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# Crop losses and patterns of wildlife damage at the periphery of Dassioko Classified Forest and Forêt des Marais Tanoé-Ehy in Côte d'Ivoire

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## Abstract

Crop losses remain Africa's most frequent consequences of human-wildlife conflicts, including Côte d'Ivoire. Conflicts are caused by a variety of animals, ranging from birds to elephants, rodents, primates, cercopithecines, buffaloes, and bush pigs. Losses are sometimes dramatic depending on both patterns adopted by raiders and the crops concerned. This study was implemented at the periphery of two protected areas in Côte d'Ivoire, Dassioko Classified Forest (DCF), and Forêt des Marais Tanoé-Ehy (FMTE) to provide a better understanding on the extend of damage. To do so, a series of crop attacks are identified and caracterized to show losses due to wildlife which are sometimes great. From villages closest to protected areas, four were selected to collect data on losses. Data were collected using individual interviews with some farmers encountered on their farms and direct observations. Direct observations were conducted in virtual grids 1000x500m at the boundary of FMTE and DCF by walking slowly through crops to record as well as all plants attacked and species involved. The study reveals diverse species with different patterns raiding on various crops. Among these, elephants, bushpigs, monkeys, and cane rats can cause great losses by foraging. They attack stems, roots, pods, cobs seeking to feed. Elevating local tolerance for wildlife will require diverse approaches to managing such conflicts, including protecting economic benefits for farmers and providing compensation in limited cases.

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## Introduction

Human-wildlife conflicts (HWC) are complex and current issues occur in both developed and developing countries. They occur in areas where humans and wildlife share the same habitat (Branstratror *et al.*, 2022; Abrahams *et al.*, 2023), drawing some consequences according to the context and people's lifestyle in each country (FAO, 2010). Africa is the continent where these conflicts are particularly frequent and severe (Ilukol, 2002; Osborn and Parker, 2002; Sam *et al.*, 2002; Bauer, 2003). Many forests in Africa still support various animal species, from birds to mammals, including insects and reptiles. Among these species, certain are on IUCN (International Union for Conservation of Nature) red list, like pygmy hippopotamus and elephants (Kouao, 2012; Kouao, 2021). Establishments of increasing people's activities around forests create some permanent contact with animals, generating by the way human-wildlife conflicts.

Located in West African, Côte d'Ivoire established several protected areas on legal and institutional bases after independence to protect biodiversity (Ibo, 1993). This country dealt with densely settled agricultural land abuts protected areas containing more animal species. Among these species, some are attracted to human activities (Kouao, 2021), causing, by the way, regular human-wildlife conflicts in crops surrounding forests. These conflicts are frequent in Côte d'Ivoire (Sidawy, 2010) around protected areas like the Forêt des Marais Tanoé-Ehy (FMTE) and Dassioko Classified Forest (DCF). According to Kouao (2021), these conflicts take various forms. These are crop depredation, damage to private property such as livestock enclosures/housing huts, death/injuries to humans and finally, human reaction to animals. Of these four forms, the most common concerns crop depredation, as in the work of Warren (2003), Hill (2004) and Distefano (2010). Crops are attracted by a variety of animals ranging from birds to elephants, rodents, primates, duikers, buffaloes, bush pigs, hippopotamuses and more (Kouao, 2021; Milda *et al.*, 2023). Some studies have shown that animals move to crops at certain times to obtain nutrients essential to their existence such as carbohydrates and protein (Kiringe *et al.*, 2007; Webber *et al.*, 2011). The crops most often attacked concerning subsistence crops are cassava, maize, and yam; following cash crops, there are cocoa, oil palm, and rubber. Animals attack crops, undoubtedly led by a preference for different parts of these plants, caused by the way crop losses. Given the recurrence of such losses at the periphery of various forests in Ivory Coast, our study has thus chosen to characterize patterns of crop raiding at the periphery of DCF and FMTE for a better understanding of why certain scientists reveal that wildlife losses cause crops are sometimes dramatic (FAO, 2010; Braczkowski *et al.*, 2023; Nyeema *et al.*, 2023). The specific objectives were to determine animal species involved by crops and their preference and evaluate the extent of losses caused by wildlife.

## Material and methods

*Study sites*

*Forêt des Marais Tanoe-Ehy*

The Forêt des Marais Tanoe-Ehy (FMTE) with an area of 12,000 hectares, is located at the extreme south-east of Côte d'Ivoire on the border with Ghana. It is bordered in some parts by the Tanoé River and the Ehy Lagoon. The FMTE is surrounded by eleven villages, namely, Saykro, Ehania Tanoé, Kongodjan Tanoé, Kadjakro, Yao-Akakro, Atchimanou, Nouamou, Dohouan, Kotoagnuan, Allangouanou and Andjé. It presents two different landscapes. The villages of Yao-Akakro, Kongodjan Tanoé, Atchimanou Kadjakro kept dense forest in contrast to the remaining villages (Fig. 1). FMTE is also characterized by the richness and specificity of its fauna and flora. It abounds in several endemic species with the special status of plants, fishes, birds, amphibians and mammals like *Potamochoerus porcus Tragelaphus scriptus*; *Thryonomys swinderinus*, *Atherurus africanus*, some Primate *Cercopithecus roloway*; *Cercopithecus petaurista*; *Cercopithecus lowei*; etc. (Béné and Akpatou, 2007).

