Mitigation strategy of human tiger conflict in Leuser Ecosystem using SWOT matrix

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Abstract. Human and tiger conflict (HTC) has become one of the main drivers’ factor of the decline population of the Sumatran tiger (*Panthera tigris sumatrae*). The Leuser Ecosystem is an important landscape for tiger habitat covering 13 districts in Aceh Province and 4 districts in North Sumatra. The purpose of this study was to analyse the HTC mitigation strategy based on internal and external factors at Leuser. The location was chosen by purposive sampling in two potential areas of conflict, namely Timbang Lawan (TL) Village, in Langkat Regency and Panton Luas (PL) Village in South Aceh Regency. These two villages are directly adjacent to the tiger habitat. Data collection was carried out through field observations, interviews and focus group discussions. Respondents are experts and people living in conflict areas. The analysis was carried out using SWOT to measure IFAS (strengths and weaknesses) and EFAS (opportunities and threats). The results of the SWOT analysis show the differences in the mitigation strategies of each location. The comparison of IFAS and EFAS values places Timbang Lawan in quadrant III (WO strategy) while Panton Luas in quadrant I (SO strategy).

1. Introduction

Conservation effort to save Sumatran tigers is one of the most talked recent years. This is one of key species that hold a very important role in the ecosystem of Sumatra Island. Unfortunately, the number is declining by year to year. The status of sumatran tiger according to the IUCN (International Union for Conservation of Nature and Natural Resources) is critically endangered species with only around 600 left and spread in 33 spots on Sumatra Island with isolated conditions [1]. The interaction of human and tiger has experienced dynamics as long as the increasing number of human population and expansion their livelihoods coverage by fragmenting the habitat of wildlife [2].

[3] noted that for more than 20 years (1978-1997) the period of human and tiger conflict (HTC) in Sumatra caused deaths and injured, among human, tiger, livestock and others. Data from Natural Resouces Conservation Agency during the 2007-2017 period recorded more than 112 HTC incidents within Aceh and North Sumatra Province [4]. Several studies are related to the causes and predictions of conflict, characteristics and conflict management [2,3], conflict impacts [5], conservation strategies and policies [6,7]. Research related to economic aspects [8] and even social behavior and community
perceptions of wildlife conflict [9] show that the dimensions of conflict are very broad and need to get mutual attention from stakeholders. Even research on conflict mitigation techniques [10] cannot reduce the number of conflicts automatically due to the characteristics of the conflict are specific. Therefore, research on HTC mitigation strategies using SWOT analysis is expected to provide alternative strategies at the local level.

2. Methods

2.1. Study site
This research was conducted for six months in Panton Luas Village (PL) in Tapatuan District, South Aceh that has relatively remote area and Timbang Lawan Village (TL) in Bahorok District, Langkat Regency where it is relatively open access to the Gunung Leuser National Park (GLNP). The tools used in this study are digital camera, tape recorder, whiteboard and PC (Personal Computer).

2.2. Procedure on data collection
Data collection was carried out by interview techniques, field observations and focus group discussions (FGD). Case study interviews provide researchers the opportunity to ask key informants about the facts of an event as well as their opinion about the event [11]. FGD becomes a medium to summarize, check, and recheck all factors by involving people who have experience with the topics discussed. This technique is widely used as a form of participatory research in conservation [12].

2.3. Data analysis
SWOT analysis is used to evaluate strengths, weaknesses, opportunities, and threats in a project or a business speculation. These four factors form the SWOT acronym (strengths, weaknesses, opportunities, and threats) [13]. Two factors include IFAS (Internal Factors Analysis Summary) criteria, namely strengths and weaknesses, and two including EFAS (External Factors Analysis Summary) criteria, namely opportunities and threats. The accepted criteria are then analyzed by giving weight and rating to each criterion. The weights have an interval ranging from 0 (not important) to 1 (very important). Rating, for each factor (probability and strength) is given a scale ranging from 1 (lowest) to 4 (highest). As the next step of SWOT, [14] developed TOWS as alternative strategies. In developing strategies TOWS matrix provides a logical combinations of factors relate to internal strengths (or weaknesses) and external opportunities (or threats) (Table1).

| Factor                  | Internal Strengths (S)          | Internal Weaknesses (W)                  |
|-------------------------|---------------------------------|------------------------------------------|
| External Opportunities (O) | "Maxi-Maxi" Strategy that use strengths to maximize opportunities | WO: "Mini-Maxi" Strategy that minimize weaknesses by taking adv |
| External Threats (T)    | "Maxi-Mini" Strategy that use strengths to minimize threats | WT: "Mini-Mini" Strategy that minimize weaknesses and avoid threats |

