Interdisciplinary Land Use and Natural Resource Management (ILUNRM)

Crop raiding by gaurs in rural Thailand: a symptom of protected area management

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Abstract

Human-wildlife conflicts (HWCs) are widely regarded as an important issue in conservation and protected area management. We investigated a potential HWC caused by crop raiding by gaurs (*Bos gaurus*) in rural Thailand. Using qualitative assessment techniques, we found that crop raiding was considered a serious problem by farmers, but that there were no effective mitigation strategies in place. We found that farmers are constrained in their coping strategies, and we propose four possible explanations related to governance and protected area management. We suggest that a possible motive for these constraints is the need for government to control territory through protected areas.

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Work distribution within the group

Section	**Responsible author**
Introduction	All
Methodology	All
Results and discussion	All
Conclusion	All

List of contents

Chapter 4: Discussion

Chapter 5: Reflection on methods and teamwork

1. Introduction

Nature conservation seeks to maintain populations and habitats for species other than humans. Since human activity is widespread, most conservation programs must account for the fact that species will interact with local human populations.

1.1 Human-wildlife conflicts and crop raiding

Humans' sharing of environments with other animals can lead to positive or negative interactions for both species. Negative interactions can be considered human-wildlife conflicts (HWCs), a term which we use to mean any situation with the potential to cause a loss of human life or property. These losses, or the fear of them, can in turn prompt the killing of wildlife, even in violation of protected status. The species involved will then suffer a population decline, which is especially problematic for endangered species. HWCs have attracted attention from researchers around the world due to their conservation significance and social impact.

One important type of HWC is crop raiding, which occurs when herbivorous animals visit farmers' fields in search of food, causing damage to the crop in the form of browsing and trampling. This results in an economic loss for the farmer, and can cause problems for conservation as farmers consider wildlife to be pests.

Relevant scientific literature on crop raiding is compiled in Appendix 1; a summary of the topic is presented in the following paragraphs. Farmers' opinion of wildlife is influenced not just by whether species damage crops, but also the environmental and social context in which the damage occurs. Opinion differs both within and across communities. These perceptions have important effects on the viability and legitimacy of conservation programs, as well as the actions taken by local people. Losses can be economic, in terms of income and labor, and psychological, via the quality-of-life impact of fear and stress. Although average monetary losses are small, the potential of catastrophic loss hangs over farmers' heads, and they feel frustrated by government restrictions on their defensive strategies. Farmers often express support for conservation in theory, but object to its practice, especially in the form of government intervention. It seems that a farmer's ability to cope with losses due to crop raiding is determined by their wealth, alternative sources of income, support from the government or the community, and compounding factors such as drought. Social factors (e.g. past losses, relationship with authorities) are important when farmers report wildlife losses to researchers.

1.2. Conservation and protected areas in Thailand

Government protection of forest areas in Thailand began in 1960 with the Wild Animals Reservation & Protection Act (WARPA), followed by the National Parks Act (NPA) of 1961. The first national park (NP) created was Khao Yai, in 1962 (Emphandhu & Chettamart, nd), with the stated purpose of preserving a natural area for educational and recreational activities. Non-hunting areas (NHAs) are smaller reserves dedicated to the protection of single species (Panusittikorn & Prato 2001). After economic development deforested large areas in second half of 20th century, in 1989 logging in natural forests, including in NPs, was banned (Panusittikorn & Prato 2001). Protected areas now contain much of Thailand's remaining forest cover.

Policy is highly centralized, with decisions made in Bangkok with little input from PA managers or local communities (Emphandhu & Chettamart nd); enforcement of PA policy relies on direct methods (patrolling rangers under NPD headquarters, which has a branch in every park) and indirect methods (media dissemination of 'nature appreciation') (Panusittikorn & Prato 2001).

1.3. Study area: Moo 4, Wang Nam Khiao sub-district

Moo 4 (*Moo* is an administrative division beneath the level of *tambon*, or sub-district) is a group of households in the Wang Nam Khiao sub-district of Nakhon Ratchasima province in central Thailand. Moo 4 is directly adjacent to the northern boundary of Khao Yai NP, and east of the hill known as Khao Phaeng-ma. Khao Phaeng-ma was formerly cleared of vegetation, but underwent a reforestation project starting in 1994, which has established a secondary forest that now covers the hill and connects to Khao Yai NP to the south (Prayong & Srikosamatara 2017). Gaurs moved into the Khao Phaeng-ma forest from the NP in the 1990s, and the population has since increased; Khao Phaeng-ma was declared an NHA to protect the gaur population in 2012.

Map 1Moo 4 and NHA: the red lines represents the approximate boundaries of Moo 4 and Khao Phaeng-ma NHA

The gaur is a species of wild cattle native to south and south-east Asia, classified as vulnerable by the IUCN (Duckworth 2016) due to habitat loss and poaching. In Thailand, the species now survives only in protected areas; the country-wide population was estimated to have been reduced to 915 individuals by 1994, a 60% decline over 20 years (Srikosamatara & Suteethorn 1995). Gaur are difficult to monitor because of their shy behavior and forested habitat, which makes them hard to count accurately; recent estimates in Thailand have been at the national park or conservation area level, measuring isolated populations rather than a country-wide census. There are some reports that some of these populations may be increasing due to their respite from hunting pressure (e.g. Tanasarnaiboon 2016); however, the assumption that gaur are safe in protected areas is challenged by reports of poaching, including in the Wang Nam Khiao sub-district (Tangprasert 2015). The gaurs of Khao Phaeng-ma NHA have become a tourist attraction for the area, with lookouts established to allow tourists to observe the animals (Prayong & Srikosamatara 2017). Gaurs are known to raid crops and have been involved in HWC with farmers in other parts of their range (Prasanth, Kumara & Thirumala 2013).

In Moo 4 itself, most of the 378 listed residents are involved in agriculture, especially maize cropping. Some residents also derive income from in tourism, by working as seasonal and weekend employees at local resorts or by selling fruit to tourists. The majority of the 20 resorts in Moo 4 are not owned by locals, but by outside investors; however, one former farmer had established a resort on his property.

Employment in the village is seasonal and based on the respective peak seasons for cropping and tourism.

In March, when we conducted our fieldwork, many farmers are working as laborers outside the village area. The legal owner of all land in the area is the Thai state; local residents hold one of two types of certificate permitting them to occupy the area and practice agriculture.

The location of the study area places it at the centre of interaction between a protected area (Khao Phaeng-ma NHA) and an agricultural area (Moo 4). Research in other parts of the world recognizes the importance of HWCs in conservation and local agriculture; large herbivores living in protected areas are seen as a major problem by farmers on the forest edge, with negative consequences for conservation. In Moo 4, the local gaur population living in Khao Yai NP may present a similar case, since the species meets many of the criteria that tend to reduce tolerance by farmers. Crop raiding by gaurs may represent a case of human-wildlife conflict on a protected area boundary.

1.4. Research question

Is there a human-wildlife conflict caused by crop raids in Moo 4, and if there is, how do local people respond to it?

2. Methodology

We investigated crop raiding by gaur as a HWC in Moo 4. We were interested in comparing the patterns of crop raiding in this case to those reported by other researchers; specifically, whether the gaur caused similar amounts of damage, if this damage was distributed in the same way, and if local farmers reacted in the same way. We expected that the findings of other HWC research on the causes and consequences of HWCs would apply in our case. Our understanding of crop raiding as an HWC was informed by a literature review conducted before we went to the field, which allowed us to create the following conceptual framework:

2.1. Concept: Crop raiding as a human-wildlife conflict

"Human-wildlife conflict" is a classification used by conservation and social scientists to understand problematic activities of people interacting with protected areas or species. It is a management perspective, intended to help protected area managers deal with local people. Crop raiding has attracted attention from researchers in several countries and is usually understood as a form of HWC. We reviewed literature on human-wildlife conflicts from around the world to inform our fieldwork in Moo 4.

2.2. Measuring impacts of human-wildlife conflict

The impact of crop raiding can be estimated in the field by interviewing farmers about their experiences. It is also important to understand farmers' perceptions of the gaurs, which may be based on more than financial costs.

2.3. Tolerance concept

Authors (e.g. Naughton et al. 1999) have used the concept of tolerance to describe farmers' perceptions of wildlife. In this concept, tolerance is taken to mean the seriousness of a crop pest as reported by farmers themselves. Tolerance therefore determines the farmer's stance toward various wildlife species.

We know from literature on other HWCs that attitudes to wildlife as crop pests are not simply based on the amount of crop damage, but involve a range of ecological and socio-economic factors. For example, farmers may consider a sudden, obvious caused by a large animal as less tolerable than a gradual one caused by a small one, even if the latter is more costly from a purely financial standpoint.

Tolerance		Intolerance
	SOCIOECONOMIC FACTORS	
abundant land	**land availability**	scarce land
God, self, community	**ownership of pest**	government or elite
varied, unregulated	**coping strategies**	narrow, highly regulated
community, group	**social unit absorbing loss**	individual, household
abundant, inexpensive	**labor availability**	rare, expensive
high	**game value of pest**	low
low	**capital and labor investment in crop**	high
subsistence	**type of crop damaged**	cash or famine crop
various	**alternate sources of income**	none
	ECOLOGICAL FACTORS	
small, non-threatening	**size of raiding species**	large, dangerous
early	**timing relative to harvest**	late
solitary	**pest group size**	large
cryptic	**damage pattern**	obvious
narrow, one crop	**crop preference of pest**	any crop
leaves only	**crop part damaged**	fruit, tuber, pith, grain
diurnal	**circadian timing of raid**	nocturnal
self-limited	**crop damage in each raid**	unlimited
rare	**frequency of raiding**	chronic

Figure 1: some factors determining farmers' tolerance of wildlife as crop pests (after Naughton et al., 1999).

We expect that farmer's tolerance of gaur as a crop pest will be related to but not entirely based on financial costs, and that this tolerance will determine farmers' actions. The available literature suggests that gaurs would not be tolerated by farmers, as it falls on the right-hand side of several of the above factors: it is a large, dangerous animal that moves nocturnally in big groups, causing obvious and extensive damage (Prasanth, Kumara & Thirumala 2013).

2.4. Methods

Fieldwork was conducted in February-March 2017 by a team of two Thai-speaking students from Kasetsart University, three non-Thai speaking students from Copenhagen University, two interpreters, and one driver. A list of methods is presented in Appendix 2.

2.4.1. Questionnaires

We decided to use a questionnaire to quickly gather information on crop raiding from local farmers. This method was chosen because it would allow us to count and compare farmer's reports of crop raiding, and give us our first information on the nature and scale of the problem. On arrival in Thailand, we learned that the Thai-speaking members of the research team had already designed a questionnaire based on their research question. That questionnaire was pilot-tested on three local residents; after pilot-testing indicated that the questionnaire did not pay enough attention to crop raiding, we added a set of nine questions relating to that subject, translated by the interpreters (see Appendix 3).

The questionnaire was responded to by 14 residents of Moo 4. They were sampled based on convenience, by asking our driver to stop at houses with people outside and asking if one of them would like to take part. The Thai-speaking members of our research team made the first contact; the questioning was carried out jointly by Thai-speakers and non-Thai speakers with the help of an interpreter. Questionnaires were conducted during the day (between 9AM and 6PM), in accordance with the working hours of the driver and interpreters.

The topic of gaurs generated a lot of interest from respondents. Respondents tended to volunteer extra information in the form of stories and anecdotes on the subject, which turned the intended questionnaire into more of a discussion or interview.

With only 14 respondents, the questionnaire could not be used for statistical analysis; however, the qualitative information volunteered by respondents made it more useful as a kind of interview.

2.4.2. Semi-structured interviews

The questionnaire provided useful information on crop raiding, and identified topics for more in-depth research. First, the questionnaire had indicated that local government and protected area managers played a role in both conservation and mitigation of crop raids. Second, respondents had indicated that the

situation of property rights and land ownership in Moo 4 was an important factor affecting farmer's agricultural practices and ability to cope with crop raiding. Third, tourism in the area was related to the presence of gaur. Finally, we wanted to return to some of the topics brought up in the questionnaire responses by re-interviewing farmers according to a more detailed plan. We therefore decided that a series of semi-structured interviews (SSIs) was needed. The list of SSIs, respondents and topics is presented in the Appendix 4.