Human communities surrounding FMTE are composed of people from the native Agni and Appolo

ethnic groups who cohabit peacefully with the non-native Ivorians including Baoulé, Sénoufo, and Malinké people, as well as migrants from neighboring countries such as Burkina Faso, Ghana, and Mali people. The economy of the region is dominated agricultural activities and fishing (Koné *et al.*, 2011). This has resulted in the deforestation of community forests by vast coconut and oil palm plantations. Some of these plantations belong to villagers and others to the company of *Palmeraie Industrielle de Côte d'Ivoire* (PALMCI) (Zadou *et al.*, 2011). On the other hand, there are several fields of food crops, mainly maize, cassava and cash crops such as cocoa, rubber, oil palm close to FMTE. In addition to farming, a large proportion of the population practices fishing in the many rivers that run through the FMTE, notably the Tanoé River, the Ehy lagoon and their ramifications.

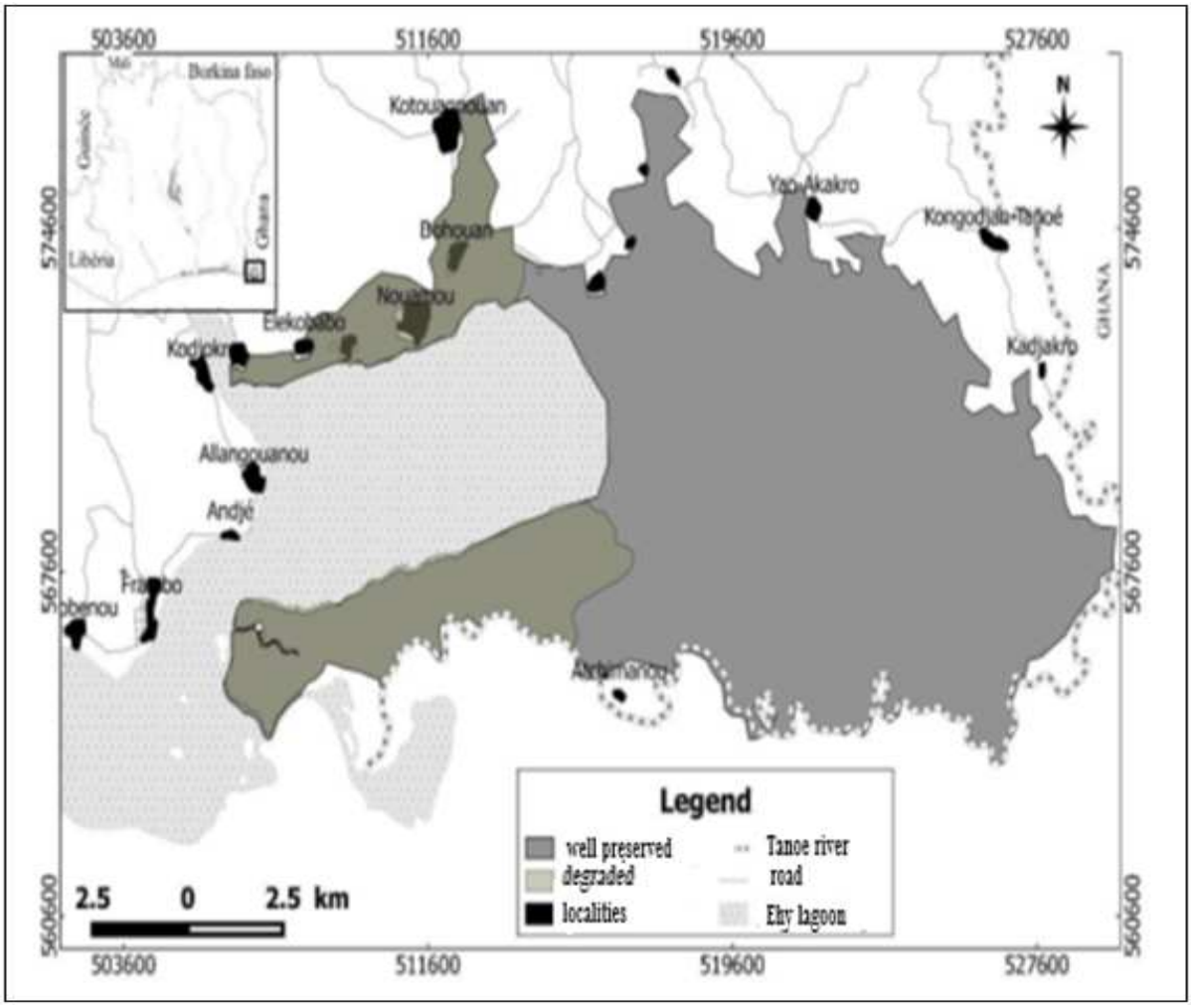


**Fig. 1.** Location of the study area (RASAPCI, 2010).

*Dassioko classified forest*

The Dassioko Classified Forest (DCF) belongs to the rainforest area of Guinean domain. It is an evergreen lowland forest, characterized by several types of vegetation including land forest, swampy forest on hydromorphic soils and coastal thickets (Fig. 2). This forest supports a wide range of wildlife, from entomo-fauna to mammalian and fish species. Recent studies led by Yao (2013) revealed the presence of 19 species of large mammals distributed within six families, namely Elephantidae Hippopotamidae, Bovidae, Suidae, Cercopithecidae and Pongidae. Communities settled around this forest are involved in several activities carried out near DCF. However, agriculture is the dominating form of human activities. People practice coffee, cocoa, rubber, oil palm, coconut, and citrus for cash crops. Subsistence crops are dominated by cassava, and rice.

