Do oil palm impacts on species richness negatively affect the local livelihoods?

Arzyana Sunkar¹, Stephany Debby Eka Putri¹, Shinta Nur Rahmasari¹, Ade Saraswati¹, Farras Imantoko¹, Lutfy Alif Putra¹

¹Department of Forest Resources Conservation and Ecotourism, Faculty of Forestry, Bogor Agricultural University, P.O Box 168 Bogor, Indonesia

*E-mail: arzyanas@gmail.com

Abstract. Land use conversion is the leading cause of biodiversity changes, and biodiversity is often used as an indicator of sustainability. A great number of scholars and public, in general, have often associated biodiversity loss, such as species richness, with unsustainable oil palm plantations. Similarly, oil palm expansions were also associated with negative impacts on the local people’s livelihoods. Seldom in discussions on oil palms sustainability, do they take into consideration the perceived biodiversity changes from social points of view. This study seeks to determine the local people’s perceptions of the changes in species richness due to land conversion into oil palm plantations and how they have affected the local livelihoods. Household surveys were conducted using direct observation, literature study, and in-depth structured interview to 373 respondents from various ethnicities including indigenous people in 15 villages around 6 oil palm estates in North Sumatera, Riau, and West Kalimantan, whom were selected based on convenience sampling. Respondents were stratified into indigenous people, migrants, and estate’s workers. A five-point Likert Scale was employed to identify people’s perceptions while recollection technique was used to identify biodiversity loss. Results of the study revealed that there were varied perceptions related to the impacts of oil palms expansions on species richness from social perspectives. The species had different ecological and social values, depended on the benefits that people attach to the species. Although, as many as 16 wildlife and 15 plant species loss were recalled following the plantations’ development, these losses provided little contributions to the current livelihood strategies. The locals appeared to be responsive to better economic opportunities and willingness to shift the livelihood system for improved incomes. These results suggested that species richness might not always be the best indicator of plantation sustainability, as sustainability other than approached from ecology, must also have social and economic dimensions.

1. Background

Oil palm plantations, one of the several important human-induced ecosystem change through land conversion [1], have drawn much divergence from various stakeholders, covering a range of issues related to their impacts on biodiversity loss, as well as on rural communities, rural economics and...
household economics [2], [3], [4], [5]. The emergence of oil palm villages has also been associated with changes in the local cultivation practices that was blamed for altering the biodiversity composition (richness) as well as leading to local food insecurity [6], [7]. Yet, if managed properly, the socio-economic benefits of the plantations can improve livelihood and alleviate poverty [8], [9], [10], [11], [12].

Management of sustainable environment has so far been based on biological/ecological data [13], including sustainable oil palm plantations, which often ignores biodiversity relationships with humans [14]. Many international debates and discussions use biodiversity as their main instrument to value environmental management effectiveness [13] since a healthy environment is often synonymous with high biodiversity [15], [16]. Biodiversity is said to influence the functioning of ecosystems [17], [18], a term that defines the capacity of natural processes and components, in providing goods and services that will directly or indirectly satisfy human needs [19]. It provides a mixture of ecosystem services, which directly and indirectly contribute to human well-being [20].

People’s level of support to the local biodiversity would depend on several factors. In their research [21], [22] have found that preferences over wildlife are diverse and are closely related to the differences in socio-demographic background, use of the resources for consumption purposes and the effect on their welfare, years of living in the area, frequency of interaction with wildlife, and attitudes toward wildlife in general. Thus, biodiversity is part of a social construct [23], since the social values attached to biodiversity would be attributable to the benefits that such wildlife or plants provides, implying that biodiversity have various potential uses with different values depending on the beneficiaries [24].

As the direct beneficiary of oil palm plantations, the social opinions of the local communities became increasingly important to be acknowledged and understood [14], because community's perceptions will be positively correlated with the development of the plantations [25]. Perception reflects the attitude and understanding of the people’s expectations of oil palm plantations, which will also differ depending on how the environment and resources are aligned with their respective livelihood strategies [25], [26]. It is important to have understandings on how the local people perceive biodiversity loss, because in the presence of better economic option, does the willingness to shift livelihood options, suggest that the loss of biodiversity in the ecological term, also mean a loss of livelihood?