Of the farmers, three questionnaire respondents agreed to a more detailed follow-up interview. SSIs were also planned for meetings with local government officials, community representatives, staff from the NHA, and the Royal Forest Department (RFD). We also unsuccessfully tried to arrange an interview with the headman of the village, who was unavailable throughout our fieldwork period. In interviews, some farmers and officials mentioned that monks from a nearby temple help with fundraising for conservation and park management activities. We therefore also interviewed a monk from the temple to confirm this.

We conducted interviews according to a pre-determined list of topics, shared with the Thai-speaking members of the team; interpreters were used to translate between Thai and English. The plans used for the SSIs are presented in Appendix 4.

Other interviews were conducted on an impromptu basis when we encountered potential informants in the area. These did not have a planned structure, but were intended to increase our knowledge of the area, gather more opinions about crop raiding and agriculture, and identify other potential respondents. As the questionnaires had also identified tourism as an important industry in the area, we held impromptu interviews with the owner of a tourist resort & an employee at another resort.

2.4.3. Focus group and mapping activities

A gathering of people from the study area was held on 11th of March, organized at our request by the village headman. Between 15 and 20 people took part. The Thai-speaking members of the team presented their findings, and subsequently facilitated a focus group session. This focus group was intended to produce a timeline of recent (since 1950) history in the village, and a Venn diagram showing the importance of various organizations. Villagers were asked to vote on the placement of different organizations in the Venn-diagram, which is ordered as a core with three circles surrounding it; the importance of the organizations decreases proportionally with the distance from the core.

After the focus group, we started a mapping activity with five people from the meeting: three women and two men, including assistant to village headman and a prominent member of the community who called

himself the district head. The activity invited people to fill in a map with types of crops matched to their locations during the previous season, combined with map of gaur visit distribution. The map was prepared ahead of time on large sheet of paper, showing an outline of the village area and notable features like roads and local water resources. First the participants were asked to mark the spatial distribution of different crops grown in the village, specifically the crops from last season. Crops were represented by symbols to ensure that people could take part despite language barriers or illiteracy. Afterwards, participants were asked to indicate which fields had most severely been damaged by crop-raids by gaur. This activity was intended to lead into a focus group discussion, but the lateness of the hour and fatigue on the part of participants meant this had to be abandoned. The plan for this method is presented in appendix 5.

2.4.4. GPS

We used GPS devices to record the location of households whose members participated in questionnaires and interviews. This allowed us to create a map showing the distribution of participating households in the area. Interviews with the former village headman and the current headman's assistant were used to identify the administrative boundary of Moo 4.

We also conducted a walking survey of the electric fence intended to restrict gaur to the NHA, and recorded the GPS coordinates of broken parts of the fence. This allowed us to estimate the fence effectiveness and to illustrate it on the map.

3. Results

Here we present our findings on human-wildlife conflict caused by crop raiding in Moo 4. We describe the situation and the responses by local people and authorities. We also compare the findings to our prior understanding of HWCs, and attempt to explain why this case may be unique.

3.1. The crop raiding situation:

All residents encountered in Moo 4 knew of crop raiding in the area, and almost all farmers had experienced it. In questionnaires, gaurs were the most frequently reported pest, and the most serious (although other pests were mentioned, they were considered minor compared to gaurs). Crop damage by gaurs was almost always reported as a very serious problem by farmers.

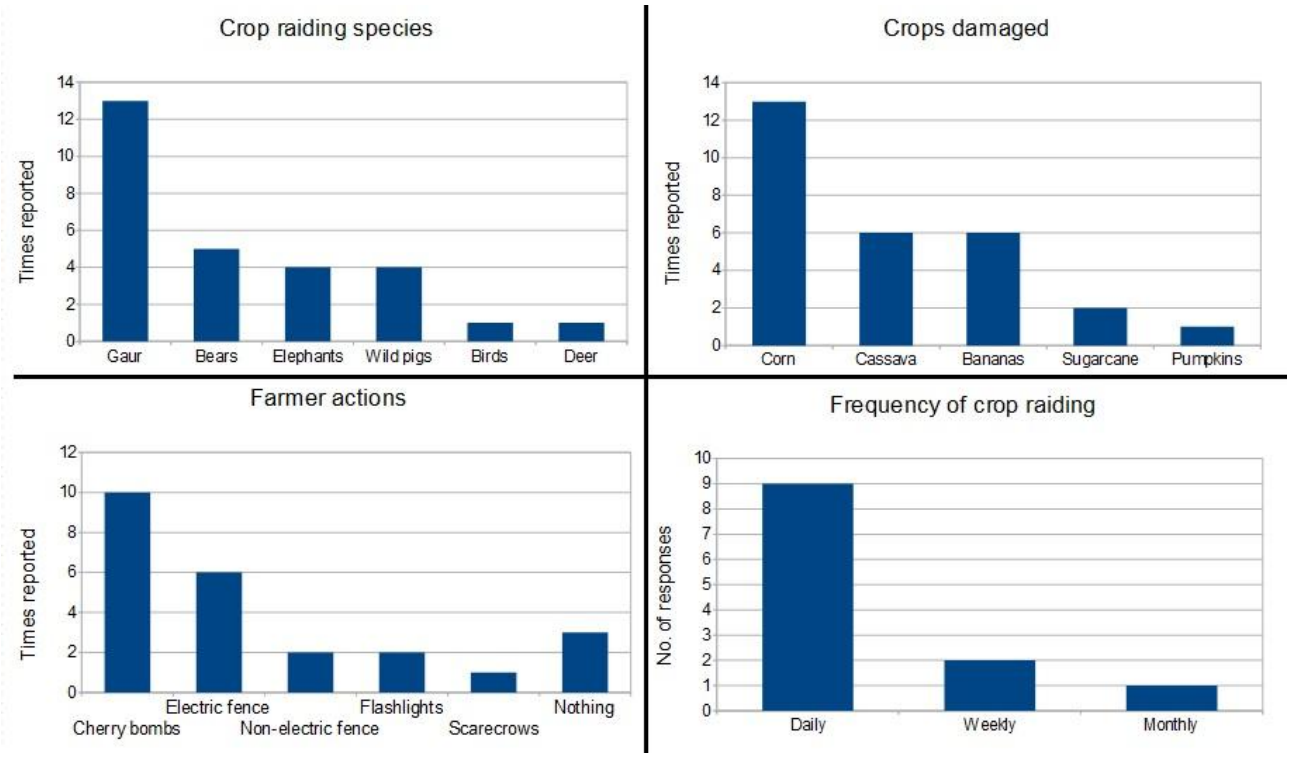


Table 1: Main questionnaire findings on gaur and crop raids

3.2. Gaurs in Khao Phaeng-ma: History and management

Protected status: According to NHA staff, the punishment for killing a protected animal depends on the species and the circumstances of the crime; in the case of gaurs, the punishment would be a fine (between 50,000 and 200,000 baht) or two to three years in jail. NHA and forest department staff reported that poaching of gaur is very rare, and that villagers comply with the law protecting the animals; the infrequent cases of poaching were blamed on hunters from outside the area. In general, protected area staff state that local people do not harm the gaurs, and want to coexist with them.

Farmers who took part in the questionnaire are aware of the penalties for killing a gaur. Farmers always reported that they are careful not to harm gaur, and some are even worried about being blamed for others doing so. One respondent claimed that after a gaur was found dead a month ago, police and soldiers arrived to search houses for firearms the same night.

3.3. History of reforestation, gaur population, and the beginning of crop raids

The reforestation program on Khao Phaeng-ma provided habitat for gaurs, which immigrated from Khao Yai NP from the mid-90's (Prayong & Srikosamatara 2017). Focus group participants and questionnaire respondents reported that the gaur population has been rapidly increasing since the reforestation program. This is supported by NHA staff, who report that gaur are breeding in their new home; the reason for the population increase is variously considered to be an absence of natural predators, the availability of reforested habitat or the effective end of trophy hunting (Prayong & Srikosamatara 2017; NHA staff & RFD official interviews). Estimates of the population size range from to 100 to over 1,000 reported by local residents; the Head of the NHA estimates between 200 and 300 individuals. Both farmers and park staff agree that population increases every year.

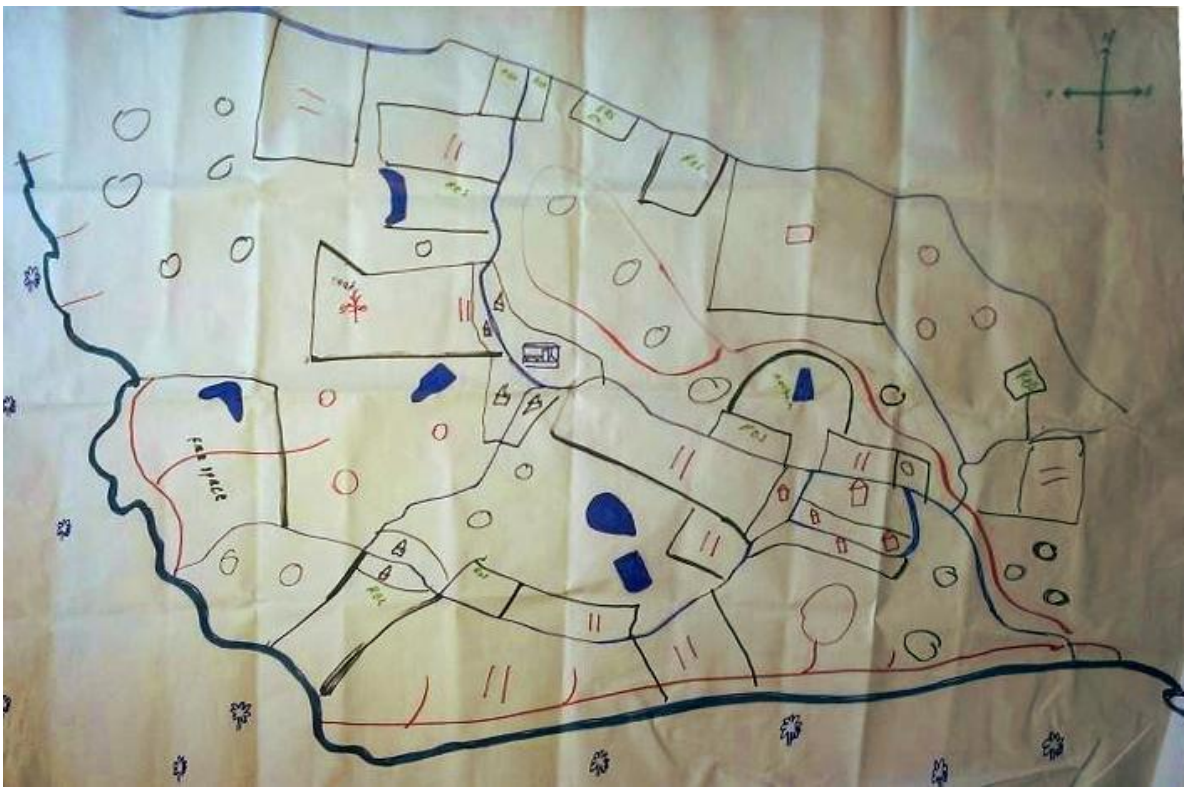
According to focus group respondents, the first crop raids by gaurs occurred in 2004; farmers reported that crop raids had first become a problem about 10 years ago. Farmers claimed that the increasing gaur population had been responsible for a corresponding increase in crop raids. Most respondents believed that the amount of food in the forest could not support the large population, and that the animals were leaving the forest out of necessity. The view that gaur are running out of food resources was also held by NHA staff.

3.4. Behavior and habits of gaurs

Farmers report that gaurs are shy, and travel through the area by following the cover provided by vegetation along watercourses; large, remote fields are most vulnerable. They leave the forest at sunset and visit fields at night. Some respondents said that gaur visit the area outside their homes every night throughout the year; others that the gaurs only visit during the dry season, when they are looking for water and green grass. Most questionnaire respondents suggested that gaurs are dangerous animals when angry, and some related the stories of gaur attacks on humans, including a local woman being killed by gaurs in the forest two years ago. NHA staff say that the gaurs are not naturally dangerous as they fear humans, but that they can be deadly if a gaur is afraid, injured or protecting a calf.