*Data collection*

Three villages were selected around FMTE to assess wildlife forays. These are Dohouan, Yao-Akakro, Kongodjan. Concerning DCF, villages selected are Dassioko, Dagbego, Kpata, Leledou. Those villages were selected according to the following criteria: (1) presence of crops within 0.5 km from the forest boundary, (2) agreement of farmers to visit their farms, (3) accessibility to farms within a 2 km radius from villages for being able easily reached by foot.

Two field assistants known as former hunters converted to wildlife protection, were recruited in each village to help identify species involved in raiding. In each of these villages, a grid was superimposed on farms.

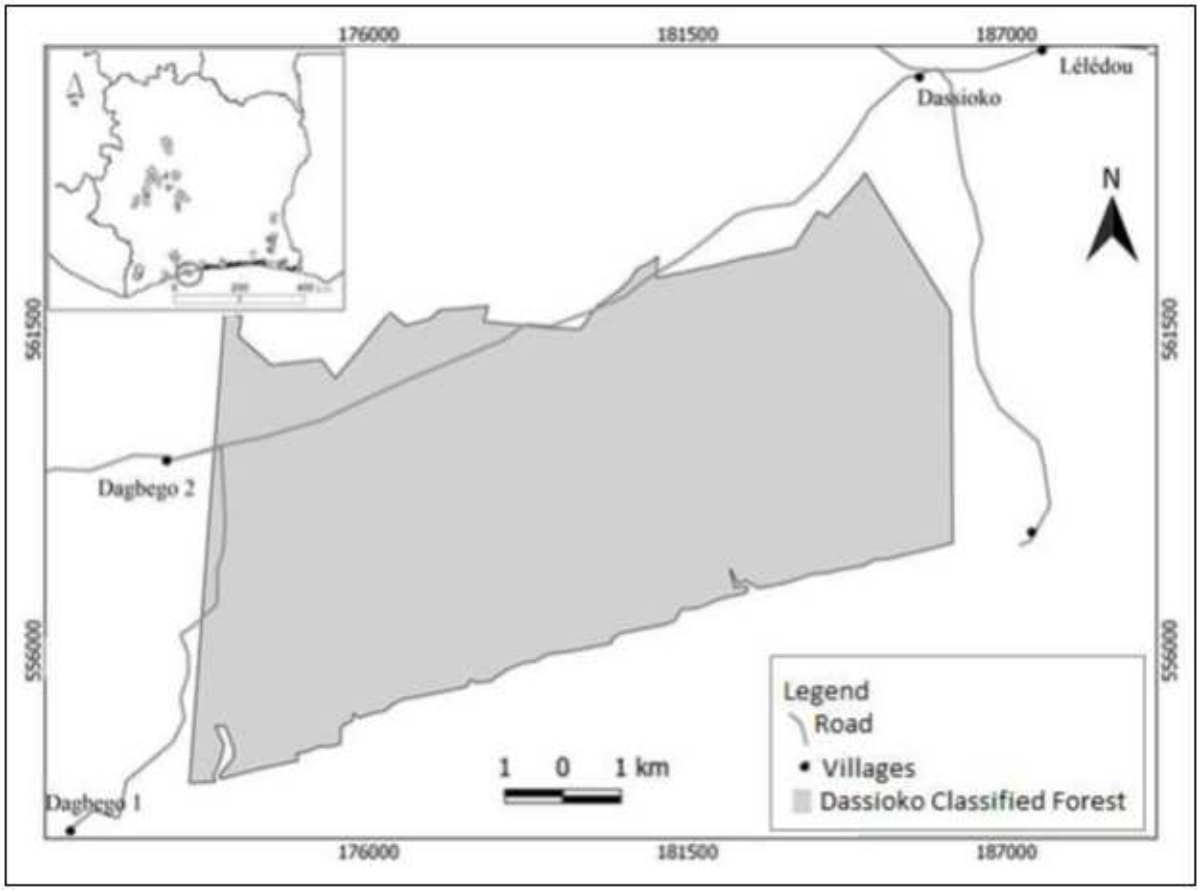


**Fig. 2.** Geographical situation of Dassioko Classified Forest.

This grid ran 1.0 km along the forest boundary and extended 0.5 km away from the forest edge. Within each grid, crops were bounded by GPS expressing in hectares (ha) (Table 2, 3). For one year, each village was visited biweekly by complete canvassing for crop damage. Animals were viewed foraging in farms only occasionally. Therefore, we relied on tracks, dung, dental impressions in plants, diggings, wadges, and other physical remains to identify the animal causing the damage. Besides direct observations, we had conducted some individual interviews with farmers encountered in their farms or villages close to selected forests.