3. Results and discussion

3.1. Characteristic of communities
Human-tiger interactions do not always lead to conflict. The two research locations have different types of interaction. Panton Luas is a prototype of a village surrounded by forests where it is an endemic habitat for the Sumatran tiger. The life of the people who has been living around the forest for decades is the key to be able to adapt well in interacting with tigers. They see the existence of tigers as part of their life. The people's belief is that as long as they don't disturb the tigers, they will be safe. This
interaction pattern is far from the name of conflict. Their traditional values guide them not to raise livestock such as cows, buffalo and goats because they believe it can provoke tiger to come. In general, people in Panton Luas can coexist with tigers. The community's local wisdom is one of the most prominent forces of life in Panton Luas.

In the other side human and tiger interactions in Timbang Lawan Village, Bahorok slightly different. Currently, the conflict was dominated by attacking livestock at the buffer zone of GLNP. In the last 3 years, this incident repeated in a shorter time intervals. The pattern of illegal grazing around the national park is the trigger for this conflict. Society tended to be more materialistic style and did not make sense that all incidents as part of human mistakes. This grazing model really provoked tigers to prey on livestock. The community is too dependent on NGOs' compensation if their livestock preyed by tiger. This is the most crucial point that must be addressed for social awareness to make public perception does not point tigers as an enemy.

3.2. IFAS and EFAS value

The local characteristics of each region give the dynamics of HTC around Leuser. Panton Luas (PL) has a higher total strength score than Timbang Lawan (TL) with value $S_{PL}(1.69) > S_{TL}(1.56)$, but on the weakness side, the score of TL is higher than PL, $W_{PL}(1.52) < W_{TL}(1.66)$. This shows internal factors of PL (IFAS) is relatively better than TL, $IFAS_{PL}(0.17) > IFAS_{TL}(-0.10)$ (see Table 2).

In terms of strength (S), there is a relative similarity between PL and TL that tiger is protected species where both of them have the highest scores, respectively $S_{1PL} = 0.39$ and $S_{1TL} = 0.31$. By having basic knowledge of protected species, it shows the awareness of community in preserving this endangered species. Further, the cooperative attitude in mitigating HTC (S5) which was shown by both locations with respective values of $S_{5PL} = 0.32$ and $S_{5TL} = 0.31$, shows the openness of attitude of local community's intend to be able to solve HTC with the parties.

Apart from these, as the 3rd strength factor (S3) in PL is local wisdom that positioning tigers as charismatic species ($S_{3PL} = 0.28$). Meanwhile in TL, the public is more likely to follow the guidelines in mitigating HTC ($S_{6TL} = 0.28$). This means that the people in PL prioritize local wisdom of living with tiger that has been passed through generation to generation as good as possible. The mitigation guidelines itself looks like a complementary to what they have done. However, there is a common awareness from both location regarding the forest as a habitat of tigers, this indicates local knowledge of the importance of protecting forest ($S_{2PL} = S_{2TL} = 0.26$). Another contrast difference is in terms of how to avoid tiger attacks, PL people have more experience than TL with a value of $S_{4PL}(0.22) > S_{4TL}(0.18)$. According to [15] people's tolerance for tigers was related to underlying attitudes, emotions, norms and spiritual beliefs.

In terms of weaknesses (W), the two locations have the highest weight that is almost the same for W5, since there is no insurance for HTC victims, $W_{5PL} = 0.30$ and $W_{5TL} = -0.31$. Similar conditions also occur in the problem of buffer zone that there is no map of the safety level for livelihoods (W1) with a relatively similar value of $W_{1PL} = -0.24$ and $W_{1TL} = -0.26$. The most prominent problem seen in TL is related to livestock grazing where people are not used to making livestock protection pens. The incidence of conflict in TL was mostly caused by poor management of cattle sheds and protection system. The different conditions in the PL that ther was no livestock surrounding the village, although in South Aceh commonly, it’s easy to find cattle in the village.