3.5. Extent and nature of crop damage caused by gaurs

Crop raiding is widespread in the village; most farmers reported that they and their neighbors experience it. The major crop in the area, corn, was always reported as being damaged by gaur, especially during the early part of its growing season when the stalks are still green (June and July). Reports of the damage caused vary, but agree that it is substantial. Some claimed that gaurs would destroy entire fields in one night; a commonly reported figure was one to two *rai* being lost at a time, a loss estimated by one farmer at 6,000-12,000 *baht*. Damage caused by gaur is due to them trampling and lying on crops as well as direct consumption.



Map 2: PRA Map developed by villagers on land use, crops and gaur visits in Moo 4

The mapping activity confirms the reported gaur behavior: The red lines indicating gaur movement follow vegetation and watercourses, and corn-fields (marked with circles) appear favored by the gaurs. Respondents emphasized the forest edge to the south as being the most directly exposed, but stated that everyone in the village is affected - the gaurs go everywhere.

Our interview with the NHA ranger suggested that all farmers in the area face the an equal risk of crop raids; however, some farmers stated that those fields closer to the forest are more prone, and that farmers try to avoid renting fields close to the forest. Some of the farmers interviewed said that some people have abandoned fields close to the forest as the gaur raids made farming untenable; these fields were later identified as 'free space' by participants in the mapping exercise (see above; left side - Map 2).

Photo 1: Villager showing a banana tree damaged by gaurs

3.6. Farmers' perception of gaurs

Farmers in Moo 4 frequently reported that they wish to coexist with the gaurs, but that they want crop raiding to be controlled. They see the gaurs as having a place in the forest, but not in their village. They say the gaur population is too high, and that the problem of crop raiding is getting worse every year. Since they are forbidden to harm gaurs, they consider their only option to be guarding their fields as best they can. They want the government to provide more help to manage the problem.

3.7. Responses to crop raiding

3.7.1. Farmer responses

Most farmers reported using cherry bombs (a type of firecracker) to scare away gaurs; however, farmers who used these often said that gaurs had become accustomed to the noise, rendering the tactic ineffective. Some farmers use fences (usually electric) to protect their fields, but these were often reported as inadequate as gaur can easily break fences when in large groups. Farmers receive help from the NHA staff in the form of batteries for electric fences, but must install and maintain them at their own cost. Farmers who do not use fences either consider them unnecessary (as their fields are far from the forest, and thus relatively safe from gaur), cannot afford them or doubt that they would help. One farmer stated in an interview that crop raiding forced people to live on the land they were farming and be constantly vigilant to prevent gaur from destroying their crop.

3.7.2. Community responses

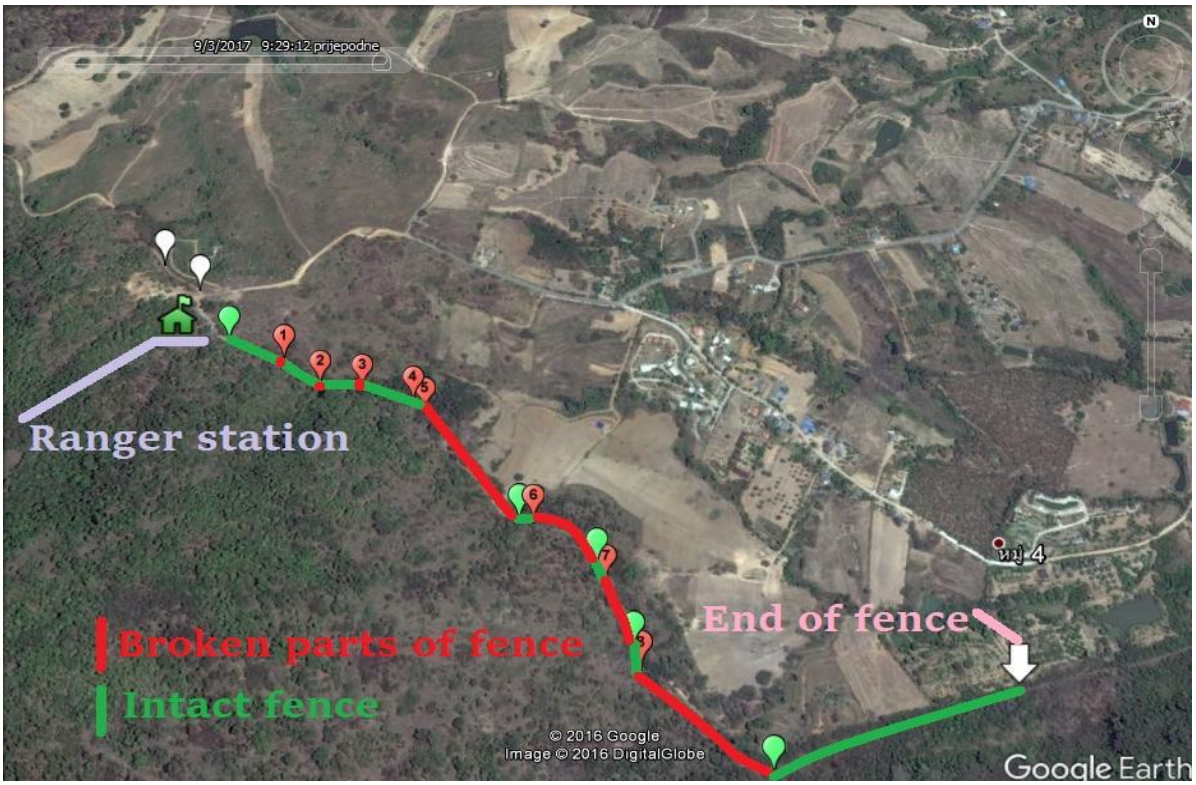
Moo 4 locals attend yearly meetings organized by PA staff about how to help each other and jointly find a solution of how to mitigate the gaur problem, but no solution has yet been agreed upon. According to farmers, there is no cooperation at the community level – farmers have very little personal or communal ability to prevent crop raiding.

3.7.3 Government responses

Although some farmers have reported damage to authorities in the hope of compensation, the government will not compensate them for crop losses. All villagers surveyed for our questionnaires reported that no compensation is given for crop-raids; this was verified by the head of the NHA, who said that a lack of budget makes them unable to provide compensation.

Wang Nam Khiao sub-district: Although crop raids is thought of as a serious problem by farmers in Moo 4, the official in charge of the local sub-district stated in an interview that it a relatively small problem, restricted to areas close to the forest. He estimates that only 1 - 3 % of the population under his jurisdiction is affected by crop-raids by gaur. For that reason there are no policies at the sub-district level to address gaur raids. Instead, the staff of the NHA at Khao Phaeng-ma assists the villagers.

Khao Phaeng-ma NHA: In an interview with the head of the NHA, we were told that the NHA staff (25 employees at 3 stations) was responsible for tourist education, the prevention of hunting, and helping local farmers to deal with gaur raids. According to the head of the NHA, the governing Department (National Parks, Wildlife and Conservation) plans, funds and builds fences on the edge of NHA to keep the gaurs away from farmers' crops; decisions on where and when to build fences are made by more senior officials at the department, with no input from local rangers. However, staff reported that the NHA's allocated budget is too small to provide robust fencing all around its perimeter; NHA management has opted for a cheaper fence that is easily broken by gaurs. Broken fences are supposed to be reported and immediately repaired; however, our survey of the fence suggests that it is in very poor condition.



Map 3: NHA and Khao Yai electric fences

Photo 2: broken fence at the edge of Moo 4

Farmers state that their main official contact for crop raiding issues is the local ranger station from the Khao Phaeng-ma NHA. Farmers phone the station to report gaurs in their fields, and rangers would arrive to help chase the gaurs away. Some villagers saw the rangers as helpful, at least in intent; however, since the rangers have the same means for deterring gaurs (i.e. cherry bombs) as villagers, their ability to help was often reported as minimal. Some farmers also claimed that rangers were unwilling to assist them.

In an interview, the local ranger from the NHA confirmed that villagers call him to report crop raiding, and that rangers are dispatched to help when requested. He reported that his station receives calls approximately twice a week, but that the frequency increases during the corn cropping season.

In the view of the NHA staff, the protected status of the gaur means that all people can do is to protect their fields and prevent crop raiding as best they can. To stop gaur from visiting Moo 4, it would be necessary to improve the habitat with the NHA by building water resources and plant grasslands in the forest; this would allegedly keep the gaurs away from crops since they would no longer be driven to search for food and water.

3.7.4. Temple responses

The involvement of monks was an unexpected factor in the mitigation of crop raids. The monk interviewed stated that, contrary to what we had been told by NHA and sub-district officials, the temple initiates and solely finances all projects relating to the crop-raiding problem. The temple is itself funded by donations from the public, although moo 4 inhabitants to not contribute to this one. The temple's stated aim is to benefit society and help local people.

According to the monk, the temple is the main contributor to the development of the NHA; he says that the department is too underfunded to do it, and can only help provide labor to projects funded by the temple. Although the two cooperate, there is allegedly no need for the monks to involve the NHA staff in their plans; the temple simply informs the NHA of its intention and does what it sees fit. He asserted that the temple, not the government, plans and funds the construction of gaur fences; the NHA staff is supposed to maintain them.

This was unexpected, as the temple had been mentioned only as a fundraising body in previous interviews with government employees, not as the major partner in protected area management. There is an obvious disparity between the information provided by government and temple representatives; it may be that one or both presented an exaggerated account of their importance. We cannot say exactly who makes the decisions and provides the funding for mitigating damage by gaur.

The monk we interviewed saw crop raiding as a consequence of a lack of food for gaurs within the NHA. In his view, the re-established forest was too dense to allow grass to grow, forcing gaurs to visit the surrounding villages in search of food. The temple's solution is to clear parts of the forest and replace it with grassland, and to build dams.

3.7.5 Future plans

Farmers believed that provision of mineral licks and water sources in the forest would help reduce crop raids, since gaurs would be less likely to leave the forest if their needs were met within the NHA. Farmers also wanted the government to fund construction of a strong fence surrounding the NHA. According the NHA staff, they intend to improve fences once funding is available, and support the plan to build resources within the NHA. The temple, which currently funds the habitat improvement for gaur, intends to continue doing so. There is general agreement across the board that with suitable habitat inside the NHA, the gaur will cease to cause problems for farmers.

4. Discussion

4.1. Comparing results to theory

As we expected from our understanding of HWCs, farmers see crop raiding of gaurs as a serious problem. This fits with the idea of tolerance presented in the methodology section. Reviewing the factors for tolerance reported in the literature, we see that there are several factors that might account for why the gaurs get so much attention:

Scarce land	Farmers do not have the option to farm different plots, due to the system of property rights in Moo 4 and the scarcity of land.
Government-owned pest	The gaurs are protected and live in the state-owned NHA; they do not belong to the community.
Highly regulated coping strategies	Farmers are only allowed to chase gaurs away, not to harm them; nor can they move, sell, or change occupation.
Individual social unit absorbs loss	There is no community or government compensation; farmers bear costs of crop raiding themselves
High investment in crop	Farmers report that corn cropping needs a large investment for machinery, seeds, chemicals, etc.
No alternative sources of income	Most farmers have no alternative sources of income, and are forbidden from developing them. Interestingly, those few who do are less concerned about gaurs.
Large, dangerous species	Gaurs are massive animals, and most locals regard them as at least potentially dangerous; this may influence farmers' perception and reporting of gaur as a pest (Hill 1997).
Large pest groups	Gaurs are reported as visiting in large herds of 30-40 individuals, which are difficult to stop.
Obvious damage pattern	Trampled and eaten crops are very obviously damaged when the farmer sees them next morning.
Broad crop preference of pest	Farmers report that alternative crops to corn, such as cassava, are also eaten by gaur, so that it is difficult to avoid crop raiding.
Whole plants damaged	Plants are trampled down or ripped apart by browsing gaurs; their stems are broken, meaning that whole plants can be lost.
Nocturnal raids	Gaurs are reported to only visit at night. Nocturnal pests are more frustrating because they are harder to guard against, and their damage is only revealed come morning; this can be a mental blow to the farmer (Hawkes 1991).
Unlimited damage in each raid	According to farmers, between their hunger and their sheer size, gaurs are capable of destroying whole fields' worth of crops.
Chronic raiding	Many farmers report gaur visits all year round; this means there is no respite or distraction from the problem.