*Assessment of plants per crop plots*

To quantify total of sown or standing crops, before sampling in grids, sown (maize) and standing crops (cassava) were counted in 25 m² area randomly in a crop chosen around FMTE as well as DCF. After counting in 25 m², considering plants, or sown equally distributed in each crop, results obtained from 25 m² was extrapolated to all visited plots housing either of these two crops.

The recorded losses of rice plants were circumscribed and estimated in hectares. Cash crops like cocoa, oil palm, and rubber trees, were quantified based on

total number of these crops communicated by Ministry of Agriculture per hectare.

*Monitoring damage*

The amount of damage was recorded by counting damaged stems of individually planted crops (e.g., bananas, maize, cassava, cocoa, oil palm, rubber) and converting this to hectare using average planting densities for each crop. Damage to sown crops (e.g., maize) was measured directly in square meters. The total number of non-directly visible parts of plants such as cassava tubers was obtained by counting the number of tubers exposed by the animals under three randomly selected cassava plants. The average obtained was reduced to one cassava stand plant.

*Data analysis*

Data collected during direct observations were grouped into three distinct categories based on the plants state after animal forays (Table 1). These are:

Category 1: in this part, we grouped plants that keep on growing or not after being raided, case of leaves, barks attacked;

Category 2: we grouped here all plants destroyed by species seeking to feed;

Category 3: we grouped plants that parts were consumed as cassava tubers maize or cocoa pods.

The first category accords to leaves consumed, these consumptions do not draw any consequences to plant growing, there are any losses initiated. The second category considers all plants not consumed but destroyed after the incursions of animals into farms.

In the last category, we recorded plants consumed, parts as well as sown, namely cocoa pods, cassava tubers, maize, bananas, etc. Sometimes, attacked organs such as cocoa pods, if not harvested promptly, become infested by fungi, rendering them unsuitable for consumption and consequently incurring great losses for the farmers.

*Estimation of Loss Costs*

Production and income per hectare for each crop was estimated based on local production figures and average local market costs in Francs CFA (F CFA). The calculation of losses was simplified by converting the production of each crop per plant or per hectare.

*Statistical analyses*

The data were analyzed using the SPSS version 16 computer software program. Statistical tests were done with the significance level set at P = 0.05.

The questionnaire was coded via sphinx and run to SPSS. Data were analyzed using descriptive statistics and responses and compared using the chi-square test for different variables.

**Results**

*Comparison of crop feeding among animals*

In total, 45 crops have been recorded around FMTE, concerning subsistence food, the most common are maize *Zea mays* (38 %), cassava *Manihot sp*, (12 %), and banana *Musa paradisiaca* (2%). Perennial crops recorded are mainly cocoa tree *Theobroma cacao* (7 %), oil palm *Elaeis guineensis* (9 %), and rubber tree *Hevea brasiliensis* (2 %). These kinds of crops attract wild animals.

In total, 43 crops have been surveyed around DCF. Concerning subsistence food, the most common are maize *Zea* mays (7 %), cassava *Manihot sp*, (12%), potatoes *Ipomoea batatas* (5%), banana *Musa paradisiaca*) (2%), rice *Oryza sativa* (12%), peanuts *Arachis hypogaea* (7%), yam *Dioscorea alata* (2 %). Perennial crops recorded are mainly, cocoa tree *Theobroma cacao* (16 %), oil palm *Elaeis guineensis* (2 %), and rubber tree *Hevea brasiliensis* (35 %).

These different crops undergo different species damage. Considering crops forays recorded at the periphery of DCF and FMTE, 17 animal species are involved (Table 1). These species belong to 11 families, including Elephantidae, Bovidae, Viverridae, Suidae, Cercopithcidae, Thryonomidae, Hystricidae, Sciuridae, Phasianidae, Columbidae and Ploceidae. The relevant species are: elephants *Loxodonta africana*, buffaloes *Syncerus caffer,* genets *Genetta tigrina*, bushpigs *Potamochoerus porcus,* bushbucks

*Tragelaphus scriptus*, cercopithecines *Cercopithecus sp*., cane rats *Tryonomys swinderianus*, African brush-tailed porcupines *Atherurus africanus*, Gambian rats *Cricetomys emini*, ground squirrels *Xerus erythropus*, squirrels *Protoxerus aubinnii*, and birds as francolins *Francolinus ahantensis* doves *Streptopelia semitorquata*, weavers *Ploceus sp*., Among these animals, cane rats have been recording in more crop plots. Both subsistence and cash crops are visited by wildlife.

