

THE RELATIONSHIP BETWEEN CONFLICT RISK OF SUMATRAN TIGER (*Panthera tigris sumatrae*) AND VEGETATION DENSITY IN THE LEUSER ECOSYSTEM AREA OF SOUTH ACEH DISTRICT

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Abstract: Sumatran tigers (*Panthera tigris sumatrae*) in the Leuser Ecosystem of South Aceh rely heavily on dense and diverse vegetation for food and protection. However, vegetation degradation due to deforestation and land conversion has pushed tigers out of their natural habitat, increasing the risk of conflict with humans which threatens the species' survival. This study aims to analyze the relationship between tiger conflict risk and vegetation density using the Normalized Difference Vegetation Index (NDVI). The research method combines a Participatory Rural Appraisal (PRA) approach and satellite image-based spatial analysis (Landsat 8/9 or Sentinel) to calculate NDVI, while conflict data was collected through SMART patrols in 13 villages and mapped with ArcGIS. The results show that the Sumatran tiger conflict risk is spatially distributed with a significant level of variation in the study area. High risk dominates with a percentage of 61.5%, mainly concentrated in five sub-districts: Trumon Tengah, Trumon Timur, Tapak Tuan, Kluet Tengah, and Meukek. Meanwhile, moderate risk (23.1%) was identified in Bakongan Timur and Trumon Tengah, and low risk (15.4%) was only found in Bakongan Timur. There is a striking pattern between vegetation density and conflict frequency, with low vegetation areas such as Bakongan Timur (7 cases) and Trumon Tengah (6 cases) recording the highest number of conflicts. In contrast, sub-districts with high vegetation cover such as Meukek, Tapaktuan, and Central Kluet recorded only one case each. These findings strongly indicate that habitat degradation, indicated by low NDVI values, is the main factor driving the increase in negative tiger-human interactions in the region.

Keywords: Leuser; Sumatran tiger; level of conflict risk; NDVI

Abstrak: Harimau Sumatera (*Panthera tigris sumatrae*) di Kawasan Ekosistem Leuser, Aceh Selatan, sangat bergantung pada vegetasi yang lebat dan beragam sebagai sumber makanan dan perlindungan. Namun, degradasi vegetasi akibat deforestasi dan alih fungsi lahan telah mendorong harimau keluar dari habitat alaminya, sehingga meningkatkan risiko konflik dengan manusia yang mengancam kelangsungan hidup spesies ini. Penelitian ini bertujuan untuk menganalisis hubungan antara risiko konflik harimau dan kerapatan vegetasi dengan menggunakan Indeks Vegetasi Perbedaan Ternormalisasi (NDVI). Metode yang digunakan menggabungkan pendekatan *Participatory Rural Appraisal* (PRA) dan analisis spasial berbasis citra satelit (Landsat 8/9 atau Sentinel) untuk menghitung NDVI, sementara data konflik dikumpulkan melalui patroli SMART di 13 desa dan dipetakan menggunakan ArcGIS. Hasil penelitian menunjukkan bahwa risiko konflik harimau Sumatera tersebar secara spasial dengan tingkat variasi yang

signifikan di wilayah studi. Risiko tinggi mendominasi dengan persentase 61,5%, yang terutama terkonsentrasi di lima kecamatan: Trumon Tengah, Trumon Timur, Tapak Tuan, Kluet Tengah, dan Meukek. Sementara itu, risiko sedang (23,1%) teridentifikasi di Bakongan Timur dan Trumon Tengah, sedangkan risiko rendah (15,4%) hanya ditemukan di Bakongan Timur. Terdapat pola yang mencolok antara kerapatan vegetasi dan frekuensi konflik, di mana wilayah dengan vegetasi rendah seperti Bakongan Timur (7 kasus) dan Trumon Tengah (6 kasus) mencatat jumlah konflik tertinggi. Sebaliknya, kecamatan dengan tutupan vegetasi tinggi seperti Meukek, Tapaktuan, dan Kluet Tengah masing-masing hanya mencatat satu kasus konflik. Temuan ini secara kuat menunjukkan bahwa degradasi habitat, yang ditunjukkan oleh rendahnya nilai NDVI, merupakan faktor utama yang mendorong meningkatnya interaksi negatif antara harimau dan manusia di wilayah ini.

