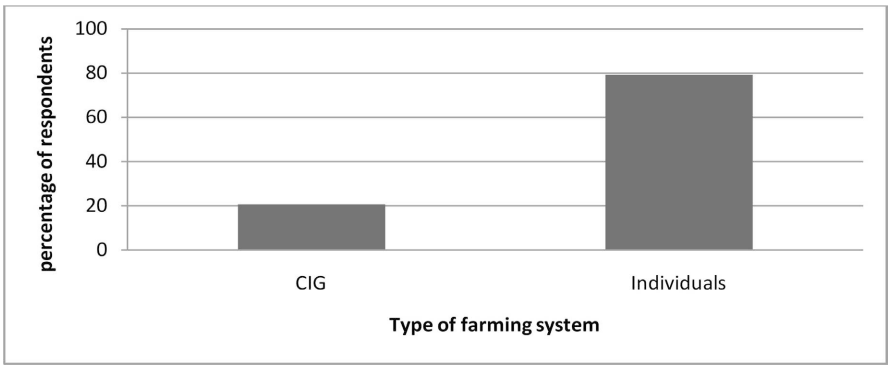

Figure 2. Type of agricultural practices.

The respondents' investment costs (Table 2) vary from 830.53 USD to 160.70 USD per ha. The average individual investments is 517.5 USD compared to 140.5 USD for associations. However, it is also observed that there is a similar range of investment costs between individual producers and associations. The Kruskal-Wallis test showed a p-value = 0.0994 which indicates no significant difference between investments in agricultural systems.

Table 2. Investment cost of producers.

Type of plantation	Investment (Fr CFA)	Exclusive sale	Sales and subsistence	Total
Association cultivation Average cost: 1714.285 CFA francs	200 000		1	1
	800 000	1	2	3
	1E+06		2	2
	1E+07		1	1
Individual cultivation Average cost: 311.000 CFA francs	50,000		2	2
	100,000		1	1
	150,000	2		2
	200,000	2	1	3
	300,000		1	1
	400,000	2	2	4
	500,000	3	2	5
	700,000		1	1

Continued

	1E+06	1	2	3
	2E+06		1	1
	3E+06		4	4
Total		11	23	34

These results are similar to those of Ferlay (2014) and Nguiguiri et al. (2017) which showed that subsistence agricultural is more practiced in the study area than the associations farming even though their investment cost are similar. This can be explained by the fact that subsistence farming is done to provide household needs rather than for commercial purposes.

The choice of sites by respondents (**Table 3**) showed that soil quality accounts for 68% followed by site accessibility 32%. This may be reason for farming near forest fertile soils which is mostly at the peripheries of protected areas and home to wildlife.

Table 3. Choice of site based on land acquisition.

Choice of site	Land acquisition				Grand total
	By knowledge	Knowledge and yourself	Myself	Ancestral land	
Soil quality	12	1	9	1	23
Site accessibility	3	0	7	1	11
Total	**15**	**1**	**16**	**2**	**34**

Agricultural production sites are chosen based on soil fertility which is also influence by the type of vegetation in the surrounding areas. This may explain the presence of plantation camps in areas far from the city. However this can lead to difficulties in monitoring and protecting the plantations from elephant and other animals from incursions. Farm associations (CIG) are therefore used for mutual assistance in protecting farms from wild animals as all members participate in guarding, surveillance of their respective farms. Unlike with Subsistence farmers who do not have the manpower to regularly guard their farms from wild animals. This unsustainable agricultural practise is seen as a principal cause of deforestation and land degradation (Breuer & Ngama, 2021).

Respondents in the study area practise mixed cropping system. The crops grown in the study area are mainly cassava (*Manihot esculenta*) and Banana (*Musa* spp.) at more than 75%. Other crops such as Macabo (*Xanthosoma sagittifolium*), Yam (*Dioscorea* spp.), Sweet potato (*Ipomoea batatas*), Sugar cane (*Saccharum officinarum*), Pineapple (*Ananas comosus*), Peanut (*Arachis hypogaea*) and Oil palm (*Elaeis guineensis*). Vegetables including: chili Pepper (*Capsicum chinense*), Eggplant (*Solanum aethiopicum*; *Solanum macrocarpon*). amaranth (*Amaranthus* spp.) and sorrel (*Hibiscus sabdariffa*) are also grown for

household consumption.