**Table 1.** Animals identified in conflicts with humans around Dassioko Classified Forest and Foret des Marais Tanoe-Ehy.

| Family of animals | DCF | FMTE | Species | Crops attacked | Parts attacked |
|---|---|---|---|---|---|
| Elephantidae | *X* | | *Loxodonta africana* | Cassava, maize, rice, yam, cocoa, rubber tree | Tubers, pods, rubber tree barks |
| Bovidae | *X* | | *Syncerus caffer* NT | Rice, rubber tree | Rice stalks, rubber trees, leaves |
| Viverridae | *X* | ***X*** | *Genetta tigrina* LC | Cocoa | pods |
| Suidae | | *X* | *Potamochoerus porcus* LC | Cassava, maize | Tubers, cobs |
| Bovidae | ***X*** | ***X*** | *Tragelaphus scriptus* LC | Cassava, cocoa | Leaves, young tender pods |
| Cercopithecidae | | ***X*** | *Cercopithecus sp*. VU | Maize, cassava, bananas | Cobs, tubers, fruits |
| Thryonomyidae | ***X*** | ***X*** | *Thryonomys swinderianus* LC | Cassava, maize, oil palm, cocoa | Tubers, grains, younger stems |
| Hystricidae | ***X*** | ***X*** | *Atherurus africanus* LC | Maize, cassava, cocoa | Grains, tubers, beans |
| Sciuridae | ***X*** | ***X*** | *Cricetomys emini* LC | Cassava, maize, cocoa | Tubers, grains, beans |
| | ***X*** | ***X*** | *Xerus erythropus* LC | Maize, cassava, cocoa | Tubers, grains, beans |
| | *X* | *X* | *Protoxerus aubunnii* LC | Cocoa | beans |
| Phasianidae | | ***X*** | *Francolinus ahantensis* LC | Yams, maize | Tubers, grains |
| Columbidae | ***X*** | ***X*** | *Streptopelia semitorquata* LC | maize | grains |
| Ploceidae | ***X*** | ***X*** | *Ploceus sp*. LC | maize | grains |

Legend: x means species tracks recorded, NT means Near Threatened, VU means Vulnerable, LC means Low Concerns.

Elephants, bush pigs, Cercopithecus, cane rats, atherures, rats, francolins, and bushbucks, regularly visit subsistence crops, namely cassava fields. The first three eat parts or sometimes the entire tuber while the last ones consume smaller portions of cassava tubers (cassava roots). Bushbucks visit this type of field only for leaves to graze. For reasons remain unknowns, animals cited above appear to prefer more cassava roots used for "foutou" preparation variety than those intended for "gari" or "attiéké" production.

Certain animals like elephants, Cercopithecus cane rats, as well as francolins, doves, and weavers, preferred maize stand out forests. Elephants bushpigs ingest all cob, cane rats pick grains, birds as the doves make incursions into this type of field to consume sown at the beginning and feed also on grains when maize ripe. Taro in fields around FMTE attract mainly atherures who consume smaller portions of tubers. Cercopithecines eat bananas ripe fruits. Yams stand out attract elephants, bushbucks, and francolins. Elephants feed on tubers while bushbucks consume only leaves. Francolins eat a few parts on tubers, elephants eat tubers, sometimes the entire produced tubers. According to farmers interviewed, elephants can remove yams to eat tubers or the ones in storage.

Around DCF, rice fields also attract elephants, buffaloes, cane rats, doves *Streptopelia semitorquata*. Elephants, buffaloes, cane rats consume the entire rice stalk, whereas birds only eat the grains when rice is ripe. Both elephants and cane rats consume rice after germination, during the heading stage and continues until crop maturity. Besides food crops, some species feed also on cash crops. Elephants eat

ripe cocoa pods on trees as well as that one cocoa pod stacked up near forest. Apart from elephants, certain rodents namely porcupines *Atherurus africanus,* squirrels *Protoxerus aubunnii* consume ripe and sometimes unripe cocoa beans. Genets *Genetta tigrina* a species known for its carnivorous habits, surprisingly opts to feed on cocoa beans. Bushbucks were suspected to prefer the consumption of tender pods that look like okra bourgeoning on trees. Cane rats feed not only on maize or cassava but also on the pith of young palm tree stems that they cut using their teeth.