Kata Kunci: Leuser; harimau sumatra; tingkat resiko konflik; NDVI

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Introduction

Indonesia's forests are home to some of the world's most protected mammals, including the Sumatran orangutan (*Pongo abelii*), Sumatran tiger (*Panthera tigris sumatrae*), Sumatran rhino (*Dicerorhinus sumatrensis*) and Sumatran elephant (*Elephas maximus sumatranus*). Deforestation in Sumatra has dramatically disrupted the overall population of Sumatran tiger (Patana, 2023). Three tiger subspecies Bali tiger (*Panthera tigris balica*), Sumatran tiger (*Panthera tigris sumatrae*), and Java tiger (*Panthera tigris sondaica*), once roamed across many Asian countries in the early 1900s. However, the Bali tiger was reported extinct in the 1930s, and the Javan tiger was reported extinct in the 1970s (BTNUK, 2014)

One of the most important areas in Indonesia is the Leuser Ecosystem Area (LEA), a vast landscape stretching across Aceh Province, located between Lake Laut Tawar and Lake Toba in North Sumatra. This region spans 13 districts: West Aceh, Nagan Raya, Southwest Aceh, South Aceh, Singkil, Subulussalamm, Southeast Aceh, Gayo Lues, Central Aceh, Bener Meriah, North Aceh, East Aceh, and Aceh Tamiang, as well as parts of Langkat, Dairi, Tanah Karo, and Deli Serdang (Nuribadah, 2022). The total area covers approximately 2,5 million hectares. Geographically, it lies between 2,25°-4,95° N and 96,35°-98-55°E. The Leuser Ecosystem includes Gunung Leuser National Park, wildlife reserves, protected forests, nature reserves, and other conservation areas (Consortium SAFEGE, 2014; Djufri, 2015).

Dense and diverse vegetation not only supports the natural habitats of the Sumatran tiger but also provides essential resources for the prey species within its food chain. Prey animals such as deer, wild boars, and others benefit from vegetation as a source of food, shelter, and nesting areas. Vegetation is also

The equipment used in this research includes the SMART patrol (tally sheet). The SMART patrol application is a tool with the capability to plan, analyze, report, and manage data related to biodiversity, patrol activities, threats, and field management interventions. SMART has four primary data collection components: spatial data, location, patrol time, and date (Puspita, 2015; Sofyan *et al.*, 2020). Other tools include Panthera type camera traps, Citra Landsat 8/9 or Sentinel imagery, popular imagery sources used for developing multisensory data, equipped with Onboard Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS), consisting of 11 bands (bands 1-9 on OLI and Bands 10-11 on TIRS) (Irwan, 2016), a computer unit, a research area map, a documentation camera, a Garmin GPS (Global Positioning System), and questionnaires. The location of the study area based on the preliminary survey results can be seen in table 1.

Table 1. Location of Tiger Conflicts in South Aceh District (Leuser Conservation Forum 2020-2023 data)

Village name	Sub-district	District
Koto	Kluet Tengah	South Aceh
Panton Luas	Tapak Tuan	South Aceh
Seubadeh	Bakongan Timur	South Aceh
Lhok Bengkuang	Tapak Tuan	South Aceh
Seunebok Alue Buloh	Kota Bahagia	South Aceh
Chalk Mountain	Trumon Tengah	South Aceh
Buket Meuh	Meukek	South Aceh
Jambo Papeun	Trumon Tengah	South Aceh
Naca	Trumon Tengah	South Aceh
Kapa Seusak	Trumon Timur	South Aceh
Seulekat	Bakongan Timur	South Aceh
Jambo Dalem	Trumon Timur	South Aceh
Alur Dua Mas	Kota Bahagia	South Aceh

Satellite image processing with Normalized Difference Vegetation Index (NDVI) analysis is a commonly used method for obtaining information on vegetation distribution and plant conditions at research sites (Huang *et al.*, 2021). The following are the general steps in processing satellite images with NDVI analysis.

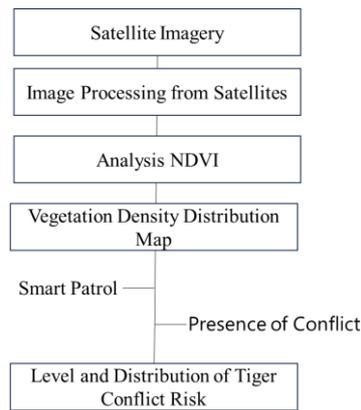


Figure 2. Working Diagram

Select satellite imagery

The satellite imagery used in the NDVI analysis was selected based on the suitability of its spatial resolution and recording time within the research period. The selection also considered the coverage of the study area and the data quality to support vegetation analysis.

Image preprocessing

Image preprocessing is necessary to remove disturbances or errors in satellite imagery. The following common preprocessing steps include radiometric correction, which corrects the image to remove brightness differences caused by atmospheric conditions and image capture geometry. Atmospheric correction removes the atmosphere's influence on the image to obtain a more accurate surface reflectance. Geometric correction is to align or correct geometric distortions in the image to produce a geometrically correct image. Calculating NDVI is after the image has been processed, the next step is to calculate NDVI. NDVI is calculated by the formula according to Johansen and Tømmervik (2014) as follows:

$$NDVI = \frac{(NIR-RED)}{(NIR+RED)} \dots\dots\dots(1)$$

Description:

NIR : Near-Infrared reflectance band (band 5)

R : Red band (band 4) (Smets *et al.*, 2018)

Where NIR (Near-Infrared) is the reflectance value in the NIR channel and RED is the reflectance value in the red channel. The NDVI formula produces values between -1 and 1. Positive values indicate the presence of vegetation with higher intensity, while negative values indicate the presence of water or objects that have no vegetation. NDVI Interpretation: After calculating the NDVI, the next step is to interpret the results. High NDVI values indicate healthy and dense vegetation, while low NDVI values indicate areas that lack vegetation or have obstacles such as water

or bare soil. Visualization and analysis: Finally, visualizing and analyzing the NDVI image is done using image processing software or GIS (Geographic Information System). Here is an overview of image processing to NDVI.



