Evaluation of Human–Elephants (*Elephas maximus sumatranus*) Conflict in Aceh Province, Indonesia

K Berliani¹*, H S Alikodra², B Masy’ud² and M D Kusrini²

¹ Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Jalan Bioteknologi No. 1 Kampus USU, Medan 20155, Indonesia
² Tropical Biodiversity Conservation Programme, Faculty of Forestry, Bogor Agricultural Institute

*E-mail: kaniwa.berliani@yahoo.com

Abstract. The occurrence of human-elephant conflict varies and extends in the elephant’s home ranges. In general, the conflict is generated by the damage of agricultural crops. The purpose of this study is to evaluate conflict from the wild elephant (*Elephas maximus sumatranus*) in Aceh Province. This study was conducted in five sub-districts (Cot Girek, Mane, Meureudu, Sampoiniet and Pante Ceureumen) with documented human-elephant conflicts by using interview and questionnaires methods. The data were obtained from the communities directly affected by elephant crop raiding, as well as indigenous leaders and local government officials. The data collected includes causes of human-elephant conflict and typology of human-elephant conflict in Aceh Province. The data are analyzed in descriptions to give a specific picture of the cause of human-elephant conflict and its typology in Aceh. The results showed that expansion of agricultural land, plantations, settlements and forestry industries directly affect the reduction of elephant habitat, which may cause human-elephant conflict. The typology of human-elephant conflicts are; damaging plants/vegetation, damaging cottages and community houses, attacking human and/or elephants killed by humans. The study gives a special illustration of human-elephant conflicts which may facilitate the effort and participation of the community to mitigate future conflicts in Aceh.

1. Introduction

Human-wildlife conflict poses a serious threat to sustainability of critically endangered species and affect socio-economic of a community. The conflict was once reported to cause 95% destruction of agricultural crops, harm or death of livestocks, damage to cottage and local housing as well as threat or death to human [1]. Human-wildlife conflict may occur in urban and rural area but mostly occurred within or outside of conservation area. Deforestation and habitat fragmentation of wildlife due to expansion of agriculture and plantation, mining and housing, were the causal factors of human-wildlife conflict [2]. Therefore, habitat degradation push the wildlife to trespass into agriculture/plantation field nearby forest area, causing destruction to commodity crops planted by the community [3].

The occurrence of human-elephant conflict varies and extends in the elephant’s home ranges. The conflict was not only occurred in Indonesia, but also countries with elephant population. The conflict was generally caused by destruction of commodity crops. This conflict caused an economic loss with an average of 4–7% for each harvesting season in Uganda, 14% from annual agricultural
production in Karnataka, India, 31% from agricultural sector in Cameroon, loss of US$ 314000 from 1996-1999 in Samao, China and damage to agricultural field with an average of 0,98 ha annually in Ghana [4,5,6,7].

The elephants move from forest area into agriculture field [8] and cause damage to community houses, commodity crops, even harm and death to people [9,10,11], disturb daily activity of people [12], which then lead to high economic cost [13]. Therefore, damage to commodity crops directly cause loss to socio-economic aspect of a community [14] with varying degree of damage in each area, in which their economy relied on rural agricultural activity [15]. During three years since 2000, economic loss caused by elephant conflict in Riau has reached 1,99 billions IDR [16]. In 2013, economic loss in Jambi reached 13,65 billions IDR [17], not including the overall suspected elephant conflict in Sumatera as well as mental loss felt by the community within conflict area.

Based on general information from a local community, reports from researchers and elephant conservationists, and preliminary surveys in several conflict areas in Aceh Province, there is a phenomenon of causes and typologies of human-elephants conflict. The purpose of this study is to evaluate conflict from the wild elephant (*Elephas maximus sumatranus*) in Aceh Province which will give a special illustration of human-elephant conflicts that may later facilitate the effort and participation of the community to mitigate the conflicts in Aceh.