3.2. Evaluation of Human Wildlife Conflict

➢ **Animals cited by respondents in farms**

The results (**Figure 3**) of the study revealed that elephants (*Loxodonta africana Cyclotis*) are the most cited in farms by respondents (60.1%). followed by ungulates Antilopes (*Cercocebus torquatus*) and Buffalos (*Syncerus caffer*) with 30.4%. in third positions are Monkeys Moustac (*Cercopithecus cephus*) with 7.1% next to the list are apes chimpanzee (*Pan troglodytes*) and Gorilla (*Gorilla gorilla*) and lastly by Rodents with 1.5%. The damage done to crops by these animals is described as significant even though these are not the only animals involved in crop destructions.

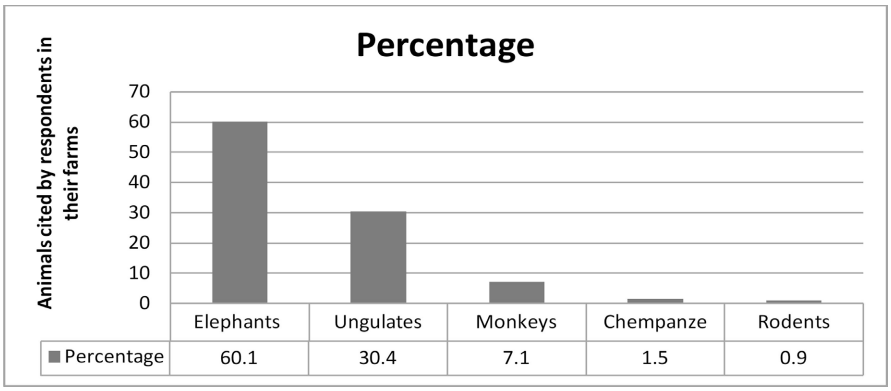

Figure 3. Animals cited destroying crops in the study area.

➢ **Assessment of damage on the ground**

3.3. Intrusion of Animals into Farms

Monitoring the intrusion of animals into farms by wildlife during the period 2022, 408 visits were affected with 168 intrusions observed while in 245 visits no observations were seen. The simple Chi-square proportion test presents a significant difference (p-value = 0.00004916) between the observed and absence of animals in farms. Within the 163 intrusions observed, the elephant (*Loxodonta african cycotis*) is the most incriminated animal with 60.1% followed by ungulates 30.4% and lastly by rodents 0.9% respectively (see **Figure 3** above). The Kruskal-Wallis test (p-value < 2.2e−16) shows a significant difference with elephant been the animals that destroyed most farms.

The studies of Lee & Graham (2006); ANPN, 2016 have identified other animals that we did not encountered during our study by Lee & Graham (2006); ANPN, 2016 and Kermabon (2022). In addition the study by Fairet (2012) in the Loango zone identifies rodents as 90% involved in crop destruction followed by antelopes 75% while Elephants 35% and lastly by Buffaloes 25% respectively. Similarly, the work of Walker (2008) in Loango identified the Hedgehog as the animal most involved in HWC (50%) followed by the Elephant (38%) and the Porcupine (13%)

by the works of Walker (2008) and Walker (2010).

The results of our study identified elephants as the most destructive animal in the study area. This can be justified by large herds of elephant in Loango national park and also with their large sizes their food intake is much. In 2008 during wildlife survey in Loango national park over 2000 Elephants were identified (Idiata-Maounga, 2008); comparing to over 10000 Elephants that were identified in 2022 in the same park (Space for Giant, 2023). The increasing development of agricultural activities in the area (Graham & Ochieng, 2010) has also contributed to the exacerbation of the conflict. Indeed. Population of Gamba increased from 5000 inhabitants in 90s to about 15000 persons in 2010 (Graham & Ochieng, 2010). More land is needed to produce enough to feed the increasing number of months. The rate of intrusion differs according to the different cultivation zones (**Figure 4**), while wildlife intrusion was very low in the Sounga. Carrière 1. 2 and Mayombi 1 and 2 zones (less than 20%). Animal intrusion was higher in the Sette cama 1 (41%), Sette cama 2 (50%), Totou 1 (67%), Totou 2 (52%) and Totou 3 (100%) zones. The linear model test showing animal intrusion according to zone shows that there is a significant difference (p-value: < 2.2e−16). These areas with the highest intrusions were very close to the peripheries of the park.