Figure 3. NDVI Index data collection diagram

NDVI values are obtained by comparing near infrared and red data (Waas and Nababan 2010) with the following formula:

Table 2. Interpretation of NDVI values

NDVI Value	Interpretation
0,00-0,32	Low density
0,32-0,42	Medium density
0,42-1,00	High density

Results and Discussion

Risk Level of Tiger Conflict

To provide a comprehensive understanding of the human-tiger conflict in South Aceh, the research findings are presented at the district level, even though data collection was conducted at the village level. This approach was chosen to offer a broader overview of the distribution of human-tiger conflicts and vegetation cover degradation based on NDVI analysis. Aggregating village-level data into a district-scale presentation facilitates spatial interpretation and pattern identification. In line with this spatial approach, it is important to explain the concept of conflict risk further as a basic for assessing human-tiger interactions.

The level of conflict risk refers to a measure or assessment of the likelihood and impact of conflict between two or more parties. Conflict is a mismatch of goals between two parties, resulting in conflict (Ratnasari, 2019). Conflict will occur if there is a difference in understanding between two or more people towards various disputes, and tensions between parties who do not agree (Bonsu *et al.*, 2019).

Conflict risk assessment includes an evaluation of factors that could trigger negative interactions between tigers and humans, such as the presence of tigers around settlements, attacks on livestock, or situations where tigers feel threatened and respond aggressively. In addition, the risk level also includes community perceptions and responses to the presence of tigers, which can influence the extent to which conflict can develop.

These conflicts arise due to a variety of factors, including habitat conversion, livestock abundance, and poaching of tigers and their prey. These factors contribute to spatial variation in human-tiger conflict, with areas near forest edges and

agricultural communities experiencing higher levels of conflict (Struebig *et al.*, 2018). Tiger conservation efforts should be based on a comprehensive assessment of the animal's entire range, known as a *home range-based* mitigation approach. In designing conservation strategies, an in-depth understanding of an animal's movement patterns and *home range* is essential. The Kernel Home Range Method is an effective analytical tool to evaluate and characterize tiger home ranges. In using this method, location data collected from the tiger is analyzed to identify areas most frequently visited or used by the animal during a given period. Kernel home ranges for nesting and post-nesting periods using the Geospatial Modeling Environment (Beyer, 2012); for additional details on home range development, see Lorenz *et al* (2015).

The Ministry of Forestry's 2008 conflict distribution matrix is an important tool in understanding LEA's conflict risk level. The data reflects the location and nature of conflicts, as well as their impact on psychological, economic and physical/life losses. In this context, table 3 of the study provides an in-depth look at the distribution of conflicts and their impacts, allowing for a more detailed analysis of conflict dynamics in LEA. Conflicts are classified into three categories, namely low, medium, and high, based on percentage ranges that reflect the severity of the conflict.

Table 3. Sumatran Tiger Conflict Risk

Event Location	A. Psychological Disadvantages		B. Economic Losses				C. Physical/Life Loss				Number of Cases
	A1	A2	B1	B2	B3	B4	C1	C2	C3	C4	
1. Tiger Appears			1. Livestock Casualties Outside the Cage				1. Injured Victims				
2. Tiger Appears Repeatedly			2. Livestock Casualties Outside the Cage Recurring				2. Multiple Injury Victims				
			3. Livestock Survivors in Cages				3. Victims Died				
			4. Livestock Casualties in Cages Recurring				4. Repeated Deaths				
Plantation	X	X	X		X				X		5
Settlement	X	X	X	X	X	X					6
Fields									X		1
Protection Forest							X				1
Total										13	

(Source of Research data, 2023).

Description:

High	Medium	Low
61,5%	23,1%	15,4%

Determining the percentage of each level of conflict can be done by comparing the number of conflicts of each level with the total number of conflicts of all levels and calculated as a percent. Table 3 provides an understanding of the psychological, economic and physical/life losses that are crucial in assessing the overall impact of conflict. This not only gives an idea of the intensity of the conflict but also allows for more targeted mitigation and rehabilitation strategies. Determining these categories allows this research and stakeholders to identify areas that require special attention, design appropriate coping strategies, and understand the complexity of conflict dynamics as a whole. The range of human-tiger conflict categories is outlined below:

The risk assessment of human-tiger conflict in the study area is based on Table 3 and analysis of NDVI values. Low or negative NDVI values indicate deforestation or environmental degradation that could potentially convert vegetation cover to non-vegetation (Zhang *et al.*, 2021). Areas with these conditions are often tiger pathways, but because they do not cause direct harm, the risk is categorized as low. Moderate risk arises when the frequency of tiger occurrence increases, especially when it causes economic losses, such as livestock being preyed upon in enclosures. This situation triggers psychological tension in the community due to recurring anxiety, even without direct contact between humans and tigers.