In term of opportunity of mitigation efforts (O), there is a good chance to carry out collaboratively. The position of the location is also very determining because it is related to human access, potential resources and the level of interest of the parties. In this position, collaborative mitigation opportunity is higher in TL than in PL with total for each $O_{PL}(1.41) < O_{TL}(1.82)$. One of the important points of collaborative mitigation opportunities since it facilitates local wisdom in local institutions and policies that would be better [15]. The government can become a facilitator to create institutions at both villages and district levels that integrated with the agency of MoEF such as conservation agency (BKSDA), national park (GLNP) and forest management unit (KPH). Both locations put the two opportunities in the highest order, respectively $O_{1PL} = 0.29$ and $O_{1TL} = 0.34$. Other things that quite important are multi
parties socialization of HTC, self-funding of village and awareness of various parties in the mitigation of HTC. It needs to be considered that tigers are not only in conservation areas but also in all types of land use. What a quite interesting is the problem of using technology in monitoring the movement of tigers, there is still a reluctance of the parties to do this for reasons of data security and cost. The score of both locations were the lowest, namely O5<sub>PL</sub> = 0.17 and O5<sub>TL</sub> = 0.22.

| Strength (S) | Panton Luas (PL) | Timbang Lawan (TL) |
|-------------|-----------------|-------------------|
| S1. Knowledge of the Sumatran tiger status as a protected species | 0.10 | 4 | 0.39 | 0.09 | 4 | 0.31 |
| S2. Awareness of the forest as habitat for the Sumatran tiger | 0.08 | 3 | 0.26 | 0.08 | 3 | 0.26 |
| S3. Local wisdom of tiger as charismatic species | 0.08 | 3 | 0.28 | 0.07 | 3 | 0.22 |
| S4. Knowledge on how to avoid tiger attacks | 0.07 | 3 | 0.22 | 0.07 | 3 | 0.18 |
| S5. Cooperative attitude in handling tiger conflicts | 0.09 | 4 | 0.32 | 0.09 | 4 | 0.31 |
| S6. HTC mitigation engineering policies and guidelines | 0.08 | 3 | 0.24 | 0.08 | 3 | 0.28 |
| Total | 0.49 | 1.69 | 0.47 | 1.56 |

| Weakness (W) | Panton Luas (PL) | Timbang Lawan (TL) |
|-------------|-----------------|-------------------|
| W1. Less of buffer zone mapping in safety level for livelihoods | 0.08 | -3 | -0.24 | 0.08 | -3 | -0.26 |
| W2. Less of HTC early warning system based authority management | 0.07 | -3 | -0.22 | 0.08 | -3 | -0.26 |
| W3. Less of technology-based monitoring of tiger movements | 0.07 | -3 | -0.18 | 0.06 | -3 | -0.16 |
| W4. Less of livestock protection system | 0.07 | -3 | -0.20 | 0.08 | -3 | -0.26 |
| W5. There is no HTC victim insurance | 0.08 | -4 | -0.30 | 0.09 | -4 | 0.31 |
| W6. The HTC mitigation communication system hasn’t yet structured | 0.07 | -3 | -0.22 | 0.07 | -3 | 0.20 |
| W7. Less barriers between edge forest and owned land | 0.06 | -3 | -0.17 | 0.07 | -3 | 0.22 |
| Total | 0.51 | -1.52 | 0.53 | -1.66 |
| Total IFAS (S+W) | 1.00 | 0.17 | 1.00 | -0.10 |

Furthermore, in terms of threats (T), the total score in PL (T<sub>PL</sub> = -1.21) is also smaller than threat in TL (T<sub>TL</sub> = -1.60). However, the total value of opportunities and threats (EFAS) from both locations is still positive, where the EFAS<sub>PL</sub> and EFAS<sub>TL</sub> values has a very small difference of 0.02 point (see Table 3). This means that many actors are ready to be involved in collaborative mitigation of HTC for both locations (see Table 3).

Based on the comparison of IFAS and EFAS values, the two regions have unique characteristics. The location of the Panton Luas point is on (0.17; 0.20), while the Timbang Lawan is on (-0.10; 0.20). The total of IFAS<sub>PL</sub> > IFAS<sub>TL</sub> but total of EFAS<sub>PL</sub> < EFAS<sub>TL</sub>. These results place PL in quadrant I and TL in quadrant III (see Table 2 and Table 3). It means mitigation strategy for Panton Luas is SO "Maxi-Maxi" Strategy, while Timbang Lawan is WO "Mini-Maxi" Strategy. The location of PL which is relatively isolated requires the community to maximize existing local wisdom toward sustainable
coexistence of humans and tigers. Meanwhile, TL must fulfill the existing weaknesses with a buffer zone management model that can reduce the risk of HTC.