On the other hand, there is one characteristic of the gaurs that, according to the literature, could make them more appealing to farmers: their high value as game. Gaurs have been poached for their meat and trophies (McGuiness & Taylor 2014). However, this is negated by the fact that farmers wouldn't get away with poaching, so the point is moot.

The habitat and diet of gaurs also seems important to their role as crop raiders. They prefer open forest, with herbs and grasses as a food source; the pioneer trees growing in the NHA shade out the undergrowth, causing gaur to look elsewhere for food (Prayong & Srikosamatara 2017). Crops and grass in the village are evidently a preferable food source.

The fact that farmers are upset over gaur is therefore not surprising, and fits with our understanding of crop raids as a form of HWC - we expected them to see gaurs as a major problem. However, the response to crop raids is not as expected. Although farmers want to be better protected from crop raids, the mitigation strategies available to them are widely regarded as ineffective. Furthermore, farmers do not appear to be resorting to illegal ways of dealing with the problem. The reason that these HWCs are seen as important in other contexts is that uncooperative farmers cause problems for conservation. But here, contrary to expectations, farmers' frustrations are not translating into a refusal to cooperate – they are passive in the "conflict" and there is no effective solution to help them. We therefore face the question, "Why are farmers stuck with ineffective management strategies, despite the fact that they consider crop raiding a serious problem? What is stopping them from finding more effective solutions? Is Thailand a unique case, where farmers behave differently?

4.2. Explaining the situation in Moo 4

The short answer is that farmers have no other option. We present four possible explanations as to why:

1. Farmers will not kill gaurs, because they fear punishment.

One way for farmers to protect their crops would be to hurt or kill gaurs that raided their crops. Although illegal, in other cases farmers have decided that the risk of breaking the law is worth taking for the sake of their income (e.g. Tuxill 1998, chapter 7). In this case, however, the risk is apparently too great. Moo 4 is a small area, and the gaurs are well-guarded by rangers; a farmer that killed a gaur would most likely be caught. According to farmers, the fine is well beyond their means, so a prison term would be the likely punishment. It may be that HWCs in more lawless places result in more illegal killings of animals.

2. Property rights preclude alternative income sources

The certificates held by farmers in Moo 4 only permit them to occupy land and practice agriculture on it, not to sell or develop it (head of sub-district, in interview). We were told by multiple interviewees (village headman's assistant, farmers) that people had previously sold their land to outside investors. This was illegal according to the terms under which they occupied the land, but was easier to do in the past. It seems that the former government did not enforce the law, and illegal land sales were seen as permissible by

locals; but the new military government, since it took power in 2014, has been much stricter in applying property law. Interviewees from the village reported that the government now takes this very seriously. This was confirmed in an interview with the head of the local sub-district, who stated that the new government requires that it is consulted all issues concerning property rights.

Farmers reported in interviews that former corn fields had been purchased and developed as tourist resorts by investors from outside the area. The expanding local tourism industry made this an attractive option and provided an alternative source of income to the unprofitable corn market; however, with the increased government scrutiny over their activities, this is no longer an option.

Being forbidden to sell, or to develop the land they occupy as a tourist resort, farmers are left with no option but to continue practicing agriculture. This also means that if agriculture is unviable (due to crop raiding by gaurs, for example) then the land is useless to them.

3. Access to cropland restricts farmers' coping strategies

Focus group discussions and interviews with farmers revealed that, aside from the restrictions imposed by their land documents, farmers in Moo 4 are also constrained by land available. Most farmers only hold a certificate for the land they actually occupy; only a few have access to enough land to practice agriculture on their own terms. Most farmers must therefore rent land from people who hold certificates for larger areas.

Rental agreements are unofficial and arranged privately between parties. They occupy shaky legal ground since the property rights of the landlord do not provide approval for this practice. Renters need to find a plot close to their home so they can access the fields without having to travel too far, so they tend to rent within the village. Although renters prefer land further away from the forest edge, the demand is higher and travel time prevents them from renting outside the area; usually they have to take whatever is available (interview with second assistant).

In interviews, farmers reported that they would change their cropping practices if they owned their own land. A possible coping strategy to deal with crop raids could be to adapt their farming practices. For example, they could grow fruit trees instead of corn, which would be safer from gaur, or stop trying to practice agriculture on fields prone to crop raiding. For renting farmers, however, this is impossible, as they must comply with landlord's demands – renting farmers are not free to choose which crops they grow or when to grow them. Corn is the most common crop grown by renting farmers; the main reason is its short growing season, which provides a faster return on investment than other crops. Landlords want to see the

land generating a profit in the short term, and for renting farmers to pay their rent; trees would take a long time to provide a return, and fallow land no return at all, so these are not viable options. Farmers therefore have no option to adapt their agricultural practices, and can't make themselves more resilient to crop raiding.

4. Farmers receive little effective support

When interviewed, farmers said that they received little assistance from either the local government and NHA staff. While they acknowledged that rangers would help scare gaurs away, they regarded this as an ineffective measure, and wanted more to be done to keep gaurs away from their crops in the first place. The fencing between the NHA and the village is in very poor condition, despite the stated responsibility of the NHA staff to maintain it.

Interviewees complain that the government is not providing enough help to solve the problem of crop raiding, and does not care about issues affecting small villages; one respondent claimed that the government was favoring the gaurs over local people. Residents are concerned that the government's policy on property and development is preventing investment in their village, thus depriving them of opportunities.

The temple's strategy of providing dams, grassland and mineral licks to the gaur in the NHA receives widespread support from both farmers and managers; for many locals, it represents the most promising approach to the problem of crop raids. However, the perceived benefit rests on the untested assumption that gaurs will stay in the NHA if they are provided with ample resources. We believe that the long-term effectiveness of the habitat improvement strategy is questionable, since providing more resources will cause an even greater increase because the gaur population, which will lead to similar problems in the future. Even if it keeps gaurs in the NHA in the short term, it may be that an improved habitat will actually make crop raiding worse, as the forest will soon reach the higher carrying capacity as the gaurs reproduce, thus resulting in an even larger gaur population, which will quickly exhaust the extra resources and return to crop raiding.

Furthermore, it seems that an important goal for the temple is the development of tourism, by ensuring that gaurs will be available for tourists to see. Recent literature (Prayong & Srikosamatara 2017) indicates that PRA managers are concerned about keeping the gaurs visible as a tourist attraction, and interviews suggest that the temple intends to continue developing tourism. This may be the real reason for the funding of this project, as tourism is a lucrative industry; the temple, NHA and local government all stand to gain from its expansion through the increased income it could bring to the area. The real benefits of the habitat

improvement may be intended for the tourism industry, not local farmers.

4.3. Crop raiding: a symptom of governance

All of the above explanations play a role in creating the situation of crop raids in Moo 4. They are all directly caused by government decisions; it is worth noting that the government's decision to reforest Khao Phaeng-Ma is what brought the gaurs in the first place.

There is still the question of why the government has decided to operate this way. At the surface, the government's stance on crop raiding may be due to a lack of budget, a lack of cooperation between departments, or the belief that the problem is not worth consideration. These are the reasons given by farmers during interviews. It may be that the government simply does not see a need to resolve the conflict between farmers and gaurs.

However, there may be a deeper reason. Crop raiding by gaur, and local agriculture in general, occurs close to protected areas. Although nominally intended for nature conservation, protected areas may have another role in governance: a way for government to control territory.

4.4. Protected areas as a means of controlling territory

Protected areas in Thailand have been criticized as a way for government departments to expand their jurisdiction and secure budget allocations (Neef 1993, Vandergeest 1995). Thai conservation policy has long been based on the belief that forest conservation should exclude human activities; government control of land designated as protected areas relies on keeping the land unoccupied. The certificates of property rights issued to farmers in Moo 4 (and many other places) were specifically designed as a way to restrict development of land claimed by the Royal Forest Department (RFD) (Giné 2005). By preventing the development of occupied land, the government keeps its claim on it, and ensures that it can be reappropriated as forest land in the future. The situation in Moo 4 may be another case of the government attempting to exert control over the area in the name of conservation.

The local representative of the forestry department confirmed in an interview that local residents hold certificates intended as a compromise over the issue of local people living on land designated as forest. He stressed that residents have the right to occupy but not develop the land; the department is determined to remove the resorts from Moo 4.

In addition, the RFD has declared that a protected zone under their jurisdiction exists in Moo 4, including land currently occupied by farmers. According to the sub-district head, this zone is in the process of being delineated by the RFD, and local property rights are under revision; the intention is that village land will be transferred to the RFD's jurisdiction.

The RFD official stated that his department intends for Moo 4 to be returned to forest, and that if local people do not cooperate then it will be necessary to take legal action. It appears that the RFD's intention is to bring disputed territory under its jurisdiction by expanding protected areas and restricting development.

How does this relate to crop raiding by gaurs? The Ministry of Natural Resources and Environment controls both the Royal Forest Department and the Department of National Parks, Wildlife and Plant Conservation (the Department responsible for the NHA and the gaurs). It is therefore possible that the responsible branch of the government doesn't want to help farmers because it is in its interest that agriculture is replaced by protected forest under its own jurisdiction. The control of territory may have been a motive for the government-sponsored reforestation project on Khao Phaeng-ma; today, the forest provides habitat for gaurs, which may themselves be part of the strategy. Gaurs make agriculture more difficult, and farmers have no way to adapt, so their position becomes more tenuous, allowing reclamation of former farmland as protected area. Gaurs might therefore be a tool for the government to both justify and achieve its goals of controlling territory – a kind of walking forest that expands itself at the expense of local farmers.

In the context of human-wildlife conflict, we can say that this conflict is very one-sided: no branch of government is taking care of farmers' interests, but one (the RFD) is actually interested in removing people from the area. The gaurs, meanwhile, enjoy protected status backed up by strict enforcement.

4.5. Importance of tourism

Local government is supportive of tourism, according to the head of the sub-district, as it helps bring about development and offers new income sources for residents. Similarly, the temple considers tourism to be a valuable asset to the area, and is keen to promote gaurs as a tourist draw-card. This is in line with the findings of Sims (2009) that protected areas provide a net economic boost through increased tourist appeal. Observational evidence suggests that gaurs are a highlight for tourism in the area, since their image frequently appears on promotional material, signs and statues in the area. The gaur population of the NHA is important for tourism, as visitors come to lookouts to see gaur (Prayong & Srikosamatara 2017); the head NHA head estimated that 50,000 visitors had come to see gaurs in the last year. In interviews, a tourism operator and employee both report that gaurs help boost the tourism appeal.

Does the tourism appeal of gaur therefore represent a positive effect for residents of Moo 4? Some residents, especially those involved in tourist industry, claim that having gaurs living nearby provides a benefit by attracting tourists, and did not want to see them removed or their population reduced. While they acknowledged the damage caused by gaur, villagers involved in tourism wanted gaur to remain and were not concerned about the increasing population. On the other hand, locals who were not involved in tourism did not see any benefits for themselves. Locals' opinion about gaurs seems to be determined by their sources of income; farmers saw gaurs as detrimental, resort owners as beneficial. This difference may be important: tourism may have divided the community and reduced its ability & desire to protect agriculture and small farmers.

5. Reflection on methods and teamwork

5.1. Questionnaires

Season, time of day and sampling

Our fieldwork took place in March, but the corn cropping season is from July-December. This meant that many of farmers were working as laborers outside Moo 4 and were not at home during the day, reducing the number of potential respondents. Also, since we did our questionnaires during midday and afternoon, we only encountered people who were home at that time of day; this meant many of our respondents were older residents (the average age of respondents was 57). The sample obtained may not represent the true variety of farmers in the village.

In planning the questionnaire, we wrongly assumed that people were occupied with the same kind of job throughout the year and that all villagers would be found within Moo 4 - seasonal employment hadn't been considered on our part. One possible solution would be return in July and August, when the corn is green and the reported severity of crop-raids is at its highest, or to conduct questionnaires in the evening or during the corn season.

5.1.1. Questionnaire design and execution

We had a different research interest to that of Art and Kong, the Kasetsart students in our group. We agreed to merge our questionnaires, which meant that we were using the same questionnaire for different reasons. One problem with this merged questionnaire was the time it took to conduct (often one hour plus). The reasons for this were the detailed questions, which took a long time to fill out and the eagerness of respondents to talk about gaur. Respondents found the topic interesting, and our own interest would we would encourage stories and anecdotes, which could end up being a long conversation. The long time required for each questionnaire meant that it took a lot of work to complete a small number. However, the questionnaire did provide us with a lot of valuable information and proved useful for getting general information on the village, its residents, agriculture and crop-raids.