Meanwhile, high risk is characterized by recurring events that cause major losses, both economic and life safety, such as attacks on livestock outside and inside pens, as well as incidents that cause injury to human death. Based on Table 3, there were 13 conflict cases, including 4 psychological cases (category A), 5 economic cases (category B), and 2 physical/life cases (category C). The dominance of categories B1-B4, C1, and C3 served as indicators of high risk.

The other five cases are categorized as low to moderate risk because the tiger only passed by and did not cause recurring losses. As per Nasution *et al.* (2021), high risk occurs when conflicts threaten human or animal safety, while low risk is related to animal crossings without significant impact. Understanding this risk classification is crucial in developing adaptive social-ecological conflict mitigation strategies.

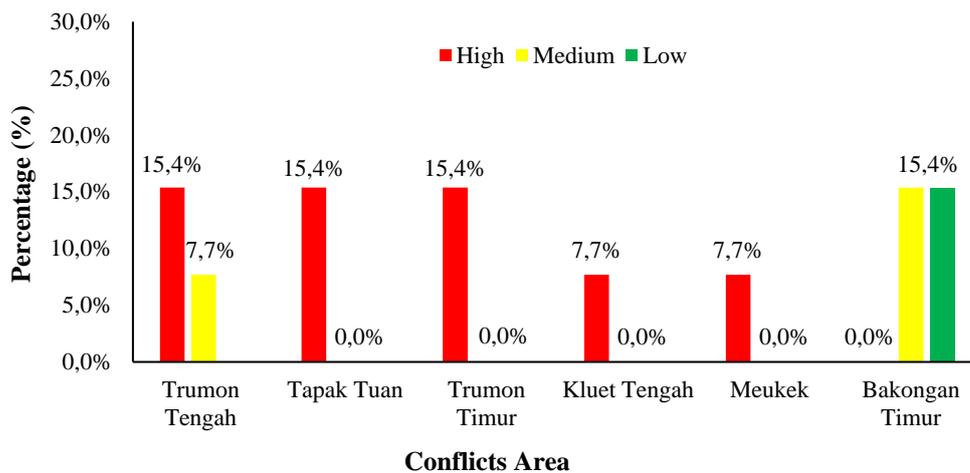


Figure 1. Conflict Risk Level for Each Subdistrict

The percentages in Figure 4 are data elaborated from the percentage data in Table 3, data derived from each conflict location and then accumulated in the conflict risk level data for each sub-district. The data in Figure 4 reflects the level of risk of conflict between tigers and humans in various research areas, the following is the interpretation of the analysis:

Central Trumon:

High: 15.4% of the area has a high risk of conflict, showing strong potential for tiger-human interactions. **Medium:** 7.7% the area has a moderate risk, with some moderate risk, with some influencing factors present but less intense. **Low:** No conflict risk was recorded in low-risk areas.

Tapak Tuan, and East Trumon:

High: High conflict risk at a land use level of 15.4%, indicating significant potential for conflict between tigers and humans in this area. **Medium and Low:** No conflict risks were recorded at medium and low levels.

Central Kluet, and Meukek:

High: High conflict risk of 7.7% in East Trumon and Central Kluet, indicating the potential for tiger-human conflict at this level. **Medium and Low:** No conflict risks were recorded at medium and low levels in Central Kluet and Meukek.

Bakongan Timur:

Medium and Low: Moderate and low conflict risk amounted to 15.4%, indicating the variation in risk of conflict between tigers and humans in this region.

This analysis shows the level of risk of tiger-human conflict in different regions, with the aim of planning and implementing mitigation measures to maintain a balance between tiger conservation and community safety. This level of risk can be assessed based on losses experienced by communities or wildlife, such

as livestock deaths or attacks on humans. Factors such as the frequency of tiger crossings, the amount of loss incurred, and the impact on human and wildlife life are key considerations in assessing the level of conflict risk. (Dickman, 2010). Conflicts between humans and wildlife occur in various parts of the world, including conflicts between people and *tigers* (*Panthera tigris*) in 2000 in Russia with historical human fatalities (Goodrich *et al.*, 2010).

According to Kholis, *et al.* (2017) stated that losses due to animal-human conflict are divided into three factors, namely social losses, ecological losses and economic losses. Conflict incidents cannot be handled with the same prevention methods every time they occur. Conflict risk levels are divided into low, medium and high categories. The categories are based on location, and community loss. Conflict involves the struggle for limited resources by humans and wildlife in an area that causes harm to the wildlife or humans (Dickman, 2010). Table 4 below illustrates conflict locations and hotspots from 2021 to 2023.