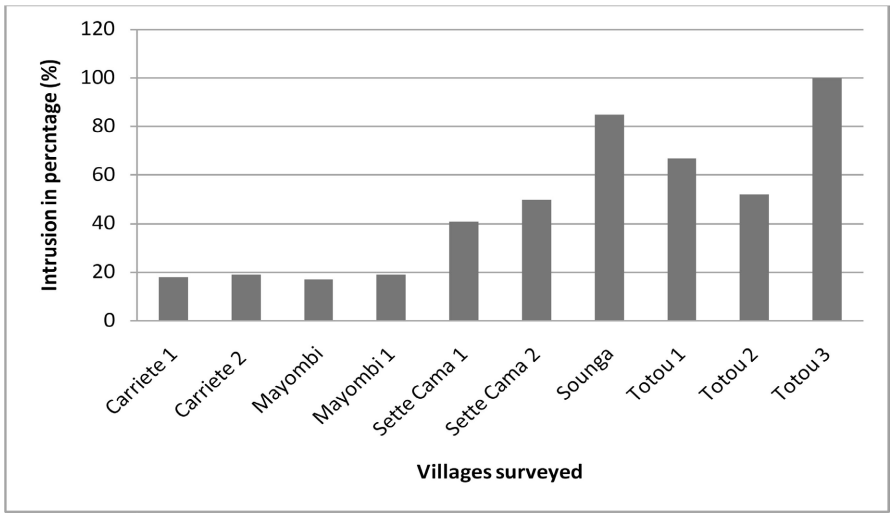

Figure 4. Showing Wildlife intrusion per zone.

Elephants and monkeys involved in all zones while antelopes and chimpanzees are present in Totou 1 and Sette cama 1 respectively. However the elephant remains the animal that inflicts the most intrusions in the zones even if these intrusions vary according to the zone. Elephants inflict the most intrusions in the Totou 3 zone (100%), Totou 2 (52%), Totou 1 (67%) and Sette Cama 2 (50%). In Carrière zones 1 and 2 or Mayombi 1 and 2 antelopes and monkeys have created majority of the damages.

The area with most crop destruction is Totou 1 (7.7 ha of crops destroyed), followed by Sette cama 1 (3.4 ha) and Mayombi 1 (3.17 ha). The linear model

shows a significant difference (p-value: 0.0004745) for Totou 1 (Estimate: 0.0540339; Std. Error: 0.0202525; t value: 2.668; Pr(>|t|): 0.00794). The studies of Sitati et al. (2003) and Sitati et al. (2005) revealed that the presence of people on the farms provided protection through guarding; and the number of the farms influences the presence of animals in the areas; where many farms exist there is always surveillance compare to areas with few farms. The destructions are higher in December because there are few farmers left in the fields due to the festive periods. Fairet (2012) considered human presence in the farms, the season and drinking points near farms as determinants of wildlife encroachment factors. However, these Parameters did not show a significant effect in our study. Parker et al. (2007) also identified disparity in factors that could influence behaviour and explain the presence of crops in farms and the absence of human as influencers.

3.4. Crops Destroyed and Surface Area of Farms

The results revealed that most destroyed crops during the study were banana (9.5 ha) followed by cassava (6 ha) and sugar cane (2.5 ha). The linear regression model showed a significant difference in crop attack (p-value: < 2.2e−16) for banana (Pr(>|t|): 0.0006), cassava (Pr(>|t|): 0.01), Sugar cane (Pr(>|t|): 0.003847) and cocoa yams (Pr(>|t|): 0.00002) respectively. Elephant were seen to have caused the most damage to crops than the other wildlife.

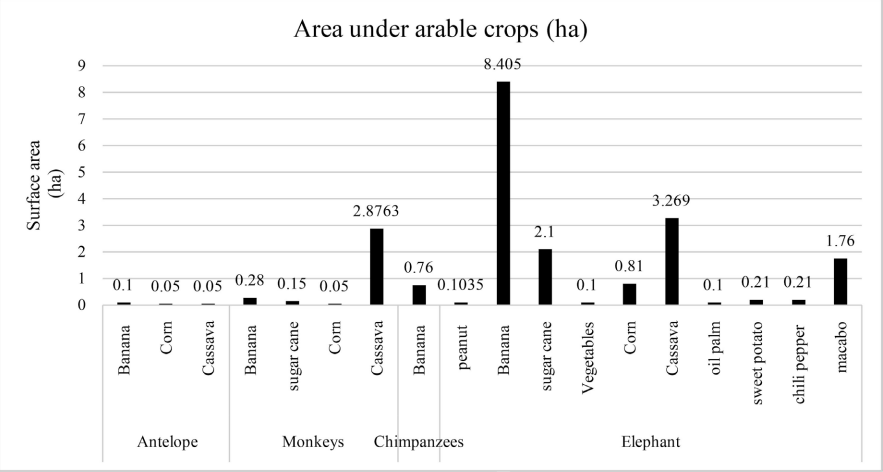

Figure 5. Types of crops and areas (ha) destroyed by the wildlife types.