5.2. Semi -structured Interviews

5.2.1. Interviews, the role of interpreters

We faced some challenges in working with interpreters. Early in the fieldwork, the interpreters would only convey information they thought would be interesting to us, and tended to change questions and answers to avoid embarrassment when discussing controversial topics such as illegal activities. We, meanwhile, had a hard time picking up on when our questions were inappropriate because the interviewees would respond to the way the question had been asked by the interpreter.

The reason for this was a failure on our part to thoroughly prepare our interpreters for the work we expected them to do for us. We should informed them of the exact nature of information we were interested in, as well as seeking their advice on how to ask for sensitive information in an appropriate manner.

5.2.2. Interviews, the role of Kasetsart University students

The two “groups” prepared question sheets for the scheduled interviews, though we would coordinate our questions. Usually, our interviews were organized by the Thai-speaking students, who often took upon themselves to contact our informants and set up the meetings. The first part of the interview would, therefore, be conducted by a Thai student and translated by the interpreters. Subsequently, we then asked our questions. We therefore ended up competing respondents' time and the focus of the interviews.

Moreover, one of the Thai-students would often intervene, translating or explaining the answers being given by the respondents, to our interpreters - who would then translate the combined answer to us. On some occasions, he took over the interview, intending to help us understand some basic fact we were unaware of. The interruptions were meant as a help for both the interpreters and us, but it proved to be quite problematic, as we were unsure exactly whose opinion we were getting. Also, it created a distance to the interviewee, because his or her answers were going through a third and fourth party (student and interpreters). It was hard for us to react to the answers that had actually been given and truly engage in a “conversation”. Finally, we explained our difficulty to the student, and it became a lot easier for us to “read” our interviewees and adjust our questions accordingly. This was another instance of insufficient initial communication on our part.

5.3. Group work

5.3.1. Collaboration with Kasetsart University students

Not working with the same research-questions, did present some obstacles, but since we agreed on data-collection methods and informants, we were able to collaborate smoothly regardless. The Thai-students contributed a lot to our project, and to our understanding of the situation – both due to the questions they would ask our interviewees, their Focus-group activity, and due to their prior knowledge on issues such as land-titling. The benefits of working in a cross-country group far outweigh the minor disadvantages mentioned earlier.

5.4. The role of the village headman, and the implications of his absence

Prior to our fieldwork in Moo 4, the village headman had been contacted by the Thai SLUSE coordinators, who informed him of our imminent arrival. Initially, we planned for the headman to be our key informant, who could put us in contact with other relevant informants and help organize activities such as a community meeting. On arrival, we tried to contact the village headman, but we were told that he would not be in the area during the first week of our fieldwork. Instead, we were put in contact with his two assistants. He later returned to the village but was still too busy for an interview. The immediate disadvantage was that it was difficult for us to contact people and to organize the group activities we had planned. Fortunately, our driver was familiar with the area, and he was able to offer us advice on who to contact and where to go.

We sensed that lacking the endorsement of the village headman influenced the way in which villagers interacted with us and the information they were willing to share. As a consequence, most of our interviews with villagers are biased towards law-abiding behavior, and our interviewees were reluctant to talk about controversial issues such as land certificates and illegal land sales.

There were also some other contextual reasons for our lukewarm reception. Unlike other SLUSE country-groups, we did not live in the village where we conducted our research, which might have limited trust-building with potential respondents. We remained to be strangers to the majority of the villagers, but impromptu interviews were usually genial and informative. Occasionally, however, discussion of sensitive issues would not go well. Possible reasons were: 1) the interviews were conducted outside their homes, with the presence of one or more household members; the setting was not conducive to a talk on sensitive issues. For one villager-interview our entire group was present, including one of our supervisors, the park

ranger and our driver (10 persons), the interview was carried out outside the interviewee's house, which is right next to one of the main streets in Moo 4. A better setting would have been just one interviewer and one translator, conducting the interview in her house.

The opinion of locals did influence the data we were able to obtain. When trying to find participants for a focus group, we found that since we didn't have the village headman's approval, no villagers wanted to talk to us. This coincided with us doing interviews on land-titles, among other things, the previous days.

6. Conclusion

Our initial interest was the issue of human-wildlife conflict. We have described a case of HWC in Thailand, and attempted to explain how people have responded to it. What we found led us to conclude that the gaurs can be seen as wildlife that is not truly wild; their existence and the problems they cause are due to government decisions. On the human side, government action (and inaction) has determined the farmer's responses as well. Crop raids by gaurs are not a force of nature, but a symptom of governance.

References

Chettamart, S 2003, 'Ecotourism resources and management in Thailand', from www.researchgate.net/publication/228910124_Ecotourism_Resources_and_Management_in_Thailand.

Emphandhu, D & Chettamart, S no date, 'Thailand's experience in protected area management', from https://www.researchgate.net/file.PostFileLoader.html?id=56cb3b915e9d978bef8b4567&assetKey=AS%3A331971717812225%401456159633287.

Hawkes, RK 1991, 'Crop and livestock losses to wild animals in the Bulilimangwe natural resources management project area', from https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/4576/Hawkes,%20Roland%20K.%20%20CASS%20%20&%20Mat%20Working%20Paper%20Series.pdf?sequence=1.

Hill, CM 1997, 'Crop-raiding by wild vertebrates: The farmer's perspective in an agricultural community in western Uganda', International Journal of Pest Management, vol. 43, no. 1, pp. 77-84.

Duckworth, J.W., Sankar, K., Williams, A.C., Samba Kumar, N. & Timmins, R.J. 2016, *Bos gaurus*, The IUCN Red List of Threatened Species. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T2891A46363646.en

Giné, X 2005, 'Cultivate or rent out? Land security in rural Thailand', World Bank Policy Research Working Paper 3734.

McGuiness, S & Taylor, D 2014, 'Farmer's perceptions and actions to decrease crop raiding by forest-dwelling primates around a Rwandan forest fragment', Human Dimensions of Wildlife, vol. 19, no. 2, pp. 179-190.

Naughton, L, Rose, R & Treves, A 1999, 'The social dimensions of human-elephant conflict in Africa: A literature review and case studies from Uganda and Cameroon', Human-Elephant Conflict Task Force of IUCN, Gland, Switzerland.

Panusittikorn, P & Prato, T 2001, 'Conservation of protected areas in Thailand: The case of Khao Yai National Park', The George Wright Forum, vol. 18, no. 2, pp. 66-76.

Prashanth, PKM, Kumara, V & Thirumala, S 2013, 'Man-animal conflicts in protected areas, a case study of gaur, Bos gaurus H Smith from the Mookambika wildlife sanctuary, Kollur, Karnataka, India', International Journal of Current Microbiology and Applied Sciences, vol. 2, no. 12, pp. 466-475.

Neef, A, Onchan, T & Schwarzmeier, R 2003, 'Access to natural resources in Mainland Southeast Asia and implications for sustaining rural livelihoods – The case of Thailand', *Quarterly Journal of International Agriculture*, vol. 42, no. 3.

Prayong, N & Srikosamatara, S 2017, 'Cutting trees in a secondary forest to increase *Bos gaurus* numbers in Khao Phaeng Ma Reforestation area, Nakhon Ratchasima Province, Thailand', *Conservation Evidence*, vol. 14, pp. 5-9.

Sims, K 2009, 'Conservation and development: Evidence from Thai protected areas', Available at SSRN: https://ssrn.com/abstract=1567833

Tanasarnpaiboon, S 2016, 'Gaur (Bos gaurus) abundance, distribution, and habitat use patterns in Kuiburi National Park, southwestern Thailand', Dissertations & Theses in Natural Resources, paper 129.

Tangprasert, P 2015, 'Another gaur found shot dead', Bangkok Post, 24 March 2015, http://www.bangkokpost.com/archive/another-gaur-found-shot-dead/506860.

Vandergeest, P 1996, 'Property rights in protected areas: obstacles to community involvement as a solution in Thailand', *Environmental Conservation*, vol. 23, no. 3, pp. 259-268.

Appendices

Appendix 1 - Relevant cases from literature on HWC

Perceptions, attitudes and opinions
Naughton, Rose & Treves' work in Africa (1999) reflects the importance of farmers' vulnerability to the risk of crop raiding in determining their attitude to wildlife. Farmers feel especially vulnerable to large animals, with the potential to cause extreme damage (as opposed to cumulative losses, even though they may be greater), and when the animal is protected by the government. While losses to a neighbour's livestock can be redressed between farmers, losses to protected species cause resentment as they are not compensated by the government (the de facto owners of wildlife in the eyes of farmers).

Ebua et al. (2011) used questionnaires and participatory rapid appraisal to assess the attitude of local people towards wildlife conservation. They found that most are interested in conservation, although some see it as detrimental to local people; also, most believe that local people do not benefit from conservation. The authors attribute this to locals' position - bearing the cost of wildlife while receiving no compensation (for crop losses etc.) and being denied access to natural resources.

Hill (1997) found that farmers' perception of the seriousness of species as pests was determined not only by their capacity to damage crops, but also their dangerousness to humans; the findings suggest that people's fear of a species significantly affects whether they see it as a troublesome pest. Hawkes (1991), meanwhile, found that "uninteresting" pests such as birds tended to be under-reported as a cause of crop losses, possibly because they were "taken for granted" and did not come to mind when farmers were interviewed.

Measuring and mapping losses
Naughton-Treves (1998) monitored crop losses to wildlife in Uganda and reported that frequency and extent varied markedly within and between villages and between species. The distribution of damage was concentrated around the forest edge, but highly skewed towards certain crops (maize and cassava) which were completely destroyed on occasion.

Hill (2000) used farm surveys and informal discussion groups to show that baboons can cause crop damage according to farms' proximity to the forest edge and the presence or absence of neighbouring farms. Monetary losses due to damage are not the only cost of crop raiding – there are also labour costs to protect crops.

McGuinness & Taylor (2014) used semi-structured interviews to investigate farming practices, raiding losses, and mitigation strategies among farmers in Rwanda near a forest fragment. Farmers reported significant losses, necessitating active guarding and potentially harmful (in terms of diet) changes in farming practices. The authors concluded that HWC impacts on livelihoods can be exacerbated by insecure tenure and population pressures.

Nath et al. (2015) reported that crop raiding by elephants in India causes negligible economic loss overall, but can be quite high at the individual farmer level, especially for those with fields adjacent to a national park. They recommend the use of buffer zones and crop guarding by farmers.

Appendix 2 - Methods list

Method	Informants	Role/Occupation	Interview topics	Date
Semi-structured interviews	Village headman's assistant	Mediator between Moo 4 residents & government departments	Introduction to Moo 4	01/03/17
	Village headman's second assistant	Assists village headman; agriculture liason for locals	Moo 4's area and extent; agricultural issues, crop raids	06/03/17
	Park ranger	Protection of wildlife and forest in NHA; also assists moo 4 villagers in chasing gaurs	NHA management,duties re: gaurs and crop raiding	07/03/17
	Subdistrict official	Office of the Wang Nam Khiao subdistrict, includes Moo 4	Land titles and property rights in Moo 4	08/03/17
	Forest department official	Head of the local branch of Royal Forest Department	Conservation and forestry policy in Moo 4	09/03/17
	Monk	Member of district's main temple; assistant to senior monk	Temple's role in mitigating crop raids	11/03/17
	Other farmers	3 other farmers in Moo 4	Crop raiding, property rights, agricultural practices (follow-up from questionnaire)	07/03/17 and 12/03/17
Impromptu interviews	Head of KPM NHA	Manages the Non-Hunting Area at Khao Phaeng-ma	Basic information on gaurs and the NHA	01/03/17
	Former village headman	Farmer, semi-retired; formerly headman of Moo 4	Moo 4 administrative boundaries; crop raids	05/03/17
	Field worker	Seasonal employment in local farms	Gaur and crop raids; property rights; government actions	06/03/17
	Resort owner	Owner-operator of a tourist resort in Moo 4	Tourism in Moo 4	06/03/17
	Resort employee	Works at a resort in Moo 4	Tourism in Moo 4	09/03/17

Other methods	Purpose & information	Date
Questionnaires	Gaurs and crop raids	04/03/17 to 05/03/17
GPS mapping	Spatial distribution of households	Whole work period
	Walking survey of the electric fence	
	Study area boundaries	
Participatory mapping	Land use	11/03/17
	Spatial distribution of main crops	
	Spatial distribution of gaur visits	
Timeline	Recent (since 1950) history in the village	11/03/17

Appendix 3 - Questionnaire document

Questionnaire

part 1 the general information of head household or key informant

Gender ( ) male ( ) female age .....years

1. **Education**

( ) none ( ) primary school ( ) secondary school

( ) high school ( ) high diploma ( ) bachelor degree ( ) higher bachelor

2. **Occupation**

( ) farmer ( ) government official ( ) state enterprise

( ) worker ( ) hired by general work ( ) ownership business

( ) other please specify.....