Table 4. Location of Conflict Events

Village Name	Location	Loss	Action
Buket Meuh	Fields	HS caught dead	Socialization and law enforcement
Panton Luas	Settlement	1 goat	Socialization and patrol
Lhok Bengkuang	Settlement	10 goats	The tiger was captured and re-released
Koto	Protection Forest	4 people in attack HS	The tiger was captured and re-released
Alur dua mas	Plantation	HS Passing	Socialization
Seunebok Alue Buloh	Settlement	HS Passing	Socialization
Seubadeh	Settlement	HS Passing	Socialization
Seulekat	Settlement	HS Passing	Socialization
Gunung Kapur	Settlement	1 goat	The tiger was captured and re-released
Naca	Settlement	1 ox	TPE Manufacture
Jambo Papeun	Plantation	HS Passing	Socialization
Jambo Dalem	Plantation	2 goats	The tiger was captured and re-released
Kapa Seusak	Plantation	3 goats and HS poisoned to death	Socialization and law enforcement

(Desc = HS; Sumtran Tiger; TPE; Tiger Proof Enclosure)
(Source: Research data obtained from BKSDA, FKL and WCS)

Table 4 describes the findings of tiger and human conflicts characterized by the coordinates of the location of the incident. These results use the kernel concept to construct spatial patterns from location data. This method includes all frequently visited coordinates and thus establishes a pattern of frequently used home ranges (Worton, 1989). Aceh Selatan District stands out as the region with the highest conflict intensity in Aceh Province, with most conflicts focused in the Leuser

Ecosystem (KEL), however, the dynamics of conflict can have serious impacts on the ecosystem.

According to local residents in villages that became other conflict areas such as Alur Dua Mas Village, Seunebok Alue Buloh, Seubadeh, and Seulekat Village, often seeing Sumatran tigers passing through plantation and residential areas caused concern from residents to move so that they prefer to stay indoors and not farm for a while to avoid direct conflict. Based on research data, conflicts that occur in South Aceh Regency generally occur due to fragmentation of Sumatran tiger habitat, coupled with people who herd and open plantation land close to protected forests. According to Nasution et al., (2021) an area that supports Sumatran tiger habitat is the presence of water sources, good forest cover and the availability of prey animals in that place.

Conflict Risk Distribution to Ndvi

There are 6 sub-districts that are the location of this research that have been analyzed for NDVI, and can be seen in the following figure:

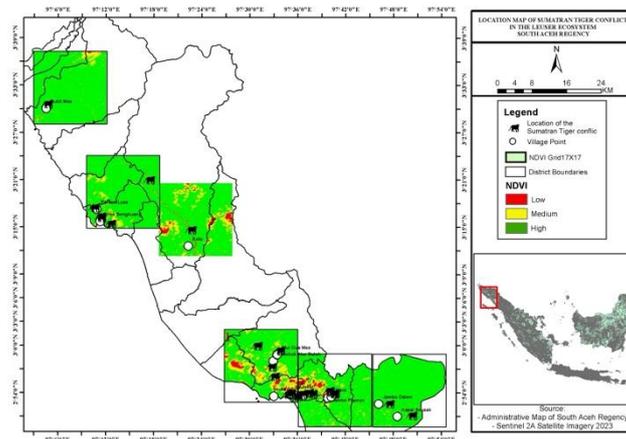


Figure 2. NDVI map of South Aceh

Based on Figure 5, six sub-districts have been analyzed for vegetation density using NDVI to determine its correlation with the risk of Sumatran tiger conflict including Meukek, Tapak Tuan, Kluet Tengah Bakongan Timur, Trumon Tengah, and Trumon Timur sub-districts with a grid area of 17 x 17 km (28.900 ha), the selection of the research location is based on the level of conflict that has occurred after conducting a direct survey, as evidenced in Tobing's research, (2019) explaining that Panton Luas Village in Tapak Tuan District, is one of the villages that is the location of Sumatran tiger conflicts with humans, the same thing also happened in Meukek District (Wikaldy, 2022), a similar statement in Trumon District by Rahmanda (2020, often occurs because the area according to the data is one of the Sumatran tiger habitat corridors in South Aceh.

Meukek Sub-district

One of the villages in Meukek Subdistrict is Buket Meuh Village or Bukit Emas, which is a village with Sumatran tiger conflicts. Based on the vegetation density index in this village, the highest reached an area of 27 thousand hectares, while the lowest was 88.6 ha.

