Analysis of Human-Wildlife Conflict in Buffer Villages Surrounding Bogani Nani Wartabone National Park

Regita Cahyani Djibu*, Djuna Lamondo, Zuliyanto Zakaria

Biology Study Program, Faculty of Mathematics and Natural Sciences, Gorontalo State University, Indonesia
*e-mail: regitadjibu@gmail.com

Abstract: Conflict between local communities and wildlife in the buffer villages surrounding Bogani Nani Wartabone National Park (TNBNW) continues to rise due to increasing human pressure on forest ecosystems. This study aims to identify the types of conflict, the wildlife species involved, and community responses to these disturbances. Data were collected through interviews with 30 respondents in East Suwawa and West Dumoga Subdistricts. Results show that most conflicts (90%) are triggered by wildlife perceived as agricultural pests, while 10% are caused by animals entering residential areas. Key species involved include the crested black macaque (*Macaca nigrescens*), Sulawesi wild boar (*Sus celebensis*), snakes, lowland anoa (*Bubalus depressicornis*), and various bird species. Reported disturbances range from crop damage and wildlife presence in farmlands to potential threats to human safety. Most community mitigation efforts are non-lethal, such as installing nets, using spiritus as a repellent, guarding fields with dogs, and setting simple traps. However, hunting still occurs in some areas for crop protection or economic purposes. Habitat loss from encroachment, logging, and land clearing exacerbates conflict by pushing wildlife out of forests into human landscapes. Overall, these findings demonstrate that human–wildlife conflict leads not only to economic losses but also threatens the survival of protected species such as *Macaca nigrescens* (VU), *Sus celebensis* (NT), and *Bubalus depressicornis* (EN). This study demonstrates scientific novelty by presenting an integrated empirical analysis of the forms of human–wildlife conflict, the composition of species involved, and community response patterns in buffer villages surrounding Bogani Nani Wartabone National Park that have not previously been systematically documented, and provides practical contributions by offering an evidence-based foundation for the development of adaptive, non-lethal, and community-based conflict mitigation strategies to support conservation area management and the protection of threatened species.

Keywords: Conservation; Human-wildlife Conflict; TNBNW.

Introduction

Wildlife is a key element in maintaining ecosystem stability, as each species has interrelated ecological roles, ranging from controlling prey populations, pollination, and seed dispersal to supporting energy flow in the food chain[1], [2]. The loss of even one species can disrupt the food web and ultimately affect the ecosystem's overall function. Therefore, wildlife is not only important for ecosystems but also serves as an indicator of environmental health and human well-being.

However, the passage of time has brought about major changes in the use of space and natural resources. Increasingly intensive human activities such as forest encroachment, illegal logging, agricultural expansion, and illegal gold mining have placed wildlife in a threatened position. In Indonesia, wildlife hunting and trading have even developed into organized crimes involving extensive networks across regions and countries, putting enormous pressure on the sustainability of native animal populations[3]. Such anthropogenic pressures not only lead to a decline in wildlife populations but also trigger changes in animal behavior due to habitat loss and decreased resource availability[4], [5].

Human-wildlife conflict arises from increasingly frequent interactions between humans and wildlife. Cconflicts generally occur due to overlapping spaces between humans and animals as a result of habitat fragmentation, narrowing of migration routes, and loss of natural food sources [6]. When habitats can no longer provide for animals' basic needs, they are forced to enter new areas, including agricultural areas, plantations, and even human settlements. This not only causes economic losses for communities, but also creates negative perceptions of wildlife, increasing the risk of killing or revenge hunting.

On the island of Sulawesi, the dynamics of human-wildlife conflict are particularly complex. Sulawesi has the highest level of endemism in Indonesia, meaning many species of wildlife are found nowhere else. However, pressure on wildlife habitats and populations continues to increase as hunting and consumption of wildlife meat, which has been practiced for generations and has become part of certain cultural identities, continues to expand[7], [8]. In fact, several traditional markets in Sulawesi are still known to trade various types of wildlife, including protected species, as high-value economic commodities. This condition exacerbates the level of threat to wildlife populations.