2. Methodology
2.1. Study sites
The study was conducted from February – March 2018 in the periphery villages of six private oil palm estates in Indonesia (names abbreviated): PHLE (2° 19’ 09” N; 99° 50’ 22” E) & LPYE (3° 26’ 40.41” N; 98° 49’ 12” E) in North Sumatera Province; KJNP (0° 46’ 59.58” N; 101° 03’ 01.03” E) & BPME (0° 36’ 14.58” S; 102° 59’ 14.58” E) in Riau Province; and PKWE (1° 31’ 07” S; 110° 28’ 18” E) & NTYE (1° 34’ 0” S; 110° 32’ 0” E) in West Kalimantan Province. The villages have experienced economic growth due to the existence of oil palm companies; thus in this study, these villages will be termed oil palm villages.

2.2. Survey methodology
2.2.1 Data collection techniques
This study is historical-comparative research using the method of historiography, in gathering oral history evidence [27]. In order to identify the species that were lost due to the establishment of oil palm plantations, historical evidence was drawn based on recollection technique that is using the statements of individuals about their experiences in sightings a species based on memory. These were done using open-ended interviews. Attitudes and responses of the local people related to the existing biodiversity were gathered using five-point Likert Scales.
2.2.2 Selection of respondents

The survey design involved a multi-stratified sampling. The household was the basic unit of analysis and respondents were heads of households. In case of absence, a member of the household was identified as a replacement. The origin/culture influences social perceptions of private oil palm plantations; while environmental perceptions are affected by the length of time, a person lives in the area, whereas economic perceptions are not influenced by any socio-economic variables [28]. Considering these factors, the population studied were stratified into 3 groups: (a) indigenous people(I) – a group of individuals attached to a specific group of ethnicity, who were born and resided in an area, and whose family have been inhabiting the place for generations and do not work in the estates; (b) migrants(M) – an individual who came and live in the area following the government transmigration scheme or an individual who migrated to another area using self-supporting scheme and does not work in the estates; (c) estate workers(W) – an individual who works at an oil palm plantation estate and is not categorized under (a) and (b) strata. The total number of respondents (T) and stratification within each estate varied as shown in Table 1. Where possible, the indigenous community and migrants strata were further stratified into households with oil-palm related livelihoods and non-oil palm related livelihoods.

Table 1. A total number of respondents in each oil palm estate.

| No. | Estate | Province | Villages | Total Respondents |
|-----|--------|----------|---------|-------------------|
|     |        |          |         | I     | M     | W     | T     |
| 1.  | PHLE   | North Sumatera | Aek Korsik, Padang Halaban, Karang Anyar | 18 | 18 | 9 | 45 |
| 2.  | LPYE   | North Sumatera | Huta Baru Nangka, Siopuk Baru | 15 | 15 | 15 | 45 |
| 3.  | KJNP   | Riau | Sekijang, KijangMakmur | 17 | 25 | 4 | 46 |
| 4.  | BPME   | Riau | Suhada, Bagan Jaya | 24 | 16 | 6 | 46 |
| 5.  | PKWE   | West Kalimantan | SP3 Semblangaan, Tanjung Medan, Lembah Hijau 1, Lembah Hijau 2 | 20 | n/a | 40 | 60 |
| 6.  | NTYE   | West Kalimantan | Nanga Tayap, Tajok Kayong | 110 | 21 | n/a | 131 |

2.2.3 Data analysis

Names of the lost species and their social values were tabularized. Each Likert item was coded: 0 = do not know, 1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5=strongly agree. To enable interpretation of the data, the numbers of response for each code in each item were analysed using frequencies, i.e., percentages and placed in tables. Distributions of the most responses (% that agree, disagree, etc.) would enable the comparisons between the respondents’ groups.

3. Result and discussion

3.1. Biodiversity

This result showed that there might be a relationship between the organic material and soil macro fauna abundance, this result expected that the organic material provides food for the soil macro fauna, for example, earthworm. The earthworm is one of the examples of soil macro fauna, which affects the dynamics of changes of organic matter in the soil, as they decomposed the bigger fragments of organic material and turned in to cast (smaller fragments). Soil fauna feeding activity has a positive correlation with the earthworm and soil insect abundance. This result was linked with the observations made by reference [17] that bait perforation was not found when only meso fauna (such as collembolans) was present but seemed to be dependent on medium and large fauna like earthworms.

As a source of economic options, the daily life of a rural community cannot be separated from nature and its environment. As a neighbour of oil palm plantations, one or more of these interactions affected the daily life of most of the people living in these oil palm villages. However, the actual level of interactions between the communities and wildlife around the oil palm plantations varied greatly depending on the location of the village (distance to the plantation), species, and daily human activities (farming, livestock grazing, trading, working in government, etc.). Table 2 lists wildlife and
plant species, recalled by the local communities as no longer existed in the area after the establishment of the plantations.