**Table 2.** Extent of losses caused by wildlife for each crop concerned in each village around DCF.

| Villages | Animal species involved | Crops | Total area visited | Area destroyed | Cost of the total crops | Cost of losses |
|---|---|---|---|---|---|---|
| | | | (ha) | % | FCFA | FCFA |
| losses due to organ consumption | | | | | | |
| | *Thryonomys swinderianus* | Maize (*Zea mays*) | 0,5 | 0,074 | 200 000 | 148 |
| Dassioko | *Atherurus africanus* | Cocoa *(Theobroma cacao)* | 7,5 | 0,003 | 2 250 000 | 270 |
| | *Thryonomys swinderianus* | Rice (*Oryza sativa*) | 0,5 | 0,25 | 200 000 | 500 |
| | *Protoxerus aubunnii* | Cocoa *(Theobroma cacao)* | 7,5 | 0,07 | 2 250 000 | 6 300 |
| | *Ploceus sp.* | Rice (*Oryza sativa*) | 0,5 | ND | 180 000 | ND |
| | *Loxodonta africana* | Rubber *(Hevea brasiliensis)* | 16,5 | 6 | 2 475 000 | 148 500 |
| | | Palm oil (*Elaeis guineensis*) | 6 | 1,19 | 840 | 9 996 |
| | | Cocoa *(Theobroma cacao)* | 3 | 2,64 | 900 000 | 95 040 |
| | | Rice (*Oryza sativa*) | 2 | 57,5 | 720 000 | 414 000 |
| | | Yam (*Dioscorea sp.)* | 0,01 | 70 | ND | ND |
| Dagbego | *Thryonomys swinderianus* | Cassava *(Manihot esculenta)* | 0,0199 | 6 | 51 350 | 3 081 |
| | *Protoxerus aubunnii* | Cocoa *(Theobroma cacao)* | 5 | 0,13 | 2 500 000 | 4 680 |
| | *Tragelaphus scriptus* | Cassava *(Manihot esculenta)* | 0,0199 | ND | 51 350 | ND |
| | *Streptopelia semitorquata* | Maize (*Zea mays*) | 0,116 | 9,48 | ND | ND |
| Dagbego | *Syncerus caffer nanus* | Rice (*Oryza sativa*) | 3 | 13,33 | 1 080 000 | 143 964 |
| Kpata | *Loxodonta africana* | Rubber *(Hevea brasiliensis)* | 16,5 | 7,45 | 2 465 000 | 183 642 |
| losses due to plants damaged | | | | | | |
| Dassioko | *Tragelaphus scriptus* | Rubber *(Hevea brasiliensis)* | 1 | 0,38 | 150 000 | 570 |
| | *Loxodonta africana* | Rubber *(Hevea brasiliensis)* | 16,5 | 6 | 2 475 000 | 148 500 |
| | | Palm oil (*Elaeis guineensis*) | 6 | 1,19 | 840 | 9 996 |
| | | Banana (*Musa sp.)* | 0,0041 | 32 | 20 000 | 6 400 |
| | | Cassava *(Manihot esculenta)* | 0,55 | 26 | 285.285 | 74 174 |
| Dagbego | *Tragelaphus scriptus* | Yam (*Dioscorea sp.)* | 0,0272 | 92 | ND | ND |
| | Syncerus caffer nanus | Rubber *(Hevea brasiliensis)* | 1 | 100 | 150 000 | 150 000 |
| Kpata | *Loxodonta africana* | Rubber *(Hevea brasiliensis)* | 16,5 | 7,45 | 2 465 000 | 183 642 |
| | | Cassava *(Manihot esculenta)* | 0,22 | 6,36 | 114 114 | 7 257 |
| Leledou | *Loxodonta africana* | Maize (*Zea mays*) | 1 | 3 | 400 000 | 12 120 |
| | | Cassava *(Manihot esculenta)* | 1,51 | 1 | 783 287 | 7 832 |

Elephants and bushbucks attack rubber trees on two parts, namely, the leaves and the bark. The barks of rubber trees attract elephants, so they feed them by removing them from trees by their trunks. Bushbucks also consume bark, which they detach by using their teeth. They also consume leaves like buffaloes. We recorded raiding traces in rubber tree nurseries near DCF.

*Forays and crops damaged*

Contrary to foray by eating crops, sometimes, we noticed during direct observations that certain species make some incursions into fields, causing severe damage to crops before feeding or without consuming any crops. Before finding tubers of cassava, elephants, bushpigs and cercopithecines sometimes destroy more standing crops by breaking or digging up many immature plants before reaching mature plants with tubers. We have also recorded that elephants and cane rats cut several stand maize plants at stages of growth from sowing to maturity.

They also break and remove numerous cassava plants before the maturity stage, causing severe losses to farmers. Aulacodes also contribute to the greatest loss. They damage by incising many young and mature cassava stems with their teeth while they are only feeding on mature stems. Elephants also cause great damage to crops, sometimes by trampling crops when they come out as well as entering DCF.

The Kruskal-Wallis H test showed that there was a significant difference ($X^2 = 4.975$, df = 1, $P < 0.05$) in crop consumption around the two study areas. Regarding plant damage, the test showed that there was no significant difference ($X^2 = 0.505$, df = 1, $P > 0.05$) around the two study areas.

**Discussion**

According to FAO, a set of global trends concerning both human demographics and changes in wildlife habitat contribute to increasing human conflicts with wildlife worldwide (FAO, 2010). Of these forms, the most common in this study concerns crop losses corroborated by (Hill *et al.*, 2002; Warren, 2003; Hill, 2004; Distefano, 2010). This study recorded two ways wildlife used to lose farmers' crops. We noticed losses from vegetable organ consumption and losses from stand plants destroying. Crops raiding is recurrent according to their occurrence and frequency due to many factors such as forest proximity, human activities level, specificity, and crops maturity periods (FAO, 2010). Each of these crops represent for each animal a preference (Kagoro-Rugunda, 2004; Kiringe *et al.*, 2007). According to researchers (Kiringe *et al.*, 2007; Webber *et al.*, 2011), this preference for crops arises from the clear nutritional needs of wild animals to balance their diet by essential nutrients as carbohydrates, proteins, tannins... Then, a wide range of wildlife, from birds to elephants, including rats, buffaloes, monkeys, bush pigs, palm rats and more, target crops around forests as food like demonstrated Naughton-Treves andTreves (2021), Rodrigues *et al.*, (2021); Riley (2007); Eniang *et al.*, (2011). Animal species remove essential nutrients from certain parts of subsistence crops as well as cash ones. Crops subsistence attacked around DCF and FMTE are namely maize, cassava, yam, rice, bananas, those of cash concerned are, cocoa, oil palm and rubber trees. Surely, to balance its diet, primate feed more on crops surrounding forests in Africa, so, they are known as one of the greatest raiders around protected areas (Redpath *et al.*, 2015; Bhatta and Joshi (2020); Mekonen (2020). According to some researchers, including Amare and Serekebirhan (2019), (Siljander *et al.*, 2020) maize seems to be the most preferred crop by primates despite the abundance of other wild fruit-bearing trees in forests.