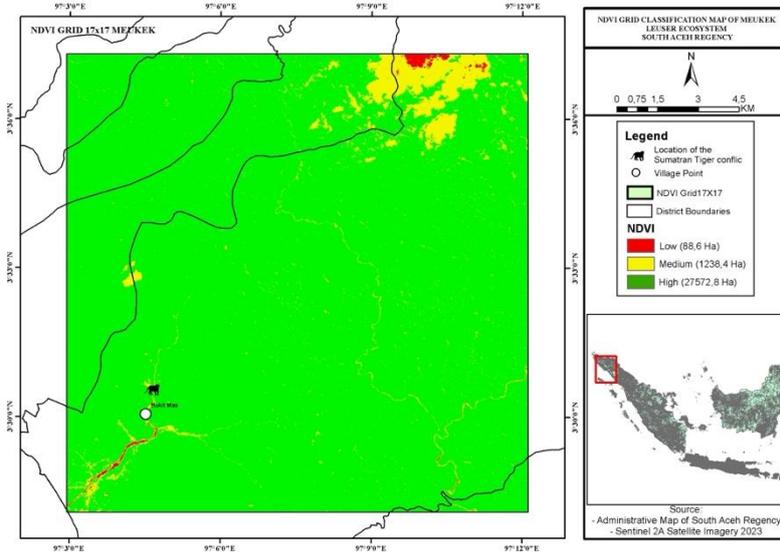


Figure 6. NDVI map of Meukek

Based on Figure 6, it can be stated that the land cover in Meukek Subdistrict has a high level of vegetation density and has a forest that is still maintained allowing the frequency of tiger conflicts to be lower, namely 1 case, and the location of the conflict in this Subdistrict occurs in fields close to the edge of the forest. This is reinforced by Lynam *et al.* (2000) which states that tigers are very dependent on dense vegetation cover, with dense vegetation it can be ascertained that many prey animals are sufficient to be hunted by tigers, this can also reduce the risk of conflict with humans because they do not attack livestock.

The frequency of conflict is low but the level of risk of conflict at this location is high with a percentage of 7.7% of the total, this is reinforced by the discovery of Sumatran tigers that died in traps set by the community near plantations/fields. According to Forestdigest (2022), Snares are set generally to hunt down pest animals that try to approach plantations/fields such as pigs and others.

Tapak Tuan Sub-district

The villages that became the point of this research were Panton Luas Village and Lhok Bengkuang Village which are two of the villages in Tapak Tuan Subdistrict, the vegetation density in Tapak Tuan Subdistrict can be quite high.

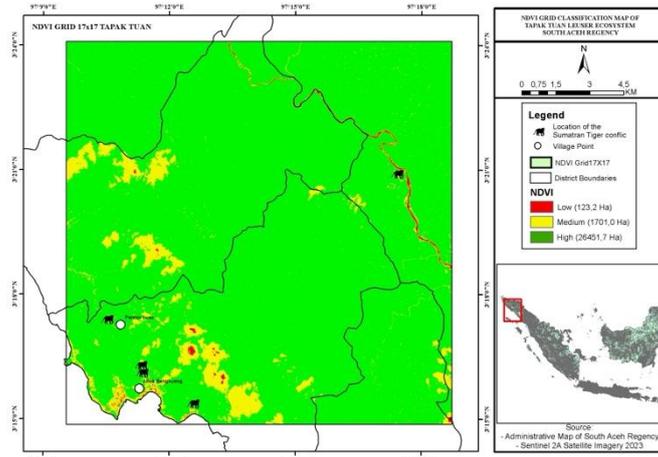


Figure 7. NDVI map of Tapak Tuan

Green areas indicate that vegetation density is high. Areas closer to the coast are indicated in yellow and red indicating lower vegetation. Based on Figure 4.4 in Tapak Tuan Sub-district there have been many forest areas converted, so the frequency of conflict in this area is quite frequent, namely 5 cases with a percentage of conflict of 15.4% with a high risk level, because there are villages that are directly adjacent to the forest which causes tigers to come down to settlements and prey on livestock and trigger a high risk of conflict.

According to Sinamo (2019), village boundaries, plantations or rice fields that are directly adjacent to forest boundaries are very risky for conflict with animals, based on conflict data in South Aceh, as many as 20 points of human-tiger conflict occurred in areas with a fairly close distance at the edge of the forest.

Central Kluet Sub-district

The village that became the research point was Koto Village where the highest vegetation density was 23 thousand hectares, while the lowest vegetation density was 1246.9 hectares.