Table 2. Species loss as perceived by the local people after oil palms development

| No | Wildlife Loss                          | Estates | Plants Loss          | Estates |
|----|---------------------------------------|---------|----------------------|---------|
|    |                                       | P      | L       | K       | B       | W | N   | P | L | K       | B       | W | N   |
| 1. | Manis javanica<sup>1,3,4</sup>        | √      | √       |         |         | √ |     |     |     | √       |         |     |     |
| 2. | Hystrix sp.<sup>1,3</sup>             | √      | √       |         |         | √ |     |     |     | √       |         |     |     |
| 3. | Cervus sp.<sup>1,3,5</sup>            | √      |         |         |         | √ |     |     |     | √       |         |     |     |
| 4. | Panthera tigris sumatrae<sup>1</sup>  | √      | √       |         |         | √ |     |     |     | √       |         |     |     |
| 5. | Elephas maximus sumatrensis<sup>1</sup>| √      |         |         |         | √ |     |     |     | √       |         |     |     |
| 6. | Muntiacus muntjak<sup>1</sup>         |         |         |         |         | √ |     |     |     | √       |         |     |     |
| 7. | Pongo abelii<sup>1</sup>              | √      | √       |         |         | √ |     |     |     | √       |         |     |     |
| 8. | Tapirus indicus<sup>1</sup>           | √      |         |         |         | √ |     |     |     | √       |         |     |     |
| 9. | Sus scrofa<sup>1,3,5</sup>            |         |         |         |         | √ |     |     |     | √       |         |     |     |
| 10. | Helarctos malayanus<sup>1</sup>       | √      | √       | √       |         | √ |     |     |     | √       |         |     |     |
| 11. | Tragulus kanchil<sup>1</sup>          | √      |         |         |         | √ |     |     |     | √       |         |     |     |
| 12. | Presbytis sp.<sup>1</sup>             | √      | √       | √       |         | √ |     |     |     | √       |         |     |     |
| 13. | Macaca fascicularis<sup>1</sup>       | √      |         |         |         | √ |     |     |     | √       |         |     |     |
| 14. | Amyda cartilaginea<sup>1</sup>        | √      |         |         |         | √ |     |     |     | √       |         |     |     |
| 15. | Paradapis hermaphroditus<sup>1</sup>  | √      |         |         |         | √ |     |     |     | √       |         |     |     |
| 16. | Hylabates muelleri<sup>1</sup>        | √      |         |         |         | √ |     |     |     | √       |         |     |     |

Note: P (PHLE); L (LPYE); K (KJNP); B (BPME); W (PKWE); N (NTYE); 1:mammal; 2:reptile; 3:source of income; 4:medicine; 5:food; 6:honey bee; 7-building materials

Given the proximity to oil palm plantations, most communities, especially those with a source of livelihood from oil palm, were often in contact with wildlife and plants thrived in the plantations and surrounding areas. Thus, they were more observant of their environment and knew when the local resources have changed. People use their local knowledge of plants and animals for either food or medicines to fulfil their household living needs, including using them for sources of income. In fact, 80% depends on this traditional knowledge to obtain their medicinal needs [29].

Table 2 indicated that 93.75% of the wildlife loss was mammals, ranging from small to large, of which 73.3% did not provide any contributions to the livelihood systems of the local communities. These results were in line with other research on biodiversity in oil palm plantations, that suggested mammals were one animal kingdom that was mostly lost after an oil palm plantation’s establishment [30], [31].

Most of the listed wildlife species loss were those inhabiting dense forest of which were mostly occurred in KJNP and BPME of Riau Province. Sumatra is home to big mammals. The communities living around KJNP and BPME could recall of the time when they were still living close to forests and were faced by threats from the big predatory mammals (table 2). Forests were cleared by the local people and plantation companies before the oil palm establishment [31]. However, according to the local communities and regulations studied [31], the stated forest area was not area appointed by the government as forest.

In addition, based on the research in the same areas, several butterflies and few birds species were noted to be ecologically loss [31], but these species were not recalled by the communities as loss. This suggested that people tend to recall wildlife based on size and their contributions to the livelihood and safety. Butterflies and most birds were small in size. They were neither used as a source of income, medicine nor food, hence were ignored in the memories. The small size and diversities of their colours added to the difficulties in recognizing different species. Aside from butterflies and birds, compared to the wildlife loss from an ecological perspective in the same study sites [31], the number of mammal species that were lost based on the recollection of the local people’s memories was higher, since the land use baseline that was used to identify ecologically wildlife loss was not forest, since
remnants of forest were not found within the area [30]. This highlighted the importance of incorporating local knowledge in historical, ecological studies.