Bogani Nani Wartabone National Park (TNBNW), as the largest terrestrial conservation area in Sulawesi, has high wildlife diversity and functions as a habitat for endemic species such as *Macaca nigrescens*, *Sus celebensis*, and

Bubalus depressicornis. This area is an important ecological space for maintaining the sustainability of wildlife. However, anthropogenic pressures in the area remain high, including encroachment, illegal logging, illegal mining, and wildlife hunting for both consumption and trade [9], [10]. These threats cause ecosystem degradation and habitat fragmentation, ultimately increasing the potential for conflict with communities in TNBNW's buffer zone.

Human-wildlife conflicts in buffer zones generally stem from community land use for agriculture and plantations. The conversion of forests into plantations deprives wildlife of their natural food sources, forcing them to search for food in plantations and causing crop damage. In addition, some species, such as wild boars, yaki, and anoa, have wide-ranging patterns, making them more likely to encounter community activities. When animals enter agricultural land or settlements, communities tend to respond in certain ways to protect their assets, ranging from chasing them away to setting traps. These conflicts not only affect land productivity but also pose a potential threat to community safety and exacerbate negative perceptions of wildlife.

From a conservation perspective, human-wildlife conflict is a critical issue because it often involves species with endangered conservation status. For example, *Macaca nigrescens* is classified as Vulnerable (VU), *Sus celebensis* is classified as Near Threatened (NT), and *Bubalus depressicornis* is classified as Endangered (EN). The killing or hunting of these species can accelerate their population decline and disrupt the balance of the ecosystem [11]. In addition, increased human-wildlife interactions also pose a risk of zoonotic disease transmission, especially when animals are traded or consumed in unhygienic conditions [12].

Given the complexity of this issue, studies on human–wildlife conflict are critically important. Research on human–wildlife conflict in the Bogani Nani Wartabone National Park (TNBNW) area remains limited. This study was conducted in response to the continuous escalation of human–wildlife conflict in villages surrounding TNBNW, driven by habitat degradation resulting from forest encroachment, illegal logging, illegal mining, and agricultural expansion. These pressures not only cause economic losses to local communities but also threaten the persistence of endemic and protected species in Sulawesi. In contrast to previous studies that generally focused on a single wildlife species [14], [17], this research adopts a comprehensive approach by integrating the identification of conflict types, the composition of wildlife species involved, and community response patterns and mitigation practices based on empirical field data from several buffer villages of TNBNW. This approach offers a more contextual and applicable local perspective, thereby filling existing gaps in scientific knowledge regarding the dynamics of human–wildlife conflict in the TNBNW area and providing a stronger foundation for the formulation of community-based conflict mitigation strategies and conservation management.

A comprehensive understanding is required to identify the underlying drivers of conflict, the relationships between ecological conditions and community social dynamics, and how local communities respond to the presence of wildlife. Such an understanding constitutes a crucial basis for formulating conflict mitigation strategies

that not only prioritize wildlife protection but also take into account the well-being of communities living in close proximity to forested areas.

Research Methods

The research was conducted in the working area of SPTN Region I, Limboto, namely in Pangi Village, Poduwoma Village, and Tulabolo Village, which are included in the working area of the Tulabolo-Pinogu resort, SPTN Region II Dolaoduo, namely in Toraut Induk Village, Toraut Tengah Village, and Toraut Utara Village, which are included in the working area of the Dumoga Barat resort.
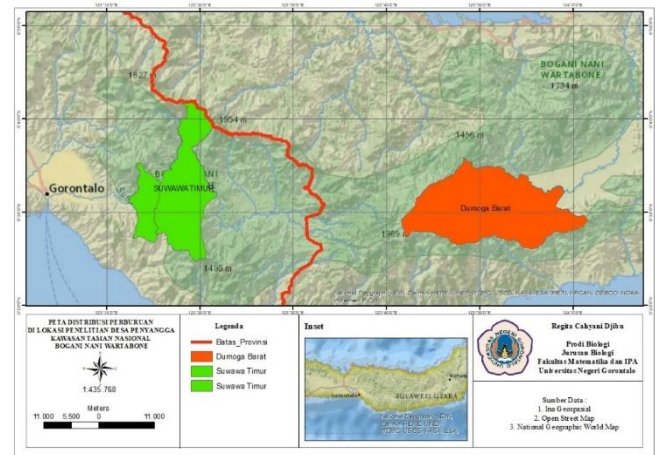