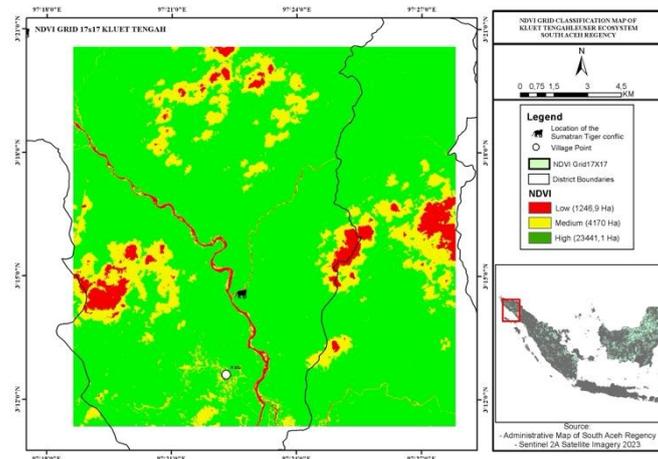


Figure 8. NDVI map of Central Kluet

The NDVI map of Central Kluet Sub-district has quite high vegetation, and the location of human-tiger conflict is in a protected forest area close to the river flow, the frequency of conflict at this location is 1 case with a percentage of 7.7 % and classified as a high risk of conflict, because this conflict resulted in 4 people being injured due to a tiger attack that was going through a protected forest which was thought to be a cruising area for these animals, because the Sumatran tiger's cruising area is quite extensive, as in Winarno and Ameliya (2009) stated that the cruising area for a tiger reaches an area of 20 - 100 km² , and according to Seidensticker *et al.* (1999) stated that the Sumatran tiger has a wide range, (1999) states that Sumatran tigers are very easy to find in forest areas close to water sources. In protected forests where there is still dense vegetation, with the availability of water and the presence of many prey animals is one of the factors that the area will become a Sumatran tiger crossing route (BKSDA, 2022).

East Bakongan and Central Trumon sub-districts

Bakongan Timur sub-district is one of the sub-districts that most often becomes a Sumatran tiger's track area.

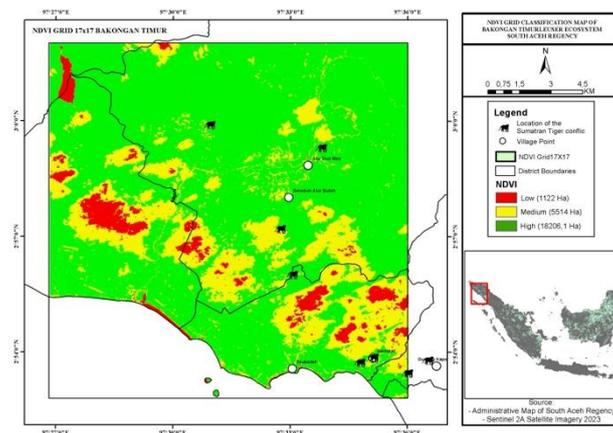


Figure 9. NDVI map of East Bakongan

There are variations in the risk of conflict in Bakongan Timur Sub-district, namely low and medium levels with a total of 7 cases. The percentage of low and medium level conflicts is 15.4% each. Meanwhile, the NDVI map of Trumon Tengah sub-district can be seen as follows.

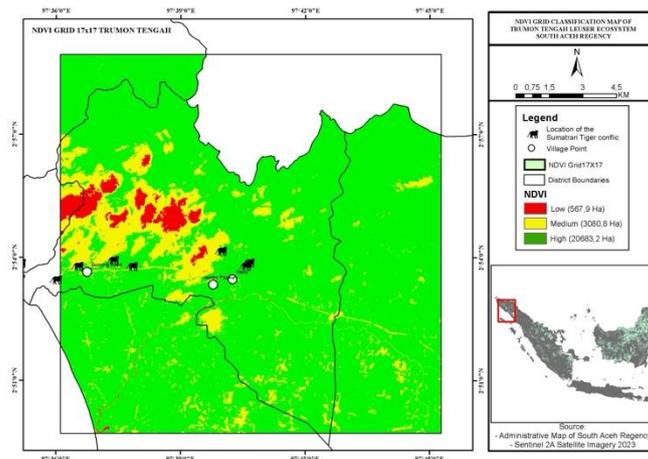


Figure 10. NDVI map of Central Trumon

There are many forest areas that have been converted into oil palm plantations along the roads in the villages of this sub-district. The level of conflict risk in this sub-district also varies, with a high risk level at 15.4% and a moderate risk level at 7.7%, with a total of 6 cases. The high risk of conflict occurred due to the death of residents' livestock as a result of being preyed upon by tigers, while tigers crossing repeatedly is a moderate risk of conflict.

Kecamatan Bakonga Timur and Trumon Tengah are the locations with the highest frequency of conflict. Based on figures 4.6 and 4.7, the total frequency of conflicts that occurred in Bakonga Timur Subdistrict reached 7 conflict cases and 6 cases in Trumon Tengah Subdistrict. The relationship between Sumatran tiger conflict and the density of a vegetation (NDVI) in this study is also clearly visible as happened in Bakongan Timur and Trumon Tengah sub-districts, with many forest areas converted into settlements, plantations and rice fields causing tiger conflicts to occur frequently in these sub-districts. According to the Natural Resources Conservation Center, it is confirmed that East Bakongan and Central Trumon are the sub-districts with the highest frequency of conflicts in South Aceh District. The tiger descended into settlements because one of the factors was habitat destruction due to loss of forest areas that were converted. (BKSDA ACEH, 2022).