In the same way, namely bushpigs, cercopithecines, cane rats seem preferred cassava and maize as food. Bushbucks feed namely on cassava, rubber trees leave which growing back. Most often, elephants consume maize, cassava, yam, rice including cocoa beans and rubber tree bark. Squirrels, porcupines, Gambian rats, birds feed either on grains or beans, they cause less than 5% of losses. As part of this study, apart losses caused from animal species vegetable organ consumed, certain animals destroy crops surely seeking food.

**Table 3.** Extent of losses caused by wildlife for each crop concerned in each village around FMTE.

| Villages | Animal species involved | Crops | Total area visited | Area destroyed | Cost of the total crops | Cost of losses |
|---|---|---|---|---|---|---|
| | | | (ha) | % | FCFA | FCFA |
| Dohouan | *Atherurus africanus* | Maize (*Zea mays*) | 4,43 | 0,57 | 1774000 | 10 111 |
| | | Cassava (*Manihot esculenta)* | 1 | 0,2 | 518700 | 1 037 |
| | *Thryonomys swinderianus* | Cassava (*Manihot esculenta)* | 1 | 0,218 | 518700 | 1 130 |
| | *Francolinus ahantensis* | Cassava (*Manihot esculenta)* | 1 | 0,095 | 518700 | 493 |
| | *Phataganus tricuspis.* | Cassava (*Manihot esculenta)* | 1 | 0,0041 | 518700 | 21 |
| | *Cricetomys emini* | Maize (*Zea mays*) | 4,43 | 0,03 | 1 774 000 | 532 |
| | *Tragelaphus scriptus* | Cassava (*Manihot esculenta)* | 1 | ND | 518 700 | ND |
| | *Xerus erythropus* | Maize (*Zea mays*) | 4,43 | 0,68 | 1 774 000 | 12 063 |
| | *Ploceus sp.* | | 4,43 | 0,35 | 1 774 000 | 6 209 |
| | *Streptopelia semitorquata* | | 4,43 | 5 | ND | ND |
| Kongodjan | *Atherurus africanus* | Cassava (*Manihot esculenta)* | 2,13 | 0,29 | 1 107 424 | 3 211 |
| | *Tragelaphus scriptus* | Cassava (*Manihot esculenta)* | 2,13 | ND | 1 107 424 | ND |
| | *Thryonomys swinderianus* | Maize (*Zea mays*) | 0,36 | 1 | 144 000 | 1 440 |
| | | Cassava (*Manihot esculenta)* | 2,13 | 0,05 | 1 107 424 | 570 |
| | *Protoxerus aubunnii* | Cocoa (*Theobroma cacao)* | 2 | 0,04 | 1 000 000 | 400 |
| | *Cricetomys emini* | Cocoa (*Theobroma cacao)* | 2 | 0,0015 | 1 000 000 | 15 |
| Yao-akakro | *Atherurus africanus* | Cocoa (*Theobroma cacao)* | 1,5 | 0,042 | 750 000 | 315 |
| | *Thryonomys swinderianus* | Cassava (*Manihot esculenta)* | 3,998 | 2 | 2 073 762 | 41 475 |
| | *Genetta tigrina* | Cocoa (*Theobroma cacao)* | 1,5 | 4,7 | 750 000 | 35 250 |
| | *Protoxerus aubunnii* | Cocoa (*Theobroma cacao)* | 1,5 | 0,026 | 750 000 | 195 |
| | *Streptopelia semitorquata* | Maize (*Zea mays*) | 1,015 | 9 | ND | ND |
| | *Cricetomys emini* | Cassava (*Manihot esculenta)* | 3,998 | 0,001 | 2 073 762 | 25 |
| | *Xerus erythropus* | Maize (*Zea mays*) | 1,015 | 0,011 | 406 000 | 45 |
| | *Tragelaphus scriptus* | Cassava (*Manihot esculenta)* | 3,998 | ND | 2 073 762 | ND |
| Evaluation des pertes dues a la destruction des plants | | | | | | |
| Dohouan | *Thryonomys swinderianus* | Maize (*Zea mays*) | 4,43 | 2,45 | 1774000 | 43 600 |
| | | Palm oil (*Elaeis guineensi*) | 3 | 3 | 420 000 | 12 600 |
| | *Thryonomys swinderianus* | Palmiers à huile | 1 | 6 | 140 000 | 8 400 |
| Kongodjan | *Cercopithecus sp.* | Cassava (*Manihot esculenta)* | 2,13 | 18 | 1 107 424 | 199 336 |
| Yao-akakro | *Thryonomys swinderianus* | Maize (*Zea mays*) | 1,015 | 11 | 406 000 | 44 660 |
| | | Cassava (*Manihot esculenta)* | 3,998 | 2 | 2 073 762 | 41 475 |
| | | Palm oil (*Elaeis guineensi*) | 2,5 | 3,14 | 350 000 | 10 990 |
| | *Potamochoerus porcus* | Cassava (*Manihot esculenta)* | 0,354 | 6,5 | 183 619 | 12 085 |