Contrary to wildlife, plants species that were lost had significant importance for the local livelihood with 46.67% (including honeybee) used as sources of income, 20% as medicines, 46.67% as food plants and 20% as building materials. The local people have a better recollection of memories with regards to plants that supported their livelihoods. Table 2 indicated that NTYE experienced the most plant loss in terms of a number of species, of which the plants functioned as a wild food. The people living in NTYE were mostly the indigenous Dayaks who used plants to fulfil their daily food needs [32].

3.2. Local perceptions on wildlife loss
Biodiversity is part of social construct, where people showed preferences over them, of which can be liked or disliked for various reasons. Attitudes towards wildlife are influenced by factors such as interactions with wildlife regarding space and heterogeneity [33], [34]. Some studies conducted on local attitudes towards carnivores in Asia found that in general, crop damage and animal predation by wild animals had a negative effect on attitudes of local communities, while the benefits that can be gained by the community have given rise to their positive attitudes [33], [35], [36]. Furthermore, the various preferences over certain wildlife were very much related to varied socio-demographic backgrounds, use of wildlife as ingredients of consumption and better well-being, length of stay in the area, interaction with wildlife, and attitudes towards wild animals in general [37], [38].

Indigenous people were often associated with their local traditional knowledge of the living biodiversities since they are environment-dependent. It is assumed that because these people were indigenous, they have been living in the areas for generations. Table 3 below showed that the indigenous people of PHLE showed the most contrasting responses, where most of them agreed that oil palm plantations of PHLE Estate had caused increased wildlife diversity as well as increased sightings. These responses were complemented by the fact that PHLE and LPYE, both located in North Sumatra, experienced the least loss. North Sumatra was one of the first areas in Indonesia to be cleared for plantations, where according to historical records, the area was largely cleared from forest since 1917 [39].

Before the development of the first planting period of PHLE in 1983, the area was already planted with oil palms. Most of the indigenous people, both that were dependent on oil palm and non oil palm for their livelihood in other study sites, on the other hand, have disagreed that conversion to oil palm plantations has increased wildlife diversity. In fact, they stated that there were fewer animal sightings which impacted on the number of animals that could be used as sources of income. Table 2 above indicated that KJNP and BPME showed the most wildlife loss with 80% in KJNP, since KJNP were used to be the forested area.

Table 3. Local perceptions on the existing wildlife species richness after the establishment of oil palm plantations (highest percentage)

| Estate | Likert Statement (%) | Source of income (+) | Total species (+) | Species density (+) | Sighting frequency (+) |
|--------|----------------------|----------------------|------------------|--------------------|-----------------------|
|        |                      | I       | M       | W       | I       | M       | W       | I       | M       | W       | I       | M       | W       |
| PHLE   |                      | 1       | A       | A       | A       | N       | D       | N       | 44.44  | A       | D       | D,N     | A       | N       | A       |
|        |                      | 2       | 66.67  | 44.44  | 77.78  | 55.56  | 44.44  | N       | 44.44  | A       | 55.56  | 55.56   | 33.33   | 88.89   | 44.44  | 77.78  |
| LPYE   |                      | 1       | D       | D       | A       | A       | A       | A       | 60.00  | A       | A       | A       | A       | A       | A       |
|        |                      | 2       | 60.00  | 73.33  | 46.67  | 66.67  | 66.67  | 60.00  | A      | 80.00  | 53.33  | 53.33   | 73.33   | 33.33   | 80.00  |
| KJNP   |                      | 1       | D       | D       | D       | D       | D       | D       | D      | D       | D       | D       | A       | D       |
|        |                      | 2       | 81.82  | 37.50  | 75.00  | 63.64  | 68.75  | D       | 75.00  | D       | 72.73  | 37.50   | 50.00   | 72.73   | 43.75  | 50.00  |
| BPME   |                      | 1       | D       | D       | A,D    | D       | D       | D       | D      | D       | D       | D       | K       | D       |
|        |                      | 2       | 35.00  | 91.67  | 33.33  | 85.00  | 75.00  | D       | 83.33  | 40.00  | 33.33  | 67.77   | 50.00   | 33.33   | 50.00  |
Table 3 suggested that both migrants and the indigenous people do not show many variations in their responses. Specifically, in PHLE and LPYE, it was noted that migrants had an opposite response with regards to the sightings of individuals per species; since in this area, migrants have lived around the oil palm plantation longer than the indigenous people, and thus they were similarly observant of their surrounding areas.