Figure 1. Research Location

This research method uses exploratory studies conducted in villages around Bogani Nani Wartabone National Park. Respondents were selected through snowball sampling, in which samples were obtained through a rolling process from one respondent to another. This study uses a qualitative descriptive approach to identify the forms of conflict, the types of animals involved, and the community's response to wildlife disturbances.

Data collection was conducted using the research instruments, and the analysis employed a qualitative approach, including interview techniques [13]. Respondents were selected through the snowball sampling technique, in which samples are obtained through a sequential referral process from one respondent to another. Primary data were collected through semi-structured interviews using a structured research instrument designed to identify the types of wildlife disturbances, the species involved, and the mitigation measures implemented by local communities.

The collected data were analyzed using qualitative descriptive analysis, supported by simple descriptive statistics to present the frequency and percentage of conflict occurrences. This approach enabled the results to systematically and contextually describe the dynamics of human–wildlife conflict and community responses in the buffer villages surrounding the TNBNW area.

Results and Discussion

This study included 30 respondents who lived in villages within the buffer zone of Bogani Nani Wartabone National Park. The interview technique used was snowball sampling, a sampling method in which samples are obtained

through a rolling process from one respondent to another. In this technique, the researcher interviewed only key respondents directly related to the research object. From these observations, the researcher identified 30 respondents across two locations within the TNBNW buffer zone. The selection of these two locations was based on initial observations indicating that conflicts between the community and wildlife, as well as wildlife poaching, often occurred there.

The interviews with respondents revealed that wild animals disrupted the daily activities of the community living in the buffer zone village of Bogani Nani Wartabone National Park. The forms of disturbance and the types of wild animals causing the disturbance are presented in Figure 2 and Table 1, respectively.
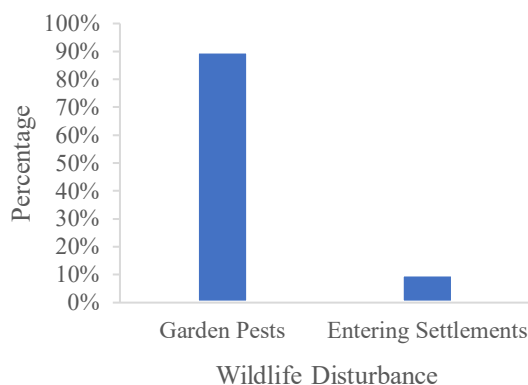

Figure 2. Forms of Wildlife Disturbance

The forms of wildlife disturbance that cause conflicts between the community and wildlife are mostly (90% (n=17)) due to the presence of wildlife that are considered pests to plantations and 10% (n=3) due to the presence of wildlife entering community settlements.

Table 1. Types of Wildlife Disrupting Community Daily Activities

No	Types of Wildlife Disrupting Community Activities
1	Monkeys/Yaki
2	Wild Boar
3.	Snake
4.	Lowland Anoa
5.	Birds

Wild animals that disturb community activities include monkeys/Yaki (*Macaca nigrescens*), wild boars (*Sus celebensis*), snakes, lowland anoa (*Bubalus depresicornis*) and various types of birds. These wild animals are considered to disturb the daily activities of communities around the buffer zone villages of Bogani Nani Wartabone National Park.