3. **Native habitat**

( ) home town ( ) settlement from other place and how long to move here

.....Year

4. **The position of this village**

( ) member of household ( ) member of sub district ( ) head of village

( ) other .....

5. **Land ownership**

( ) Land ownership ( ) rent ( ) mortgage ( ) other .....

6. **Land tile**

( ) title deed ( ) Po Bo Tor 5 ( ) Sor Por Kor ( ) Nor Sor.3 ( ) Nor Sor3.Kor ( ) other .....

7. **Water using in household**

( ) local water supply ( ) rain ( ) groundwater

( ) river ( ) reservoir/pond ( ) other.....

Do you have enough water use?.....yes/ No

How is the water quality? Good / bad

8. **Access the electricity**

( ) none ( ) electricity from hydropower ( ) electric from generator

( ) other ……

9. **Do you have any trouble with your electricity? Yes / No**

( ) electricity lost ( ) no pole of electric

( ) motor problem ( ) other……..

10. **Do you face the natural disaster? Yes/ no**

(1) Drought ( ) how often ……..

(2) Flood ( ) how often …….

(3) Land slide ( ) how often …….

Part 2 household member information

1. Household member.....people
2. Detail of household member

no	gender	age	Main occupation	Part time job	In out of the village
1					
2					
3					
4					
5					
6					

3. ***Income of household***

Total……. Baht/year; Income from agriculture .....Baht/year; government official.....Baht/year enterprise .....Baht/year; worker ..... Baht/year; general hire..... Baht/year; ownership business..... Baht/year; other..... Baht/year;

4. ***Expenditure***

   Total……Baht/year; Expend for household…..... Baht/year; School fee .....Baht/year; Tourist/vacation…… Baht/year; other activities…..... Baht/year; heath fare..... Baht/year; pay for agriculture…..... Baht/year; other…..... Baht/year;

5. In 2 to 3 years ago, does your household borrow some money? Yes/ no

   Where? ( ) Bank ( ) neighboring household ( ) cousin ( ) other…….....

6. Your household, Are a group of some organizations (choose more than one)

   ( ) annually festival ( ) Soil testing group ( ) group of agricultural

   ( ) environmental organization ( ) local loan ( ) group of job

   ( ) house keeper group ( ) Other.....

Part 3 agricultural practicing

1. What kind of agricultural do you practice?

   ( ) the same crop plantation (Maize, cassava, sugar can) ; ( ) live stock ( ) rice field with up land farm; ( ) rotation plantation crop; ( ) other……

2. The condition of practicing this agriculture

   ( ) / ( ) follow by household neighbor hood ( ) follow by the government organization

   ( ) just interested in this type of agriculture ( ) other……

3. Water for agriculture

   ( ) irrigation ( ) rain ( ) groundwater

   ( ) stream or river ( ) reservoir ( ) other ……

4. The agriculture land ….... plots and calendar of plantation

No of plot	Type of land owne	area	plantation											note
			Jan	Feb	Mar	May	June	July	Aug	Sep	Dec	Oct	November	Dec	

	rship														
1															
2															
3															
4															

5. How do you put the chemical?

( ) chemical fertilizer use by.....volume..... average/rai

( ) pesticide use by.....volume..... average/rai

( ) herbicide use by.....volume..... average/rai

( ) Other.... use by.....volume..... average/rai

6. Expenditure

Plot	Expend (Baht)										
	Seed/	Land preparation	fertilizer	pesticide	Other material	Labor cost for chemical fertilizer	Labor cost for chemical pesticide	transportation	rent	Food for animal	other
1											
2											
3											
4											

7. Equipment

1) ..... number .....

2) ..... number .....

3) ..... number.....

4) ..... number .....

8. In the past or even now, are there any organization come to help you?

( ) no ( ) yes

1. The organize.....what kind of .....
2. The organize.....what kind of .....
3. The organize.....what kind of .....
4. The organize.....what kind of .....

6. What agriculture issue do you face? What level

Problems	Level of problem				
	high	Medium		low	
Soil property					
No enough water					
Low cost production					
Drought					
No any organization come to help or support					
High cost for investment					
Other 1).....					
Other 2).....					
Other 3).....					
Other 4).....					

9.1 what factors make high investment

1.....
2.....
3.....

10. ( ) do the same plantation (cassava, maize, Sugar can…)

( ) still doing agriculture but trying to find other part time job

( ) do not practice agriculture but still staying in this village and find other job like.....

( ) practice agriculture and move to other village to find other job like……..

11. Crop raids

1. Do animals damage your crop?

( ) yes ( ) no

If no, do you know anyone who has experienced crop raid?

_____

If yes, specify which ones (animal)

( ) elephant ( ) gaur ( ) bear ( ) birds

( ) other, please specify_____

2. How often does it happen?

( ) daily ( ) weekly ( ) monthly ( ) yearly

3. What crops do animals damage?

( ) corn ( ) sugar cane ( ) cassava ( ) other

4. How much damage do they do?

( ) insignificant ( ) considerable ( ) very serious

5. What do you do to prevent it?

( ) nothing ( ) fencing ( ) chasing

( ) other, please specify _____

6. Are there any means of compensation for crop raids?

( ) yes ( ) no

If yes, please specify:

( ) government ( ) community group(s) ( ) NGOs

( ) other, please specify _____

Part 4 tourism development

1. In your family, is there any one doing job with tourism?

   ( ) none ( ) yes, the owner of tourist resort ( ) yes, the owner of shop or restaurant

   ( ) yes, the businesses relative to tourism

   ( ) yes, worker for hotel/shop/restaurant and other……

   ( ) other……

2. Had you ever changed your land for tourist?

   ( ) No ( ) yes, change land .....to.....

3. Do you sell your land to other people?

   ( ) No ( ) yes, when……year ( ) yes, I have an idea but not sell yet

4. Do you agree to develop the Khaopengma village for tourist?

   ( ) very disagree ( ) agree ( ) really agree

5. Development tourism, is that any effect for you live?

   ( ) disadvantage 1……

   2……

   3……

   ( ) advantage 1……

   2……

   3……

6. Recommendation for development the khaopengma village in the future?

……

……

……

.....

Appendix 4: SSI plans

Questions prepared prior to semi-structured interviews (SSIs)

1. SSI with the Forest Department Official

1. Basic info on the Forest Department?
   - Area of jurisdiction
   - Number of employees
   - Main responsibilities

2. Policy on wildlife in the conservation area?
   - Policy on the Gaur
   - Long-term policies
   - Long-term measures to prevent Gaur visits
   - If and how has policy been changed (when)
   - Punishment for killing the Gaur

3. Zone C boundaries?

4. Plans for solving the overlapping area problem?

5. Is there any consideration on limiting the Gaur population?

6. What are the main challenges for the Department

2. SSI with the Monk

1. Duties towards the community?
   - Size of community
   - Is KPM village affiliated with the temple

2. The role of the Munk and his temple w. regards to Gaur-prevention?
   - Organizing meetings
   - Who is involved
     - decision-making
     - influence of Government Departments
   - To which degree has the villagers been involved

3. Who took initiative?
   - Private

- Public
- Community

4. Location of lake/dam - who decides on location?
   - Criteria's for location
   - Tourist considerations

5. How were the money raised?
   - Donations; only from KPM or all of the province - are the donations voluntary
   - Does ministry or government institutions help with funding
   - Costs of a dam like the one in KPM

6. Other measures being planed, in relation to the Gaur
   - Prevention
     - fences (private or public)
     - mineral licks
     - others
   - Maintenance
   - Who finances maintenance or e.g. water supply in lake
   - How are measures implemented

7. Does the temple provide compensation in the case of Gaur-raids?
   - Who requires support
   - How is support distributed
   - Who decides on support distribution
   - What actors are involved; Village-Head, Sub-District
   - Any challenges when providing support

8. Motivation for financing Gaur-prevention, local support?

9. Who is influential in K.P.M, who to cooperate with to make things happen, why are they influential?

10. What is the relation to the Village-Head
   - Level of co-operation
   - Shared responsibilities

11. Was the temple a part of establishing the Non-Hunting-Area

3. SSI with subdistrict officer

- **points of departure noted prior to interview**

1. Agricultural policies
2. Policies on wildlife

3. Development policies; past and future
4. Tourism policies
5. The attitude of the board of department on
    - agricultural policies
    - tourism policies
    - development policies
6. Distribution of land titles in BKPM, possible to see a map
7. Changes in policies on land-titling
8. Future of wildlife policies, official plans to stop crop raids by the Gaur

4. SSI with village headman assistant

1. Information on her position/responsibilities?
2. Main issues in BKPM?
3. Strenghts and weaknesses of BKPM?
4. Gaur and crop raids?
5. Farmer practices?
6. Tourism - any connections to wildlife?
7. Land titles in BKPM (insecurities)?
8. Further information on:
    - Development in tourism
    - Available data on tourism
    - Changes in land use
9. Practicalities of doing PRA?
    - When to meet villagers
    - How to gather them for the activities
10. Possible to get a guided tour of BKMP?

5. SSI with villagers

1. Information on occupation/activities?
    - Current occupation
    - Changes in occupation/activities:
        - trough out the year (seasonal shifts)
        - over the past period

2. Q related to agricultural activities
    - What crops and why
    - Location and size of the plot/s
    - Shifts to other crops
    - Substantial changes in the way of practicing agriculture
    - Skipping the crop season
    - Selling the products
    - Challenges in agricultural production

3. Q related to the land and land use

- Information on the land ownership

1. If owner:

- inherited or purchased land
- title with regards to the land use
- location and size of the plot(s)
- rules over the land and land use

2. If renter:

- from where is the owner
- what title does the owner hold
- size and position of the rented plot(s)
- crop difference with regards to plot position (if more plots)
- if allowed to grow just corn, why? (is it a part of the contract)

3. Land use at the site of resorts before resorts were built

- if farming, what has been changed
- current activity of the villagers that used to practice agriculture on the resort land

4. Other

- Number of family members
- Occupation of family members
- Receiving any kind of support (gov./other)
- Monks impact on the community
- Villager future plans
- Villager expectations with regards to agriculture, tourism and current issues

Appendix 5: PRA plan

Presentation:
We are interested in main crops, grown last season

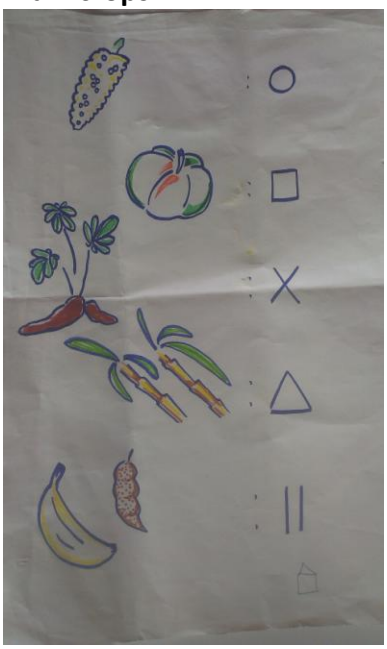
Sequence:

1. Draw the crops on map
2. Where on the map are the gaur-visits most serious; mark with red marker
3. Who's is most affected my gaur-visits? Do they use fence, bombs, other?