Estate workers mostly spent their times in the company’s plantation, thus showed the most varied responses towards their perceptions of species diversity, and indicated by the “neutral” responses and “don’t know” responses among the agree’ and “disagree” responses. These suggested that the workers have the least knowledge on species diversity, due to the relatively homogenous environment of the plantations.
Concerning wildlife, table 3 indicated that the majority of the respondent's groups showed similar responses on the local species loss, that oil palm plantations development had caused loss of economically important species (see table 2). Similar patterns of response were also showed towards perceptions on species density and sightings frequency. People who were dependent on oil palm for their livelihood and those who were not, had tendencies to show a different pattern of responses, except for indigenous people, where both groups showed similar responses (except in PHLE as the only estate which showed varied responses from each stratum and oil palm dependent/not dependent). Such similar and varied responses were influenced by how much values were placed on the species by the people about their functions in fulfilling the economy or livelihood systems [40] as well as their interactions with the species [34].

PKWE and NTYE of West Kalimantan Province demonstrated the most homogenous responses among all strata and livelihood dependence groups, although different responses were found among the estate workers about species density and sightings. West Kalimantan indigenous people were the Dayak people and Melayu Kalimantan. It was observed, that there was similarity of the local knowledge on the resources. This was possible since the oil palm plantations are the youngest among the six plantations; hence most of the local communities observed and experienced similar surroundings, in other words, experienced similar interactions with the wildlife [34]. The only difference between the two community groups was culture, where Melayu is Muslim, and Dayak is Christian, thus influenced their perceptions toward wild boar and certain local plants.

In all six study sites, although the local people could recall the names of species that were lost, however, according to them, they have no significant impacts of their well-being, since they could compensate the loss of economically valued wildlife with other species or since at present, they have a better livelihood in oil palms. Whereas for the Dayak people whom most had not to shift to oil palm plantations means of living, they stated that the wildlife loss related to construction woods for building materials could be compensated with buying another type of woods as materials. With regards to wild boar, they also stated that they were not much affected since they manage their wild boar in the garden of their houses.

3.3. Local perceptions on plant loss
The plant categories were divided based on their purposes as a source of income, medicine, consumption, and diversity (table 4). Of the medicinal plants that have disappeared, the most rapid occurred in KJNP and BPME of Riau Province and least rapidly in NTYE. Parts of the study area in Riau were used to be peatland, where for many years prior to the establishment of the oil palm plantations, the area experienced selective felling of valuable tree species, such as Shorea spp (see table 2) [41], while Nepenthes sp. was exploited due to its increased ornamental values/commercial values [42]. The plants that disappeared were mostly plants that had economic values, in which the people used as sources of income and these use as consumptions.

On the contrary to the local people perceptions on wildlife loss, table 4 indicated that perceptions of the various groups of people and oil-palm dependent/not dependent were varied in each study site, except in NTYE. The reason for this might be because the oil palm company in NTYE was the youngest among other oil palm plantations in another study area, where the planting was just started in 2010, where it was 1983 in PHLE, 1985 in LPYE, 1991 in KJNP, 1998 in BPME and 2006 in PKWE.

Similar to the perceptions of wildlife as sources of income, the people in PHLE positively perceived the local perceptions on plants loss that had economic value. In the same line, the local people of NTYE showed no different perceptions among all respondents groups and the oil-palm dependent/not dependent.

In the case of other study sites, especially in KJNP and BPME, estates, it was noted from table 4 that the perceptions of the local people who were oil palm dependent were mainly negative towards oil palm impacts on increasing plants diversity, while those who were not dependent on oil palms, tent to show varied responses, where some stated “don’t know” and some remained neutral.
The most varied responses were shown towards perceptions on medicinal plants. Before the oil palm establishments, most of them were subsistent oriented, where they had a high dependence on the local resources, especially on plants. Before the establishment of oil palm companies, most of these oil palm villages have experienced a touch of modernization, where they no longer use medicinal plants but go to the local community health centres for medicines. Furthermore, markets were slowly developed, where the people could buy the food plants they needed.