Two patterns of crops destruction have been recorded, firstly, there are damaging plants from animals looking for food, secondly, there are the manner to feed certain animal species adopted. Following the first case, we recorded elephants, bushpigs, cercopithecines breaking sometimes several cassava and maize stand plants looking respectively tubers and maize cobs. Aulacodes also break sometimes many cassavas stands plants, immature as well as mature stage, the exact reasons behind this kind of feeding behavior remain unclear. Following the second case, bushbucks can cause plants death by consuming the apical buds of yam plants corroborated by Fungo (2011), Blom *et al.* (2004). Cane rats consume on the pith of young palm tree stems, which they cut using their teeth. According to Drazo *et al.* (2008), cane rats are attracted to palm tree shoots that look like sugar cane stalks they prefer. Before they mature and start producing latex, bushbucks and elephants consume leaves as well as rubber tree bark which they detach either by rubbing against them with their horns or by using their teeth. This mode of depredation was also highlighted by FAO (2010) in its study in southern and eastern Africa concerning other animals. Three species of baboon are responsible for stripping bark from trees: the chacma baboon, the yellow baboon, and the olive baboon. In the same region, at least three species of monkey are also known to be bark strippers: samango monkey (*Cercopithecus mitis labiatus*), blue monkey (*Cercopithecus mitis*) and Syke's monkey (*Cercopithecus mitis albogularis*). These animals raid timber plantations for the inner bark of several species in the genera *Pinus, Eucalyptus*, *Acacia* and *Cupressus*. Eventually they targeted all the trees in the plantations, including the mature pine trees. Damage in all cases was similar; the baboons bite into the bark, lifting and pulling it from the tree. Then, they use their front teeth to scrape off and eat the soft inner layer of cambium. If the pine tree is not killed by ring barking, fungal and borer damage make the attacked parts unmarketable. So, apart losses from vegetable organ consumption, certain animal species are capable to cause crops losses by damaging or killing plants they attacked in fields corroborated by Kagoro (2004), FAO (2010), Yigrem (2016), Kouao (2021). By the way, wildlife can provoke significant damage in fields surrounding forests (Madden, 2006; Eniang *et al.*, 2011). From this study, Crop losses caused by elephants are mostly relatively high, as indicated Okello, 2005 in Amboseli area in Kenya. This could be explained by the large amount of food eaten by an adult elephant (nearly 200 kg of plants per day). Work conducted in Kibale in Ougadan, indicated food crop losses ranging from 19.6% for beans to 38.4% for maize caused by elephants (Ilukol, 2002).

Cercopithecus monkey losses ranging from 18% to 58% in staple crops such as cassava and maize. Eniang *et al.* (2011) reported 60.20% losses in crops at the periphery of the Fillinga Wildlife Reserve in Nigeria, attributed to Chlorocebus tantalus monkey. Hill (2000), in his research around the Budongo Forest in Uganda, reported significant losses caused by baboons, reaching 59.3% for maize and up to 60.7% for cassava. Kagoro-Ragunda (2004) around Lake Mburo National Park in Uganda, recorded 55% loss in the expected annual banana production caused by bushpigs. In northern India, Rao *et al.* (2002) estimated 65% loss of sweet potato production due to bushpigs exclusively feed on tender plant leaves without causing damage to the plant during most of their depredation (Kouély, 2007; Fairet, 2012; Yigrem *et al.*, 2016). According to (Nchanji 2002) annual maize losses due to aulacodes vary from 5% to 20% around the Banyang-Mbo Wildlife Sanctuary in Cameroon. Naughton-Treves *et al.* (2005) reported 19.6% losses in cassava crops. Arlet and Molleman's (2007) indicated nearing 20% of the countries on total annual harvest of maize cause by aulacodes. According to some researchers, any losses caused by wild animals entail strong emotions among farmers (Muruthi, 2005; Eniang *et al.*, 2011; Zarso *et al.*, 2020; Blackie, 2022; Nyeema *et al.*, 2023).

**Conclusion**

Crops surrounding FMTE and DCF are more raided according to the food preferences of animals. A wide variety of animals, from rodents to bush pigs, birds,

and carnivores are involved in crop attacks. Among these animals, certain species are more active and can cause significant losses to farmers following different patterns. Elephants *Loxodonta Africana*, monkeys *Cercopithecus sp*., bushpigs *Potamochoerus porcus,* cane rats *Thryonomys swinderianus* caused great losses to farmers when visited almost crops by consuming or destroying crops. All of these depredations have aroused a certain animosity towards species from the surrounding population. To ensure animal and food security in a sustainable way, Côte d'Ivoire government must popularize methods of crop protection to avoid negative impacts on both biodiversity and food security.

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