Conflicts between humans and wildlife have increased significantly in recent years. This issue is complex because it not only concerns human safety but also the survival of wildlife. One of the main factors driving these conflicts is the destruction of natural habitats, largely triggered by human activities, such as the conversion of forests into agricultural land for economic gain. The clearing of forests for development and to improve human welfare has caused wildlife habitats to shrink, forcing them to move

and occupy other remaining areas[14]. Rapid population growth in areas surrounding forests, accompanied by land clearing for plantations and logging, has disrupted the natural habitats of wildlife, including yaki monkeys. This situation has triggered competition between humans and yaki monkeys for limited natural resources. As a result, conflicts between the two often occur, especially in areas directly adjacent to the Bogani Nani Wartabone National Park (TNBNW).

The results of interviews conducted by researchers with 10 respondents in East Suwawa Subdistrict, namely in Pangi, Poduwoma, and Tulabola Villages, showed that 100% of respondents worked as farmers. In addition, 20 respondents in 3 villages in West Dumoga Subdistrict: 65% (n=13) worked as farmers, 25% (n=5) as miners, and 10% (n=2) as odd-job workers.

The most common occupation among respondents was farming. Respondents in East Suwawa Subdistrict have plantations that are planted with food crops such as corn, chili, and also fruits such as avocados, durians, and cocoa trees. Meanwhile, the plantation crops grown in West Dumoga Subdistrict are mostly patchouli. Their plantations are located within the TNBNW buffer zone; therefore, it is possible that wild animals often pass through them.

Data from interviews in East Suwawa Subdistrict indicate that the conflict between the community and wildlife stems from wildlife becoming a pest to plantations. This has prompted plantation owners to install nets around their plantations to prevent wild animals from entering. The animals that often enter plantations are macaques (Macaca nigrescens) and various bird species that damage plantation crops. In addition, wild animals such as snakes can also enter community plantations.

This conflict between the community and wild animals has led the community to anticipate wild animal entry into their plantations, installing nets to deter them. The presence of these nets prevents wild animals such as macaques and snakes from disturbing their plantations. Various types of birds that damage crops are left alone because the losses they cause do not significantly affect plantation yields.

Passive physical methods such as fences or exclusionary netting are often effective for species that are unable to penetrate such barriers; the literature indicates that electric fences or permanent barriers can effectively reduce crop damage caused by certain species (e.g., elephants and wild boar) when properly installed and maintained [19]. However, implementing such infrastructure requires substantial initial investment and ongoing maintenance, and it is often unsuitable for dispersed or fragmented landholdings or for low-income communities without subsidies or support from area management authorities. Studies have shown that in the absence of collective maintenance mechanisms, fences deteriorate rapidly, leading to a significant decline in their effectiveness [19].

The community in West Dumoga Subdistrict has conflicts with wildlife in the form of plantation pests (85%; n=17) and wildlife entering settlements (15%; n=3). Wild animals that enter their plantations are mostly only chased away by the plantation owners, with 50% (n=10) using homemade spirit traps, 15% (n=3) using guard dogs, and 25% (n=5) using nets/fences. while 10% (n=2) used nylon traps to prevent wild animals from entering their plantation

land. The wild animals that became plantation pests were macaques (*Macaca nigrescens*), snakes, wild boars (*Sus celebensis*) and several species of birds. Wild animals that enter settlements, such as macaques (*Macaca nigrescens*), anoa (*Bubalus depressicornis*), and wild boars (*Sus celebensis*), are also only repelled using sound shots from a mixture of spirits.

Documented local strategies (e.g., the use of simple repellents such as methylated spirits, nylon traps, and manual guarding) reflect the adoption of locally derived knowledge that is low-cost and readily accessible; however, their scientific effectiveness remains questionable. Repellents such as methylated spirits generally produce only temporary deterrent effects, displacing animals briefly rather than preventing their return, while traps or snares may injure non-target species or raise legal and conservation concerns when protected species are affected. Furthermore, hunting as a mitigation strategy presents a conservation dilemma: on the one hand, it may reduce damage in the short term; on the other hand, it can accelerate population declines of vulnerable species and increase the risk of zoonotic or interspecific disease transmission (e.g., through the use of

hunting dogs) [25]. The literature from Sumatra [18] cautions that dog-assisted hunting may provide immediate conflict reduction but generates significant challenges related to animal welfare, epidemiological risks, and long-term population sustainability [20].