Overall, there was an indication of high anthropocentric views of the local people towards wildlife for both the oil palm dependents and those who were not, indicated by the high negative responses (disagree) towards the impacts of oil palm plantations on wildlife as sources of income from all respondents strata. Despite biodiversity loss regarding ecology and economy, nevertheless, the local people perceived the ecological biodiversity loss as not a loss since they have adjusted their standards of living or even shift livelihood to continue survival, in the presence of better economic opportunities.

The local people now have a higher economic living from oil palms. Thus they are becoming more market-oriented.

4. Conclusion
The local people’s perceptions towards biodiversity indicated that there had been some declines in the frequencies of biodiversity sightings across the study sites, with KJNP and BPME in Riau Province showing the most species loss. The varying perceptions among indigenous people, migrants and workers simply indicated that perceptions on biodiversity were mostly influenced by their economic value in fulfilling household needs. Among all study sites, NTYE showed the least varied perceptions among the respondents and between the oil-palm dependent and those who were not. The establishment of oil palm plantations was a part of the modernization process, which embraced transformation of household economic pattern that led to a change in the household means of living. Thus, although ecologically the areas have experienced declines in species richness, however, from a social perspective, they were not considered as losses, since the people tent to show preferences over better economic opportunities.

Although the people acknowledged that changes in gains and loss of both plants and wildlife species richness were due to land conversion to oil palms, nevertheless, the majority agreed that their impacts upon their livelihoods were insignificant, since, in the absence of the species, they still enjoyed the welfare gains from the plantations

Acknowledgement
This work was supported by PT. SMART Tbk. Thanks are also forwarded to all the Directors and Staffs in the six oil palm estates for the permissions and facilities provided during the study period.

References
[1] N. Titeux, K. Henle, J. Mihoub, A. Regos, I.R. Geijzendorffer, W. Cramer, P.H. Verburg, L.L. Brotoms, Glob. Change Biol, 1-11 (2016)13P.A. Harrison, P.M. Berry, G. Simpson, J.R. Haslett, M. Blicharska, M. Bucur, R. Dunford, B. Egoh, M. Garcia-Llorente, N. Geamănă, W. Geertsema, E. Lommelen, L. Meiresonne, F. Turkelboom, EcosystServ, 9, 191-203 (2014)
[2] M. Colchester, S. Chao, J. Dallinger, H.E.P. Sokhannaro, V.T. Dan, J. Villanueva, Oil palm expansion in South east Asia: trends and implications for local communities and indigenous peoples, (Forest People Programme and Perkumpulan Sawit Watch, 2011)
[3] D.Sheil, A.Casson, E. Meijaard, M. Van Noordwijk, J. Gaskell, J. Sunderland-Groves, K. Wertz, M. Kanninen,The impacts and opportunities of oil palm in Southeast Asia: What do we know and what do we need to know?(CIFOR, Bogor, 2009)
[4] K.M. Carlson, L.M. Curran, D. Ratnasari, A.M. Pittman, B.S.S Filho, G.P. Asner, S.N. Trigg, D. Gaveau, D. Lawrence, H.O. Rodrigues, Proceedings of the National Academy of Sciences 109, 7559-64 (2012)
[33] A. Treves, J. Bruskotter, Science, 344, 476 (2014)

[34] L. Naughton-Treves, A. Treves, Socio-ecological factors shaping local support for wildlife: Crop-raiding by elephants and other wildlife in Africa. In: Woodroffe R, Thirgood S, Rabinowitz A(eds), People and Wildlife: Conflict or Coexistence? (Cambridge University Press, New York, 2005)

[35] J.S. Kahler, M.L. Gore, bio Conserv, 189, 49-58 (2015)

[36] Z.R. Mir, A. Noor, B. Habib, G.G. Veeraswami, Mt Res Dev, 35, 392-400, (2015)

[37] R. Kansky, A.T. Knight, Biol Conserv, 179, 93-105 (2014)

[38] J.J. Vaske, J. Roemer, J. Taylor, Wildl. Soc. Bul., 37, 122-128 (2013)

[39] K.J. Pelzer, Toau kebouen dan petani: Politik kolonial dan perjuangan agraria di Sumatera Timur 1863-1947, (Sinar Harapan, Jakarta, 1985)

[40] M.J. White, L.M. Hunter, Soc Sci Quarterly, 9, 960-82 (2009)

[41] A. Schrevel, Chapter 6: Oil-palm estate development in Southeast Asia: consequences for peat swamp forests and livelihoods in Indonesia, (FAO, Rome, 2008)

[42] T. Susanti, Edu-Bio, 3, 14-28 (2012)