The results of this study showed that Elephants are the biggest destroyers of crops in the study area (**Figure 5**). These findings are similar to those of Atta et al. (2016), Boukoulou et al. (2012) and Ngama (2018) who identified Elephants to have destroyed more crops than all the other wild animals put together in Ivory coast and Congo respectively. This can be because of their massive sizes and quantity of food intake per elephant. This destruction by wildlife angers the population who a left with no food to eat leaves then with no option other than revenge subsequently leading to the killing of these animals (Nsonsi et al., 2017; Nsonsi, 2018).

The results in Table 4 show the economic losses incurred by farmers during the destruction. These losses vary depending on the farm size and crop type. Indeed, the crops sold in the area are plantain, cassava and sugar cane juice. The average loss per household in the area is estimated at 3.898 USD per year. Banana and sugar cane are more destroyed compare to cassava despite the fact that cassava farms are larger in terms of surface area compared to sugar cane crops. Example in Totou 1 0.5 ha of destroyed sugar canna corresponds to 3.494 USD per household compared to 2.6 ha of destroyed cassava which corresponds to 1.061 USD per household.

Table 4. Showing economic damage caused by HWC in 2022.

Area (Village)	No. of Farms	Crops	Area planted (ha)	Area destroyed (ha)	% area destroyed (ha)	Crop loss (tonnes)	Economic losses (Fcfa)/2022
Carrière 1	2	Banana	2	0.4	20	400	1,400,000
		Cane	0.7	0.2	28.57	6	4,200,000
		Cassava	1.5	0.4	26.67	3.2	480,000
Carrière 2	1	Cane	0.5	0.1	20	3	2,100,000
		Cassava	0.5	0.2	40	1.6	240,000
Mayombi 1	2	Banana	3.5	2.87	82	2870	10,045,000
		Cassava	1	0.2	20	1.6	240,000
Mayombi 2	2	Banana	2	0.21	10.5	210	735,000
		Cassava	1	0.45	45	3.6	540,000
Sette cama 1	3	Banana	3	1.04	34.67	1040	3,640,000
		Cane	1.5	0.9	60	27	1,890,000
		Cassava	2	1.28	64	10.24	1,536,000
Sette cama 2	1	Banana	0.8	0.2	25	200	7,020,000
		Cane	0.5	0.3	60	9	6,300,000
		Cassava	0.7	0.6	85.71	4.8	720,000
Sounga	2	Banana	4.2	0.1	2.38	100	350,000
		Cassava	1.2	0.1	8.33	0.8	120,000
Totou 1	5	Banana	7	4.11	58.71	4110	14,385,000
		Cane	1	0.5	50	15	10,500,000
		Cassava	4	2.66	66.41	21.25	3,187,560
Totou 2	1	Banana	1	0.21	21	210	735,000
		Cane	0.3	0.25	83.33	7.5	5,250,000
		Cassava	0.5	0.3	60	2.4	360,000
Totou 3	1	Banana	1	0.405	40.5	405	1,417,500
		Cassava	0.2	0.009	4.5	0.072	10,800
Total	**20**	**41.6**	**17.99**	**1017.29**	**9662.06**	**94411.86**	**46,848,145**

The results of this study revealed that the value of destroyed crops varied base on species. However, the economic value of the loss was more for commercial crops than for subsistence crops with values of 2.853 and 512 USD respectively. This result is similar to that of Tchamba et al. (2014) that said in HWC in the South West Region of Cameroon where, 1 to 4 ha of banana plantation destroyed by wildlife was estimated at between 2500 USD to 11.233 USD. Also in a related study carried out by Sitienei et al. (2014) in the peripheries of protected areas in Kenya showed that damage to Maize, Plantains and fodder crops amounted to 33.816 USD in just a month of November. These differences in economic losses between the areas mentioned are therefore due to differences in the cost of living and the cost of production in the different areas of study. However, these HWC are inflicting heavy economic burden on the rural communities irrespective of the country of origin. These huge economic losses incurred by these communities give them legitimacy to complaint and whenever the competent authorities do take action repression by the population against these pachyderms may occur even though seen as illegal.

3.5. Limitation of the Study

This study was limited to the peripheries of Lounga National Park in Gabon. Interviews were done with households' heads that own crop plantations in the study area and were available and willing to participate in the study.