From the perspective of mitigation effectiveness, the strategies implemented by communities surrounding the TNBNW area, such as the installation of nets, manual field guarding, the use of simple deterrent materials, the employment of guard dogs, and direct animal harassment, have demonstrated short-term effectiveness in reducing the intensity of wildlife disturbances to agricultural land [21]. These findings are consistent with studies from other regions indicating that mitigation methods based on local knowledge and low-cost approaches are relatively easy to adopt and can temporarily reduce economic losses.

Nevertheless, the effectiveness of these strategies tends to be situational and highly dependent on the intensity of guarding, land conditions, and the species involved. As a result, they are generally insufficient to provide long-term solutions to structurally rooted human–wildlife conflicts [24].

(a)

(b)

Figure 2. a) *Macaca nigrescens*, b) Distribution of *Macaca nigrescens*
(Source: IUCN)

Macaca nigrescens has an IUCN conservation status of Vulnerable (VU), a category given to species facing a high risk of extinction in the wild if no better conservation efforts are made. Many primates, including *Macaca nigrescens*, which is endemic to Sulawesi, are threatened by rapid human settlement expansion that is destroying their fragile habitats. Infrastructure projects and other developments fragment or destroy the forests that are their main source of food and space, endangering the well-being of the entire ecosystem. Even protected forests in Sulawesi are increasingly threatened by human settlements, including illegal gold mining operations.

Macaca nigrescens also damages crops, sometimes making them targets for local farmers. In addition to protecting their crops, farmers may have an incentive to kill trespassing macaques to sell their meat. Poaching is a serious

threat to both the crested black macaque and the Gorontalo macaque. Although illegal, their meat is still commonly displayed in local markets.

Human–monkey conflict primarily manifests as monkey crop raiding and is strongly influenced by the distance between agricultural fields and forest boundaries, as well as the extent of agricultural land. Such conflicts typically occur when monkey habitats are lost or degraded, resulting in the loss of shelter and food resources and, in some cases, leading to starvation. Under these conditions, monkeys become more likely to encroach upon and raid household gardens and agricultural plots [23].

(a)

(b)

Figure 3. a) *Sus celebensis*, b) Distribution of *Sus celebensis*
(Source: IUCN)

The conservation status of *Sus celebensis* according to the 2016 IUCN Red List is Near Threatened (NT). This status was given because the population of this species faces threats from various factors, including habitat destruction from deforestation and land conversion, as well as excessive hunting.

Wild boars that enter community farmlands are often considered pests that need to be exterminated or even hunted. This can lead to a decline in the wild boar population. Wild boars enter community farmlands/settlements because their habitat has been disturbed. Forest degradation disrupts wildlife migration routes, altering migration routes beyond forests. This forces wildlife to seek new migration areas, which can potentially lead to conflicts with communities if their migration areas intersect with community activity areas [15] .
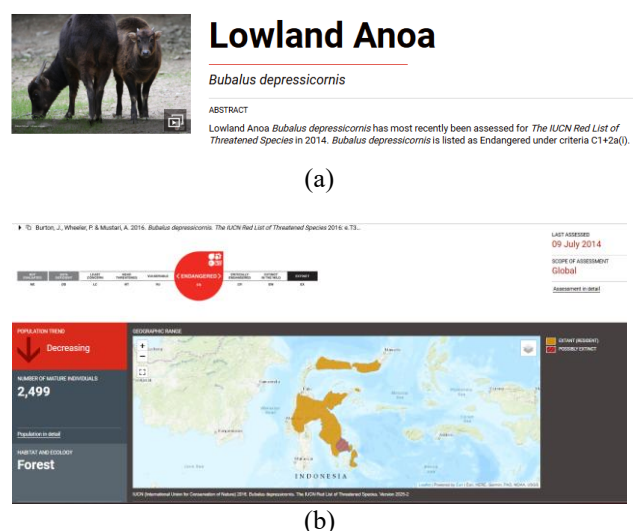