The map works as a point of departure, for a **focus group interview**

4. Level of impact, is it seasonal?
5. Do people change crops or skip a crop-season to avoid gaur-visits
6. Can people move their production?
    1. Can they move to a different plot in KPM (what would this imply)?
    2. Would they move their production outside of KPM, to a different village (what would this imply)?
7. What is the attitude towards the protected status of the gaur

Main crops:



Corn:	Circle
Pumpkin:	Square
Cassava:	Cross
Sugarcane:	Triangle
Fruits, vegetables:	Two vertical lines

Appendix 6: Synopsis

Conservation and adaptation: local significance of a protected species in Thailand

Synopsis of ILUNRM research plan, February-March 2017

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Maria Birkholm Søndermark

William McNeice

Ivan Naletilić

CONTENTS

1. INTRODUCTION

Nature conservation seeks to maintain populations and habitats for species other than humans. Since human activity is widespread, most conservation programs must account for the fact that species will interact with local human populations.

1.1. Human-wildlife interactions

Humans' sharing of environments with other animals can lead to positive or negative interactions for both species. Negative interactions can be considered human-wildlife conflicts (HWCs), a term which we use to mean any situation with the potential to cause a loss of human life or property. These losses, or the fear of them, can in turn prompt the killing of wildlife, even in violation of protected status. HWCs have attracted attention from researchers around the world due to their conservation significance and social impact.

HWCs in rural contexts

One important type of HWC is crop raiding, which occurs when herbivorous animals visit farmers' fields in search of food, causing damage to the crop in the form of browsing and trampling. This results in a financial loss for the farmer, and is a problem for conservation as farmers consider wildlife as a pest. Farmers on forest edges the most exposed to crop raiding as the forest provides a refuge for raiding species. Relevant scientific literature on crop raiding is compiled in *Appendix 2*; a summary of the topic is presented in the following paragraphs.

Farmers' opinion of wildlife is influenced not just by whether species damage crops, but also the environmental and social context in which the damage occurs. Opinion differs both within and across communities. These perceptions have important effects on the viability and legitimacy of conservation programs, as well as the actions taken by local people.

Losses can be economic, in terms of income and labour, and psychological, via the quality-of-life impact of fear and stress. Although average monetary losses are small, the potential of catastrophic loss hangs over farmers' heads, and they feel frustrated by government restrictions on their defensive strategies. Farmers often express support for conservation in theory, but object to its practice, especially in the form of government intervention.

It seems that a farmer's ability to cope with losses due to crop raiding is determined by their wealth, alternative sources of income, support from the government or the community, and compounding factors such as drought. Social factors (e.g. past losses, relationship with authorities) are important when farmers report wildlife losses to researchers.

1.2. Protected areas in Thailand

History

Government protection of forest areas in Thailand began in 1960 with the Wild Animals Reservation & Protection Act (WARPA), followed by the National Parks Act (NPA) of 1961. The first national park (NP) created was Khao Yai, in 1962 (Emphandhu & Chettamart, nd), with the stated purpose of preserving a natural area for educational and recreational activities. NPs in Thailand are administered by the Royal Forest Department (Panusittikorn & Prato 2001).

Economic development deforested large areas in second half of 20th century. 1989 saw the banning of logging in natural forests, including in NPs (Panusittikorn & Prato 2001), which now contain much of

Thailand's remaining forest cover. Extractive use of NPs is banned, but in other types of protected areas some limited use is allowed.

Policy

The legal authority for creating and managing NPs is the 1960 WARPA and 1961 NPA. NPs have been "promulgated and managed for nature-based tourism with opportunities for learning by the public" (Chettamart 2003).

There is no system plan or overall management strategy for the NPs, though some of the larger parks have their own management plans. Policy is highly centralised, with decisions made in Bangkok with little input from PA managers or local communities (Emphandhu & Chettamart nd).

Management

Enforcement of PA policy relies on direct methods (patrolling rangers under NPD headquarters, which has a branch in every park) and indirect methods (media dissemination of 'nature appreciation') (Panusittikorn & Prato 2001). Authors report conflict between government & locals over resource use and park boundaries, leading to illegal activities such as logging and poaching (Emphandhu & Chettamart nd). Another problem is disagreement between government departments due differing duties and interests. Concerns have been raised over the impact of tourism, development and illegal activities in Khao Yai NP (Panusittikorn & Prato 2001).

Tourism

The Thai government promoted tourism as an industry in late 90s, and the scenic and wildlife attraction of areas such as Khao Yai NP have drawn tourists in increasing numbers (Mahdayani 2014). The increasing pressure due to heavy tourist traffic & infrastructure development has been cited as a threat to NP conservation (Panusittikorn & Prato 2001).

1.3. Study area: Moo 4, Wang Nam Khiao sub-district

Moo 4 (*Moo* is an administrative division beneath the level of sub-district) is a loose grouping of farms, houses and hotels directly adjacent to the northern boundary of Khao Yai NP, in the area known as Khao Phaengma. Most of its 349-strong population is involved in agriculture, although tourism is increasingly important.

The location of the study area places it at the centre of interaction between a protected area (Khao Yai NP) and an agricultural area (Moo 4). Research in other parts of the world recognises the importance of HWCs in conservation and local agriculture. In places like Africa and India, large herbivores living in protected areas are seen as a major problem by farmers on the forest edge. In Khao Phaengma, the local gaur population living in Khao Yai national park may present a similar case.

The gaur is a species of wild cattle native to south and south-east Asia, classified as vulnerable by the IUCN (2016) due to habitat loss and poaching. In Thailand, the species now survives only in protected areas; the country-wide population was estimated to have been reduced to 915 individuals by 1994, a 60% decline over 20 years (Srikosamatara & Suteethorn 1995). The population in Khao Yai NP was estimated at approximately 100 individuals. Gaur are difficult to monitor because of their shy behaviour and forested habitat, which makes them hard to count accurately; recent estimates in Thailand have been at the national park or conservation area level, measuring isolated populations rather than a country-wide census. There are some reports that some of these populations may be increasing due to their respite from hunting pressure (e.g. Tanasarnaiboon 2016); however, the assumption that gaur are safe in protected areas is challenged by reports of poaching, including in the Wang Nam Khiao subdistrict (Tangprasert 2015). Gaur are known to raid crops and have been involved in HWC with farmers in other parts of their range (Prasanth, Kumara & Thirumala 2013), and were reported as a problem for farmers in the study area.

The gaur may therefore be seen as major threat to farmers in Moo 4, since the species meets many of the criteria that tend to reduce tolerance by farmers. It is also related to the conservation issue, since it is protected by law and has a refuge in the national park. On the other hand, its tourism appeal may be an important attraction for the area, and photographs of gaur in the NP appear in much of its promotional material. The gaur therefore represents a case of human-wildlife conflict in a forest-farm boundary, and a socio-economic conflict between agricultural, conservation and tourism interests.

2. RESEARCH QUESTION

How does human-wildlife coexistence influence local livelihoods in Mu 4?

2.1. Sub research questions:

1. How are benefits and costs of coexistence distributed in the community?
2. Are human-wildlife coexistence a driver of change in livelihood strategies?

Definitions:

Local - Mu 4 area with its administrative boundaries
Livelihood - various activities practiced by local people in order to improve living conditions

3. METHODOLOGY

3.1. Concepts and theory

Livelihoods and assets
Livelihoods are composed of various forms of assets: human, natural, social, physical and financial capital. We will use DFID model (1999) to find out whether the Gaur has a role in adding or straining some of people's livelihood assets. This could serve us as a way to conceptualize possible costs and benefits of human-wildlife coexistence. We conceive of wildlife as something that can add or take away from these assets. Conflict and risk fit into this as a potential loss of a certain type of asset.

Livelihood strategies
The Sustainable Livelihood Framework offers a theoretical framing of our research (see Appendix 3). We are investigating whether the gaur significantly contributes to the *vulnerability context* in Mu 4 and if so, how it is then expressed through the *livelihood strategies* employed by the villagers, what is the *outcome*? A livelihood strategy is employed to maximize the sum of *assets*, thereby reducing household vulnerability. Transforming Structures and Processes can amongst many others be identified as conservation policies and the local land-rights system, through which the individual household is granted a specified use right to community land (DFID, 1999).

Land use and livelihoods
Uses of land, it can be both houses, agriculture, parking-lots etc. Can also be mixed.We will be looking at land use as a spatial livelihood outcome because it is considered to reflect livelihood strategies, and can be observed in the field or reported by respondents.

Not all land is managed by locals, we should be careful to distinguish local activities from those of developers etc.

Risk management

We consider risk to be composed of three parameters: exposure (the likelihood of an unwanted event occurring), severity (the predicted consequences if it does occur), and resilience (the capacity to cope with the event). We expect that people assess these parameters (consciously or unconsciously) in their own lives, and attempt to reduce their risk by reducing one or more of the three. Perception of risk is therefore an important factor in determining human activity. In this case, we can consider farmer's perception of the risk of crop raiding; we expect that farmers will behave according to the model above.

Perception and tolerance of wildlife

We know from literature on other HWCs that attitudes to wildlife as crop pests are not simply based on crop losses, but involve a range of ecological and socio-economic factors. For example, farmers may consider a sudden, obvious loss as less tolerable than a gradual one, even if the latter is more costly from a purely financial standpoint. We consider this phenomenon to be related to the concept of risk, in that social and emotional factors play a part in determining perception and thereby action when faced with a risky situation.
In this case, we expect that farmer's tolerance of gaur as a crop pest will be related to but not entirely based on financial costs, and that attitudes to crop raiding will determine farmers' actions according to our model of risk management (see above).

Measuring impacts of human-wildlife conflict

Financial costs of crop raiding can be estimated in the field by questioning and interviewing farmers. However, it is also important to understand farmers' perceptions of wildlife, which may be based on more than financial costs. Our methods should allow us to compare an objective assessment of financial costs, and a subjective assessment of perceived losses.

3.2. Data sources

Key informants

Initially our key informant will be the village headman, who we hope will inform us of the ways of Mu 4 and put us in contact with people of particular interest to us and our research. However we need to be careful not to only use informants provided by the headman, we'll seek information from different sources, to ensure somewhat nuanced data.
Government officials (Land and Development Department) and Park Rangers, provide a different perspective, and will be our key-informants on non-village issues.

Definition of study area

Moo 4 is our area of study, defined by the administrative borders. However in practice the population of Moo 4 might not organize themselves in accordance with the administrative borders, but instead rely on borders defined and acknowledged locally. We are interested in the spatial organization of land use, and for our study to capture the dynamics of land use changes, we would be obliged to define our study area by the borders actually in use.

3.3. Proposed methods for data-collection

Transect walk

Upon arrival to Mu 4, a transect walk with the village headman will enable us to determine the placement of the administrative borders. Furthermore the village headman might inform us of potential discrepancies between centrally defined borders and the de facto spatial spread of Mu 4. We intend to register both the administrative- and the locally defined borders, using GPS and by doing so spatially limit our research. Moreover, we expect the village headman to introduce the land-rights system in place for Mu 4; who is

entitled to land, is land to some degree managed communally, are the land-plots of individual households spread throughout the area, to which extent does a household exercise authority over the land it manages? We believe this information to be of great significance for the land-use patterns that we will detect.

Additional walks will be carried out, starting at the National Park border moving outwards onto the land that constitutes Mu 4, with a focus on the spatial distribution of Gaur-visits, different land-uses, the land-rights system and the extent to which different land-uses are prioritized. The walks will be recorded with GPS, so that we can plot the information gathered and couple it with a map of the area. Overall the walks will provide us with basic knowledge of the area – we expect to use this knowledge when we decide on a sampling method for our questionnaires. Appendix 4 offers a rough sketch of how we intend to organize our transect walks.

Questionnaires

Our questionnaire will be developed within the first few days after our arrival, to ensure a certain level of context sensitivity. We plan to pilot-test our questionnaires on 3-5 respondents, this will give us a chance to rephrase questions if they are worded in an inconvenient way or they are being misunderstood - ensuring the comprehensiveness of our questionnaires. A pilot test will also enable us to assess the relevance of our proposed research question. We plan for a sample size of 50 respondents, this size will allow us to analyze the data statistically. As we hope to conduct a somewhat representative survey, we will attempt to stratify our sampling, using the knowledge gathered from our transcendent walks and PRA activities (see below). The survey will be conducted at household-level and we plan for it to be completed within the first week – an early completion allows us to investigate the survey-results while still in the field. Through the questionnaires we wish to collect data on; gaur-visits, severity of visits, measures used to mitigate the risk of a gaur visit, costs and benefits of the gaur, livelihood strategies, income diversification, the role of agriculture and tourism in the area, land use and perceptions with regard to wildlife; the gaur. Ultimately we expect this data to tell us if there is any correlation between attitude towards the gaur and household livelihood-strategies and -outcomes. All participating households will be registered in the GPS, with a number corresponding to the number on the questionnaire. See Appendix 5, for considerations for questionnaire.