2. Materials and Methods

2.1 Time and Study Sites

The study was conducted from August 2013 until April 2014. Preliminary surveys on human-elephant conflict was carried out in December 2012 until May 2013 prior to study. The locations designated as conflict areas were chosen in regards with consistent occurrence of human-elephant conflict since 2005-2014. The study sites were five sub-districts in Aceh Province namely Cot Girek, Mane, Meureudu, Sampoiniet and Pante Ceureumen.

2.2 Data Collection and Analysis

The research used interview method and questionnaire fill to collect data. The data were obtained from the communities directly affected by elephant crop raiding i.e. their commodity crops and fields were trespassed by the elephant in groups, and their commodity crops were consumed by the groups as the main subject of the study. Data were also gathered from indigenous leaders and local government officials. Total respondents in this study were 150 respondents with 30 respondents in each sub-districts [18]. Data collected in this study include: causes and typology of human-elephant conflict. Data were analyzed descriptively to give general illustration of occurring conflict in Aceh.

3. Results and Discussions

3.1 Cause of Human-Elephant Conflict

Human-wildlife conflict occurs when needs and behaviours of wildlife pose negative impacts to human and vice-versa [19]. Human-wildlife conflict is manifestation of all interactions between human and wildlife that cause negative impacts to social, economic, cultural aspect of a community as well as to conservation of wildlife and its habitat [20]. In general term, human-elephant conflict exist because of similar needs, elephants are conserved species while along with the conserving activity, there is a socio-economic aspect of community that need to be protected due to crop raiding by the elephants.

Wildlife hold important role for human being, whether to balance ecosystem or to economy and socio-culture aspects of a community [21]. Sumatran elephant (*Elephas maximus sumatranus*) is
protected species which take part in ecosystem balance. Presence of wild elephants in Aceh are now predicted to occupy several areas namely elephants’ population pockets, such as: Bireuen, Bener Meriah, Aceh Jaya, Aceh Barat, Aceh Tenggara, Pidie, and Aceh Timur. For Sumatera forest region, Aceh is the last stronghold for Sumatran elephant population, after Lampung and Riau. According to GIS analysis in 2007, distribution of sumatran elephants is dominantly being outside of conservation area (85%), which divided into production forest area (67%) and protected forest (12%), with remaining at outside of forest area (5.6%). The remote data showed that Aceh was the province with the largest elephant home-range (31%), followed by Riau (25%) and South Sumatera (23%). Other result from Ministry of Forestry in 2007 [29], showed that condition of population pockets are now scattered around habitat due to fragmentation. Condition of production and protected forest cover which recently converted into agricultural field, plantation and industrial forest have caused a split in elephants tracklines that lead into human-elephant conflict.

Decreasing forest coverage in Aceh tend to intensify human-elephant conflict, especially Sumatran elephants. Expansion rate of agricultural, plantation fields, settlements, and forestry industries directly affect occurrence of human-elephant conflict. Overlapping location between industrial forest or plantation and elephants’ habitat, has made the highest occurrence of conflict in area harbored together by human and elephants. Most conflicts are reported to occur within converted fields from forest into industrial forest and oil palm plantation.

Development in the agricultural sector often conflicts with conservation activities or conservation of biological natural resources because the expansion of agricultural land often damage ecosystems and elephant habitats that require large and compact area. Elephants require extensive habitat and wide ranges, habitat fragmentation will lead to a reduction in movement space. To meet the ecological needs of the elephants, reducing movement space is very potential to cause conflict between these animals with developmental activities around their habitat. Finally, the conflict may end up with casualties on both sides, human and elephants but generally more deaths caused by elephants due to conflict [22].