(a)

(b)

Figure 4. a) *Bubalus depressicornis*, b) Distribution of *Bubalus depressicornis*
(Source: IUCN)

The conservation status of the lowland anoa (*Bubalus depressicornis*) is endangered, according to the IUCN Red List of Threatened Species. The anoa (*Bubalus* sp.) is protected under Indonesian law and listed in Appendix 1 of CITES, the highest level of protection. Therefore, the Indonesian government, through Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.106/MENLHK/SETJEN/KUM.1/12/2018 concerning Protected Species of Animals and Plants, guarantees and protects the survival of the anoa population. The anoa is on the brink of extinction due to its declining population in its natural habitat.

The anoa is also a keystone species. The health of an ecosystem depends on the existence of this species, making its presence very important. Anoa eat fruit and seeds, and when the seeds they eat are not digested in the anoa's digestive process, they are excreted in their feces. The germination rate or viability of plant seeds found in animal feces is very high. Plant seeds will germinate and then grow into new individuals to ensure the sustainability of forest regeneration [11]. The main causes of the decline in the anoa population are illegal hunting for meat and habitat loss due to forest destruction. The decline in the anoa population is caused by the shrinking habitat of the anoa, which has the potential to lead to inbreeding in the wild population, which will cause the anoa to gradually become extinct [16].

Conflict between humans and wildlife is influenced by factors that vary across regions. In general, this conflict arises directly from human activities, such as the destruction and pollution of natural resources, the conversion of habitats into agricultural land, and the hunting and killing of animals for their meat (bushmeat), as pets, or to protect agricultural crops and plantations. Habitat loss, environmental degradation, and competition for natural resources can disrupt the behavior and movement patterns of wildlife. These conditions ultimately lead to overlapping species ranges and increase the likelihood of interactions and conflicts between wildlife and humans [6] .

The primary limitations of the community-based mitigation strategies identified in this study are their reactive nature, lack of standardization, and minimal institutional support. In contrast to studies from other regions that report successful community-based mitigation through collective management, technical training, and policy support (e.g., integrated guarding systems or compensation schemes) [22], mitigation practices in the TNBNW area remain largely individual and sporadic.

Moreover, the continued presence of hunting practices as a means of crop protection or economic utilization indicates the limitations of existing non-lethal approaches and simultaneously generates negative implications for the conservation of endemic and threatened species [21]. Accordingly, it can be critically concluded that while current community-based mitigation strategies possess pragmatic and adaptive value within the local context, they are not yet sufficiently effective or sustainable to comprehensively address human–wildlife conflict without planned interventions that integrate ecological, social, economic, and institutional dimensions.

Conclusion

Most conflicts (90%) between communities and wildlife are triggered by wildlife considered to be plantation pests, while 10% are caused by animals entering human settlements. The animals most often causing disturbances include yaki (*Macaca nigrescens*), wild boar (*Sus celebensis*), snakes, lowland anoa (*Bubalus depressicornis*),

and various birds. Wild animal species that have conflicts with communities include protected species such as *Macaca nigrescens* (VU), Sus celebensis (NT), and *Bubalus depressicornis* (EN). Conflicts occur due to habitat loss, destruction of natural resources, and competition for resources, which can disrupt the daily activities and movement patterns of wild animals.

Author's Contribution
R. C. Djibu: carried out the entire research process, including problem formulation, field data collection and analysis, and final manuscript preparation. D. Lamondo and Z. Zakaria: served as supervisors who provided academic guidance, corrections, and refinements to the content of the manuscript.

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