4. Conclusion

The HWC in the periphery of Loango National Park has its peculiarity that human and elephants have coexisted for a long time due to the conservation efforts of the state. In this area wildlife can be seen near villages. Recently unemployment and poverty force the populations to intensify their agricultural activity consequently leading to HWC. The economic loss caused as results of human-wildlife conflict in the study is enormous and has affected the standard of living of the populations. The conflict prevention method used in this area is surveillance. There is a need to find lasting solutions to this conflict without a lasting solution; the consequences will be catastrophic to wildlife conservation. This will lead to reduction in their populations and a loss of their benefits to the ecosystem. Solutions to this conflict must truly address the social components of the populations living in these areas. Participatory management of protected areas should be encouraged and benefits be shared.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix 1: Data Collection Form: Direct Observation of Plantations

General information									
Date of data collection:	Study area:		GPS coordinates		Form no:		Producer's name		
Plot N°:	Age of the plot		Total surface area of the plot		Description of the area:		Forest zone/Savannah zone /Marsh area		
Presence of protection	Yes/which/No		Presence of incursion	Yes/which/No	Types of incursion	Visit with attack/Non-attack visit			
Data on crops attacked									
Crop type	% of crop presence	Maturity stage	Types of damage	Area of crop destroyed	Incriminated animal	Indication of animal presence	Location of protection	Protection disturbance level	Other comment

Maturity: young, growing, budding, flowering, fruiting, ripening, harvesting, senescence, etc.; Plant quality before damage: good, average, poor; Elephant presence index: droppings, smears, breakage, screams, etc.; % of crop presence: 0 to 25%; 25% to 50% 50% to 75% and over 75%; Damage: leaves, fruit, roots, trunk (destroyed); Duration of index: 0 to 24 h; 24 to 48 h; 48 to 72 h; more than 72 h; Animal involved: elephant, hedgehog, epic pig, antelope, wild boar; Location of protection: inside the plantation; outside the plantation with no separation distance; outside between 0 and 5 m from the plantation; outside more than 5 m away; Level of disturbance of protection: Intact, Totally destroyed, Moderately destroyed.

Appendix 2. Data Collection Sheet: Population Survey

CONFLICT MANAGEMENT INSTITUTIONS

1) Who do you contact in the event of damage? (Please tick multiple boxes)
☐ Cantonnement Eaux et Forêts; ☐ ANPN; ☐ Préfecture; ☐ Ministère; ☐ Agriculture; ☐ Brigade faune; ☐ Personne; ☐ Other.....

2) What do you expect from the authorities who receive your complaints?
☐ Compensation; ☐ Protection technique; ☐ Administrative battles; ☐ Other specify.....

3) SOCIAL PERCEPTIONS

A) In your opinion, is wildlife conservation important?
☐ Not at all; ☐ A little; ☐ Quite; ☐ I don't know; ☐ I don't want to answer

B) If (a little/a lot), specify their importance
☐ Forest regeneration; ☐ Tourism; ☐ For future generations; ☐ Ecosystem regulator; ☐ Other

C) In your opinion, has the creation of national parks increased crop devastation?
☐ Not at all; ☐ A little; ☐ Quite; ☐ I don't know; ☐ I don't want to answer

D) In your opinion, has logging increased crop devastation?
☐ Not at all; ☐ A little; ☐ Quite; ☐ I don't know; ☐ I don't want to answer

E In your opinion, has poaching increased crop devastation?
☐ Not at all; ☐ A little; ☐ Quite; ☐ I don't know; ☐ I don't want to answer

F) In your opinion, have wildlife laws (e.g. the ban on killing elephants) increased crop devastation?
☐ Not at all; ☐ A little; ☐ Quite; ☐ I don't know; ☐ I don't want to answer

G) In your opinion, what is the role of the park: ☐ Protecting animals; ☐ Protecting trees; ☐ Protecting rivers; ☐ Defending the taking of natural resources; ☐ Creating jobs; ☐ Local development; ☐ Other (specify).....

4) Producer survey form

General data					
Date:	Study area:	Producer's name:	village	Producer's name	
Conflict perception data					
Can you define the human-elephant conflict?					
How would you describe your conflict with elephants?					
Specific damage data					
What is the estimated surface area?					
What crops are grown on your plot?					
What crops are attacked by elephants and how much are					
Culture	Estimated surface area	Estimated yield before damage	Organ attacked	Estimated loss due to damage	Expected harves