Conflicts that occur between socio-economic-cultural interests and conservation are potentially harmful to elephants, eliminating economic sources, threatening human health and death. The movement and extent of the elephant group ranges from one region to another varies across regions, determined by the availability of feed, shelter and breeding site. Due to fragmentation and degradation within the habitat, the availability of feed, shelter and breeding site is disrupted. Therefore, elephants start looking for alternative feed into agricultural / plantation areas that are within or close to their roaming areas. Elephants out of the forest area allegedly because the natural habitat could not carry the needs of elephant biology both in quality and quantity. Elephants trespassing into agricultural/plantation areas will cause damage to crops that are cultivated by the community. Damage to plants caused by elephants according to [22], can be categorized into two parts namely damage to plants that occur due to elephants accidentally find agricultural land within or adjacent to the area of opportunity (opportunistic raiding) and plant damage caused by elephants that come out of habitat due to damage, fragmentation or severe habitat degradation (obligate raiding).

The path of the elephant roaming area that follows the annual period causes the elephants to pass through forest areas that have been transformed into agricultural, plantation and settlement areas. Moreover, in accordance with the results of [23], showed that elephants have fixed movements, so that certain areas or route of the elephant movement never change despite the changing conditions. The movement of elephants in their roaming areas will continue periodically (repeated in certain period), although it has been cut off by settlements, transmigration sites and agricultural and plantation areas. Elephants will still assume that the areas that people open are part of their home range and territory because they have no other alternative. According to [24] even if the forest area containing elephant roaming area are all converted into agricultural land and plantation land, elephants will still follow the roaming area because of the history of the roaming area formed by a group of elephants.
Therefore, the conflict between human-elephant will continue to occur and varies widely in the elephant roaming area.

Almost all the terrestrial regions of Aceh Province have a distributed population of Sumatran elephants. The distribution of this population is largely outside the conservation area. This condition shows that wild elephant conflicts with the community are unavoidable and there must be conflicts in many places. It can be seen in Figure 1 that the human-elephant conflict occurs almost entirely in lowland areas. One of the causes of this conflict is that people and elephants both occupy the lowlands and little ramps. This is in accordance with [23] statement, which states that elephants prefer lowland forests which have now been converted to agricultural land as lowland forests that provide more feed resources. This condition supports the high frequency of human-elephant conflict in Aceh Province.

![Map of Research Location](image)

**Figure 1.** Distribution map of Human-Elephant Conflict in Aceh

The human-elephant conflict occurring in the province of Aceh is spread over areas with populations of Sumatran elephants (Figure 1). Forest region of UluMasen with an area of 750,000 hectares and Leuser Ecosystem Area with 2.2 million hectares in 2010 are inhabited by 400-500 elephants from a total of 2,800 elephants on Sumatera. The amount is estimated to decrease each years. This is not separated from the overlapping forest status in Aceh. Many production forests and plantation areas are cleared in protected and conservation forests. The conversion did not pay attention
to elephant roaming routes, thus affecting the movement of elephants in foraging, finding mates and sheltering.

### 3.2 Typology of Human-Elephant Conflict

Based on the results of research conducted on five sub-districts in Aceh Province namely Cot Girek, Mane, Meureudu, Sampoiniet and Pante Ceureumen, there are four types of conflict typology which are: elephants damaging plants / vegetation, elephants damaging cottages and community homes, elephants attack/injure humans and humans injure/kill elephants. Human-wildlife conflicts are resulted in 95% damage to agricultural crops, destruction of homes and threatening or killing humans [1]. Elephants outside of the forest area then into the agricultural area caused damage to houses and crops, injured and killed people [9,10,11], disrupted the daily activities of the community [12], resulting in high individual economic costs [13]. Therefore, damage to crop commodities results in socio-economic losses of the community [14] with the value of the damage seen varying in each region [16], in accordance with the area of land owned and the economic community dependent on rural agricultural activity.