Low forest density can also cause the frequency of prey animal encounters for tigers to decrease drastically, so that residents' livestock become prey targets for Sumatran tigers which leads to conflict with humans. According to Hadadi et al., (2015) the lack of vegetation density and diversity that occurs due to land clearing causes a decrease in vegetation biomass which also means a decrease in habitat quality, and this decrease in habitat quality affects the population of prey animals. According to Dinata and Sugardjito, (2008) which states that the existence of prey animals is strongly influenced by many factors, including ecological factors and the

threat of hunting prey animals by the community to natural habitat destruction such as land clearing or forest conversion.

Another problem that can be caused by low vegetation density is the loss of shade as a tiger shelter, especially for the safety of tiger cubs from predators, so that the mother tiger evacuates her cubs to safer places such as plantations. BKSDA Aceh (2022) states that female tigers very often bring their cubs out of the forest to settlements or plantations in addition to looking for prey, also aimed at avoiding attacks by male tigers or other predators. Based on the distribution of conflicts on each NDVI map, most of the Sumatran tiger conflict finding points with humans occur close to the watershed, this can be stated that the river is one part of the range area for Sumatran tigers because there are water sources.

According to Dinata and Sugardjito, (2008) Ecological and behavioral factors can limit the distribution of tigers in Sumatra, making the population vulnerable to habitat changes by humans. Distance from rivers, prey hunting, and tree cutting are three important factors that affect tiger encounter rates. Of the three factors, prey hunting is the most significant factor and has a large influence on the frequency of tiger encounters.

East Trumon Sub-district

East Trumon there are 2 villages that are the research locations, namely Jambo Dalem and kapa seusak. conflict locations and vegetation density index can be seen in Figure 11 as follows.

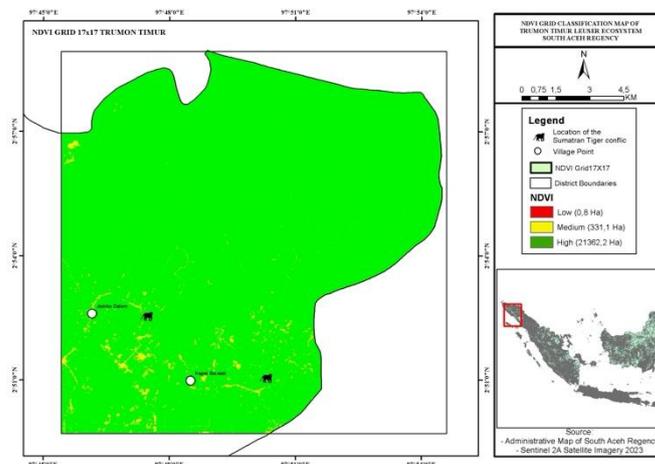


Figure 11. NDVI map of East Trumon

East Trumon sub-district is a location that has a high vegetation density, seen from NDVI analysis, the area that has vegetation reaches 21 thousand hectares, and only 0.8 ha of areas that have low vegetation density. Based on Figure 11, it can be stated that East Trumon Subdistrict has 2 villages with a total frequency of tiger conflicts of 2 cases that caused deaths to residents' livestock, and Sumatran tigers were found poisoned so that the level of risk of conflict at this location is classified as high with a percentage of 15.4% of the total. The location of the conflict that

occurred in the plantation was because the plantation was directly adjacent to the edge of the forest, which was originally an animal's home range, so habitat fragmentation occurred which triggered a lack of living space for Sumatran tigers. As stated by Rahman (2021), forest landscape fragmentation can encourage conflict because natural vegetation has been filled by anthropogenic areas so there is an intersection of animal range in cultivated land or plantation land.

Conclusion

Based on the results of the research that has been carried out, it can be concluded that the risk of Sumatran tiger conflict in KEL in South Aceh Regency consists of a high risk of conflict with a percentage of 53.8% which is spread in the Central Trumon District, and Tapak Tuan by 15.4% each, as well as in East Trumon, Central Kluet, and Meukek Districts with a percentage of 7.7% each. While at moderate risk of conflict with a percentage of 30.8%, spread in East Bakongan District by 15.4%, as well as in Central Trumon and East Trumon Districts with a percentage of 7.7% each. Then the low risk of conflict with a percentage of 15.4% is only in the East Bakongan sub-district.

The highest distribution of conflict risk occurs in low vegetation density in KEL in South Aceh District is in Central Trumon District at 7.7%. Low conflict risk with a percentage of 15.4% is only in Bakongan Timur sub-district. The highest distribution of conflict risk occurs in the low vegetation density class in East Bakongan District with an area of 1.1 thousand Ha with 7 conflict cases, Central Trumon District has the lowest vegetation density of 567.9 Ha with 6 conflict cases. The lowest conflict risk distribution in high vegetation density is in Meukek Sub-district covering 27 thousand hectares, Tapaktuan covering 26 thousand hectares, and Central Kluet covering 23 thousand hectares each with only 1 conflict case.

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Conflict of interest

The authors declare that there is no conflict of interest in the conduct of this research. The entire process of data collection, analysis, result interpretation, and manuscript preparation were carried out independently, without any influence from any party that could affect the objectivity of the research results.

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