Table 3. EFAS in mitigating HTC at Panton Luas and Timbang Lawan

| Opportunities (O)                                      | Panton Luas (PL) | Timbang Lawan (TL) |
|-------------------------------------------------------|-----------------|--------------------|
|                                                       | Weight | Rating | Score | Weight | Rating | Score |
| O1. Facilitating of local wisdom in institutions and policies | 0.08    | 4      | 0.29  | 0.09    | 4      | 0.34  |
| O2. Multistakeholder HTC socialization                 | 0.09    | 3      | 0.24  | 0.09    | 4      | 0.34  |
| O3. Self mitigation village of HTC                     | 0.09    | 3      | 0.26  | 0.09    | 4      | 0.34  |
| O4. Enhancing multi-stakeholder awareness in mitigating HTC | 0.08    | 3      | 0.21  | 0.09    | 4      | 0.34  |
| O5. Development of a technology based monitoring system | 0.07    | 2      | 0.17  | 0.07    | 3      | 0.22  |
| O6. Collaborative bufferzone management                | 0.09    | 3      | 0.23  | 0.08    | 3      | 0.24  |
| Total                                                 | 0.51    | 1.41   | 0.52  | 0.52    | 1.82   |

| Threats (T)                                           | Weight | Rating | Score | Weight | Rating | Score |
|-------------------------------------------------------|--------|--------|-------|--------|--------|-------|
| T1. Tiger poaching in the jungle                       | 0.08   | -3     | -0.21 | 0.09   | -4     | -0.31 |
| T2. Unbalanced number of preys                         | 0.07   | -2     | -0.17 | 0.08   | -3     | -0.24 |
| T3. Actions outside the legal limits                   | 0.09   | -3     | -0.23 | 0.08   | -3     | -0.27 |
| T4. Livestock on the forest border                     | 0.07   | -2     | -0.16 | 0.08   | -3     | -0.29 |
| T5. Illegal activities and land conversion             | 0.09   | -3     | -0.26 | 0.07   | -3     | -0.18 |
| T6. HTC mitigation is not comprehensive yet            | 0.08   | -2     | -0.18 | 0.09   | -4     | -0.31 |
| Total                                                 | 0.49   | -1.21  | 0.48  |        |        | -1.60 |
| Total EFAS                                            | 1.00   | 0.20   | 1.00  | 0.22   |

3.2.1. **SO strategy of Panton Luas.** The mitigation strategy of HTC in Panton Luas Village is an aggressive strategy (SO), that means a strategy by maximizing its strength to take advantage of existing opportunities. Regarding discussion with experts and field observation the steps could be taken using its strength such as follow:
- SO1. Maximizing local knowledge of Sumatran tiger status as a protected species
- SO2. Optimizing community awareness of the forest as habitat for the Sumatran tiger
- SO3. Maintaining local wisdom of tiger as charismatic species
- SO4. Disseminating knowledge on how to avoid tiger attacks
- SO5. Supporting cooperative attitude in handling tiger conflicts
- SO6. Internalizing HTC mitigation technique and guidelines into livelihood

3.2.2. **WO strategy WO of Timbang Lawan.** HTC's mitigation strategy in Timbang Lawan is a turn around strategy or changing tactics, a strategy that maximizes the opportunities aviability to minimize existing weaknesses. In other words, HTC's mitigation efforts are suggested to change the existing strategy, due to it's worried that the old strategy will be difficult to seize the existing opportunities and at the same time to improve the HTC challenges.
- WO1. Facilitating of local wisdom both in institution and policy
- WO2. Intensifying multistakeholder HTC network
- WO3. Self-assisstance conflict mitigation village
- WO4. Enhancing multi-stakeholder awareness in mitigating HTC on how to avoid tiger attacks
- WO5. Developing of a technology-based monitoring system
WO6. Initiation of collaborative bufferzone management

Finally, various strategies can be developed in an effort to mitigate human and wildlife conflicts. This is in accordance with the conflict mitigation guidelines P.48 / 2008 from the Ministry of Environment and Forestry [16] that mitigation human and wildlife conflicts should consider the principles of: a) humans and wildlife are both important; b) site specific; c) there is no single solution; d) landscape scale and e) responsibility of all parties.

4. Conclusions

The complexity of the HTC mitigation problem requires a strategy that is in accordance with the characteristic conditions of each region. Panton Luas and Timbang Lawan Cases illustrate the different forms of intervention that must be carried out. Total IFAS Panton Luas is greater than Timbang Lawan (IFAS_{PL} > IFAS_{TL}), but the total EFAS Panton Luas is smaller than Timbang Lawan (EFAS_{PL} < EFAS_{TL}). The strategic approach taken for Panton Luas is SO strategy, while Timbang Lawan using the WO strategy.

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