Based on information and observations at human-elephant conflict sites, conflicts occurred because elephants damaged or ate the types of community cultivations. The damage occurring on the basis of the respondents indicates the existence of elephant behavior that destroys the crops and feeds the cultivated crops as much as 70% (Figure 2). Damage to plants by elephants is also suspected by the high level of fondness (palatability) of elephants against plant species grown by farmers [24]. The fondness for this type of plant is accompanied by selective elephant traits in choosing food and will eat several taxa from very different plants, to meet the energy needs and optimal strategies for feeding. The conditions are met by the elephants because the feed are available in the human-elephant conflict such as: Cot Girek, Mane, Meureudu, Sampoiniet and Pante Ceureumen. Therefore, elephants will again try to eat the cultivated plants of community. When the elephants enter the farmland/community plantation then there will be damage to community cultivation. This damage is caused by the movement of elephants in the search for food, so there are plants that are trampled or damaged but not consumed. In addition, crop damage occurs because the elephant deliberately eat the cultivated plants. Farmers also saw some elephant behavior categorized as passing the crops without destroying (4%), trampling plants without eating (2%), destroying, eating plants and damaging houses (22%) and destroying, eating plants, destroying homes and injuring humans (2%) (Figure 2).

![Figure 2. Elephant behaviour during human-elephant conflict](image-url)
The Sumatran elephant (*Elephas maximus sumatranus*) is a browser animal, folivore, frugivore, grinder and other part of the plant to meet the mineral needs. These mega-herbivores consumes more than 400 different plant species and vary widely on plant parts, such as leaves, fruits, shoots, midribs, young stems, flowers, skin and liana, depending on the region, weather and ecosystem. However, elephants are also very selective in choosing their feed [25], and are influenced by its vegetation type [26]. Elephants have a high feeding rate in relation with their body size, age and sex, depending on the region, weather and ecosystem. Feed requirement for adult elephant reaches 200-300 kg / day while drinking water requirement is about 200 liters/ day. Therefore, if the natural feed is not sufficient in habitat, elephants will seek to feed near or outside the elephant roaming area. Feeding activities allow elephants to enter farming and community plantations. Elephants will soon eat after finding the feed and eating activity will decrease as the distance foraging further and further away. At the time the elephants enter the agricultural/ plantation area and destroy or eat the commodity crops planted by the community, it will lead to increased intensity of conflict between elephants and farmers.

![Figure 3](image_url)

**Figure 3.** Crop raiding in community plantation:
Oil palm (A), Betel Nut (B), Rubberplant (C) dan Banana (D)

**Figure 3** shows some of the crops damaged and eaten by wild elephants on farmland/ community plantations in Aceh Province. It is this damage that causes human-elephant conflict. From 2007 to 2008, there were 18 cases of damage to community cultivation. Conflicts are increasing in 2011 to 2012 with recorded 38 cases on community cultivation. Based on the results of this study, in Pante Cereumen, wild elephants entered the agricultural area and damaged oil palm, banana, rubber and peanut plants for three consecutive days that destroyed dozens of hectares of plants. Human-
Elephant conflict continues in the village Menuang Kinco, there are 12 elephants that destroy various agricultural/plantation business community. The elephants surrounded the village, so people do not dare to go outdoors let alone doing activities in the area of agriculture/plantation. In Cot Girek, hundreds of rubber and oil palm plantations are also damaged by a group of elephants which are estimated to be 40 individuals in the morning. One male elephant damaged 23 oil palm plants in Sampoiniet. Next, a group of 15 elephants roamed to destroy and eat the oil palm plant by ransacking the plant for a week in the village of Alue Gajah. When elephants enter the oil palm plantation area, elephants often eat leaf buds and the ends of stems which are the growth center of the young plants, leaving the plants to die. In Meureudu, a group of elephants destroyed 50 ha of community field planted with paddy rice, betel nut and banana for five days. Next, the paddy rice plants are also eaten by the elephants every night during three days in Mane.

When elephants consumed areca nut, elephants will choose the inside of the areca nut by tearing and removing the soft part for consumption. Blake [27] also stated that elephants strongly prefer to consume the inside stem of the Arecaceae family plant. This is mainly due to the high water content and soft texture inside of the plant. Elephants love paddy rice and banana. This is because those plants contain high levels of nutrients and water. When the elephant feeds on the branches and bark of the rubber plant, the elephant will process the feed, making it comfortable for the swallowing process. In addition, elephants also eat bark rubber rods for consumption. In accordance with the opinion of [28], elephants will choose the quality and quantity of feed types associated with the levels of crude fiber and certain nutrients that are palatable and easily digested.

Human-elephant conflict is increasingly common as elephants damage cottages and community homes (Figure 4). Human-elephant conflict in the province of Aceh from 2007 to 2008 has caused four cases of damage to community homes. Based on the results of this study, there was a disturbance in Mane with the entry of elephant group that is estimated to be 17 individuals, invading the rural area up to a week. Disturbance caused by the wild elephants is always followed by damaging of cottages and community houses. District government often extrude the large animals, but they actually return again to disrupt the community. People from Cot Punti and Ranto Sabon village, Sampoiniet, have become restless against the disturbance caused by 15 elephants roaming around the settlements.
Figure 4. Cottage and Community Houses Raiding at Mane: (A), PanteCeureumen (B), Sampoiniet (C) and Cot Girek (D)

The impact of human-elephant conflict is increasingly frightening the society because wild elephants have known to attack and even injure human. From 2000 to 2007 there were 25 cases of human deaths from conflict in Aceh. In 2007 to 2008, there was four cases of death and injury to human while five cases in 2011 to 2012. The current report from our study revealed that in Pante Ceureumen, West Aceh, a citizen was trampled by elephants and critically injured. This incident occurred around the area of oil palm plantations. The next incident was two weeks later in the same sub-district, a farmer was killed by an elephant and injured another. Conflict occurred again in this district, when three wild elephants rampaged around 20:00 pm, injuring a mother and child resting in a hut. In addition, the people of Hamlet Krueng Meulaboh with 54 heads of household, were forced to flee to another village and remained there for three days due to rampaging group of wild elephant.

Conflicts that occur tend to cause a negative attitude of society towardsthe elephants, which is the lack of public appreciation of elephants and resulted in detrimental effects on conservation efforts. The human-elephant conflict occurred, is indicated with increasing elephant deaths due to traps, toxins and hunting. Further according to [29] that during March to July 2012, dead elephant have been found to be poisoned in several places in Aceh. Initial investigation results from conservation activists indicate there is a link between elephant deaths in Aceh. Previously in the year 2000 to 2007, death record on elephant in various regions in Aceh reached 71 individual while, elephants captured are 221 individual. The results of this study also found human-elephant conflict ended up with the death of a wild female elephant due to poison. The dead elephant is found in the area of oil palm plantations, in Krueng Ayon Village, Sampoiniet. If the elephant killings continue, then 10 to 15 years into the future elephants will be extinct in the forests of Aceh.
4. Conclusions

Decreasing forest cover of Aceh continues to have an impact on the increasing intensity of human-wildlife conflict, especially the Sumatran elephant species. The extent of agricultural land expansion, plantations, settlements and forestry industries has directly affected the decline of elephant habitat, leading to human-elephant conflicts. Typology of human elephant conflict occurred are found to be: elephant damage plants/vegetation, elephants destroy cottages and community houses, elephants attack/injure humans and humans injure/kill elephants. Thus, the study reflected causes of conflict and typology of human elephant conflict in order to facilitate community efforts and participation in mitigating future human-elephant conflict in Aceh.

Acknowledgments

The authors would like to express the highest gratitudes to: Balai Konservasi Sumber Daya Alam (BKSDA), Conservation Response Unit (CRU) Aceh, Aceh Climate Change Initiative (ACCI) for giving us research permit and field assistances. The author would also personally thank to the Mahout, who helped in tracking, observing elephants in human-elephant conflict zones.

References

[1] Peterson MN, Birckhead JL, Leong K, Peterson MJ, Peterson TR 2010 Conservation Letters 3 74
[2] Jones EB 2012 Tracking human wildlife conflict: A prerequisite for linking conservation and poverty alleviation (Kenya: Poverty And Conservation Learning Group Discussion) Paper No. 06
[3] Distefano E 2009 Human wildlife conflict worldwide: collection of case studies, analysis of management strategies and good practices (Tanzania: Natural Resource Forum)
[4] Naughton-Treves L, Mena L, Treves A, Alvarez N, Radeloff C 2003 Conservation Biology 17 1106
[5] Madhusudan MD. 2003 Environmental Management, 31 466
[6] Weladji RB, Tchamba MN 2003 Oryx 37 72
[7] Adjeudoh P, Beier P, Sam MK, Mason JJ 2005 Pachyderm 38 39
[8] Yogasara FA.Zulkarnaini, Saam Z 2012 Jurnal Ilmu Lingkungan Universitas Riau
[9] Nyhus PJ, Sumianto, Tilson R 2000 Oryx 34 262
[10] Sitompul AF 2004 Conservation implication of human-elephant interaction in two Nasional Park in Sumatra (Athens: University of Georgia)
[11] Woodroffe R, Thirgood S, Robinowitz A 2005 People and wildlife: Conflictor co-existence? (Cambridge: Cambridge University Press)
[12] Hoare RE 2000 Oryx 34 34
[13] Kiringe JW, Okello MM 2007 Ecology and Environmental Research 5 49
[14] Hoare RE 1992 Environmental Conservation 19 160
[15] Messmer TA 2000 International Biodeterioration and Biodegradation 45 97
[16] Fadhli N 2004 Gajah di Tesso Nilo dan konfliknya [Unpublished Report] (PekanBaru: WWF Area Riau Project)
[17] [FZS] Franfrut Zoological Society 2013 Strategi mitigasi konflik gajah dan satwa liar di Kabupaten Tebo [Unpublished Report] (Jambi)
[18] Nazir M 2003 Metode penelitian (Jakarta: Ghalia)
[19] Makindi SM, Mutinda MN, Olekaikai NKW, Olelebo WL, Abod AA 2014 IJSR 3 1025
[20] [PHKA] Perlindungan Hutan dan Konservasi Alam 2008 Pedoman penanggulangan konflik antara manusia dan satwaliar Permenut no: P 58/Menhut-II/2008 (Jakarta: Direktorat KKH)
[21] Alikodra HS 2002 Pengelolaan satwa liar (Bogor: IPB Press)
[22] [DEPHUT] Departemen Kehutanan 2007 Strategi dan rencana aksi konservasi Gajah Sumatera dan Gajah Kalimantan 2007-2017 (Jakarta: Dirjen PHKA)
[23] Febriani R 2009 Pemetaan daerah rawan konflik gajah menggunakan system informasi geografis di Taman Nasional Gunung Leuser (Medan: Universitas Sumatera Utara)
[24] Rood EJJ, Azmi W, Linkie M 2008 Gajah Journal 29 17
[25] Sukumar R 2003 The living elephants: Evolutionary ecology, behavior and conservation (New York: Oxford University Press)
[26] Tehamba MT 1996 Seasonal forage utilisation by elephant in Waza-Logone region (Wageningen: Ponson and Looyeen).
[27] Blake 2002 The ecology of forest elephant distribution and its implication for conservation. (Edinburgh, NZ: University of Edinburgh)
[28] Stokke S, du Toit JK 2000 Ecography 23
[29] Azmi W, Hasballah, Trysani F, Kholis M, Kiswayadi D, Linkie M 2012 Conservation Response Unit in Aceh [Annual progress report] (Banda Aceh: Flora Fauna International)