Semi-structured interviews

We intend to conduct semi-structured interviews (SSI) for collecting various forms of information. Prior to our fieldwork, we will do a literature search to get an overview of the management plan in place for Khao Yai National Park. Once in the field, we would follow up on our literature search, by conducting SSI's, preferably with a local representative from the Land Development Department (LDD). It will be of particular interest for us to get information on the legal status of the gaur. Furthermore, we aim to do an interview with one or two Park Rangers, both to understand how the management plan is interpreted in practice and to detect whether there discrepancies between the official plan and on the ground conduct. Also, we hope SSI's with Park Rangers can provide information on the level of enforcement and the measures used to enforce conservation policies, as well as their perceived level of compliance in the area. Ideally the SSI's with the Park Rangers would take place in the National Park, and maybe even resemble a transcendent walk. Specifically we are interested in the Khao Yai National Park borders and the regulations which apply to the people living in Moo 4, both with regard to forest- and wildlife- conservation. SSI's with villagers of Mu 4 will be conducted to follow up on the information gathered through our questionnaires. We might choose to return to some of the questionnaire respondents to get more in depth information on their attitudes towards the gaur and livelihood strategies, information that could help us identify potential drivers of change. Additionally the interviews might provide insight into the land-rights system of Mu 4. Preferably these SSI's with villagers will take place in their homes, making the issues discussed more tangible. The households interviewed will be registered on GPS.

To the extent possible, we would return for additional interviews with the same interviewees.

Participatory mapping

We expect to make use of participatory mapping at several levels. On household level we are considering to couple SSI's with participatory mapping of the land use and resource flows (livelihood strategies) of each household. Coupled with a questionnaire, these maps will provide detailed insight into the strategies employed by the individual household.

Participatory actives on a community level will be carried out as well. As a first thing we find it useful to make a timeline of important events in the area, providing points of reference for later PRA exercises where we wish to detect changes over time.

A map which portrays the spatial and temporal distribution of gaur visits, will be drawn up by villagers identified as knowledgeable on subject. The map will give us an idea of both the frequency of gaur visits, as well as the spatial exposure. We hope for the exercise to also provide some information on the severity of the visits and whether the gaur is perceived as a pest. We want to do land-use mapping of Mu 4 and a wealth-distribution map, both maps that can help us organize our research and underpin our sampling decisions.
The land-use maps will contribute to our understanding of how people in Mu 4 organize themselves on the land they occupy, maybe assigning uses to land we would have otherwise thought was unused. Coupled with transcendent walks and questionnaires, these maps will give us an idea of the spatial distribution of land-uses in Mu 4. Using the timeline as a reference we will attempt to register drastic changes in land use over time. Once the maps have been produced, we will try to facilitate a group discussion on the drivers of land-use and hopefully acquire an understanding of the dynamics of land-related decision-making and the land-rights system in place for Mu 4.

A mapping exercise to map wealth/status in Mu 4, will be conducted to understand the social composition of the community, using local indicators. We assume this knowledge will be useful for us, with regard to both sampling and data-analysis.

Currently we don't know the social dynamics of Mu 4, making it hard to decide on group-composition. However a precautionary measure would be to aim for a high level of homogeneity; at least with regard to gender, making separate male and female groups for all mapping exercises, age and social status should also be considered. With regard to gender, we expect to detect differences in the information provided in the land-use maps drawn by men and women respectively, as we assume land use to some extent will be gendered.

Observation

Observation is an inherent part of all the methods described above, as such we will be observing most of our time in the field. More specifically will try to observe and identify the measures used by villagers to avoid gaur visits; such as fences, dogs, changing to crops not favored by the gaur etc.

4. REFERENCES

Chettamart, S 2003, 'Ecotourism resources and management in Thailand', from https://www.researchgate.net/publication/228910124_Ecotourism_Resources_and_Management_in_Thailand.

Department for Internationl studies (1999): Livelihood Framework

Ebua, VB, Agwafo, TE & Fonkwo, SN 2011, 'Attitudes and perceptions as threats to wildlife conservation in the Bakossi area, South West Cameroon', International Journal of Biodiversity and Conservation, vol. 3, no. 12, pp. 631-636.

Emphandhu, D & Chettamart, S no date, 'Thailand's experience in protected area management', from https://www.researchgate.net/file.PostFileLoader.html?id=56cb3b915e9d978bef8b4567&assetKey=AS%3A331971717812225%401456159633287.

Hawkes, RK 1991, 'Crop and livestock losses to wild animals in the Bulilimangwe natural resources management project area', from https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/4576/Hawkes,%20Roland%20K.%20%20CASS%20%20&%20Mat%20Working%20Paper%20Series.pdf?sequence=1.
Hill, CM 1997, 'Crop-raiding by wild vertebrates: The farmer's perspective in an agricultural community in western Uganda', International Journal of Pest Management, vol. 43, no. 1, pp. 77-84.

Hill, CM 2000, 'Conflict of interest between people and baboons: Crop raiding in Uganda', International Journal of Primatology, vol. 21, no. 2, pp. 299-315.

International Union for Conservation of Nature (2016) Bos gaurus.
http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T2891A46363646.en

Nath, NK, Dutta, SK, Das, JP & Lahkar, BP 2015, 'A quantification of damage and assessment of economic loss due to crop raiding by asian elephant Elephas maximus (Mammalia: Proboscidea: Elephantidae): A case study of Manas National Park, Assam, India', Journal of Threatened Taxa, vol. 7, no. 2, pp. 6853-6863.

Mahdayani, W 2014, 'Ecotourism in the National Park of Thailand', National Research Council of Thailand.

McGuiness, S & Taylor, D 2014, 'Farmer's perceptions and actions to decrease crop raiding by forest-dwelling primates around a Rwandan forest fragment', Human Dimensions of Wildlife, vol. 19, no. 2, pp. 179-190.

Naughton, L, Rose, R & Treves, A 1999, 'The social dimensions of human-elephant conflict in Africa: A literature review and case studies from Uganda and Cameroon', Human-Elephant Conflict Task Force of IUCN, Gland, Switzerland.

Naughton-Treves , L 1998, 'Predicting patterns of crop damage by wildlife around Kibale National Park, Uganda', Conservation Biology, vol. 12, no. 1, pp. 156-168.

Panusittikorn, P & Prato, T 2001, 'Conservation of protected areas in Thailand: The case of Khao Yai National Park', The George Wright Forum, vol. 18, no. 2, pp. 66-76.

Prashanth, PKM, Kumara, V & Thirumala, S 2013, 'Man-animal conflicts in protected areas, a case study of gaur, Bos gaurus H Smith from the Mookambika wildlife sanctuary, Kollur, Karnataka, India', International Journal of Current Microbiology and Applied Sciences, vol. 2, no. 12, pp. 466-475.

Srikosamatara, S & Suteethorn, V 1995, 'Populations of gaur and banteng and their management in Thailand', Natural History Bulletin of the Siam Society, vol. 43, pp. 55-83.

Tanasarnpaiboon, S 2016, 'Gaur (Bos gaurus) abundance, distribution, and habitat use patterns in Kuiburi National Park, southwestern Thailand', Dissertations & Theses in Natural Resources, paper 129.

Tangprasert, P 2015, 'Another gaur found shot dead', Bangkok Post, 24 March 2015, http://www.bangkokpost.com/archive/another-gaur-found-shot-dead/506860.

5. APPENDENCIES

5.1. Appendix – data matrix

OBJECTIVE	SUB QUESTIONS	SUB SUB QUESTIONS	DATA REQUIREMENT	DATA COLLECTION METHODS/ACTIVITIES	INPUTS (equipment, people etc)	NOTES
Our aim is to investigate how does human-wildlife coexistence influence local livelihoods in Ban Khao Phaengma village (Mu4)	Are human-wildlife coexistence a driver of change in livelihood strategies?	What is the role of the Gaur in human-wildlife coexistence in Mu 4?	context of the Gaur: - legal status¸(de jure) - compensation measures in case of damage caused by Gaur - de facto status of the Gaur	- historical timeline of legal status - questionnaire - semi structured interview (SSI) with park rangers - SSI with LDD representative(s) - GPS	- team members (2-3) - village chief - affected villagers - large papers - coloured pens - a list of symbols (resource mapping) - developed to enable villagers to easily understand the map - example of resource flow map (RFM), made by another villager - prepared questionnaire - GPS device	
			exposure and severity of visits: - spatial, temporal and seasonal distribution of the Gaur visits - size of area raided - direct and indirect costs (local definition) - deaths?	- PRA (timeline + map of gaur visits) - focus group interview as a part of PRA - SSI - questionnaire - GPS	- team members (2-3) - village chief, villagers - a list of symbols (resource mapping) - prepared questions for SSI - prepared questionnaire - GPS device - laptop - coloured pens - papers (A4, A3) - notebook - dictaphone (cell phone recorder)	
		How does resilience to human-wildlife conflict influence households?	- distribution of wealth (social status): - household characteristics - household land use -past land use	- SSI - PRA - transect walk - questionnaire (on household composition etc.) - GPS (plot measurement) - observation - SSI with villagers - SSI with villagers and headman coupled with transcent walk - PRA (using informations on	- team members - villagers - prepared questionnaire - noteboooks - pens (coloured) - GPS device -laptop - papers (A3, A4)	We assume that perception of the Gaur and other wildlife is influenced by level of resilience

				collective land use) - timeline map		
			- measures to improve resilience e.g. - shifts in agricultural practices - fences - dogs - collective action	- observation - SSI with villagers	- team members (2) - prepared questions for SSI - dictaphone - notebooks - pens	
	How are cost and benefits of coexistence distributed in the community?	What is the relation between local activities and pereception on the Gaur?	- dependence on agriculture - dependence on tourism - importance of the Gaur	- assets of DFID e.g. does the gaur add or strain assets? (possible reasons?) - PRA mapping (HH level) - semi structured interview - questionnaire - GPS	- team members (3) - household members - questions for SSI and questionnaire - GPS device - paper (A3, A4)	Our assumption is that villagers depend on tourism practices are positively dependent while those engaged with agricultural practices negatively
		To which degree does the perceived risk influence livelihood strategies?	- percieved costs and benefits of the Gaur - local perception - spatial distribution of perception	- assets of DFID - SSI with focus group (to find out local indicators) - questionnaire (use of local categories to frame our questions)	- team members (3) - group of farmers (or tourist workers) - questions ready - dictaphone/cell phone recorder - paper, pens, pencils...	
			Risk management - land use: de jure and de facto rights (level of household rights with regard to land use and land use change)	- SSI with park manager(s) and LDD representative(s) - literature research - SSI with exposed villagers (informal compensation)	- team members (2-3) - park manager(s) - land development department representative(s) - exposed villagers - questions - dictaphone - papers, notebooks, pens...	

5.2. Appendix - Relevant cases from literature on HWC

Perceptions, attitudes and opinions

Naughton, Rose & Treves' work in Africa (1999) reflects the importance of farmers' vulnerability to the risk of crop raiding in determining their attitude to wildlife. Farmers feel especially vulnerable to large animals, with the potential to cause extreme damage (as opposed to cumulative losses, even though they may be greater), and when the animal is protected by the government. While losses to a neighbour's livestock can be redressed between farmers, losses to protected species cause resentment as they are not compensated by the government (the de facto owners of wildlife in the eyes of farmers).

Ebua et al. (2011) used questionnaires and participatory rapid appraisal to assess the attitude of local people towards wildlife conservation. They found that most are interested in conservation, although some see it as detrimental to local people; also, most believe that local people do not benefit from conservation. The authors attribute this to locals' position - bearing the cost of wildlife while receiving no compensation (for crop losses etc.) and being denied access to natural resources.

Hill (1997) found that farmers' perception of the seriousness of species as pests was determined not only by their capacity to damage crops, but also their dangerousness to humans; the findings suggest that people's fear of a species significantly affects whether they see it as a troublesome pest. Hawkes (1991), meanwhile, found that "uninteresting" pests such as birds tended to be under-reported as a cause of crop losses, possibly because they were "taken for granted" and did not come to mind when farmers were interviewed.

Measuring and mapping losses

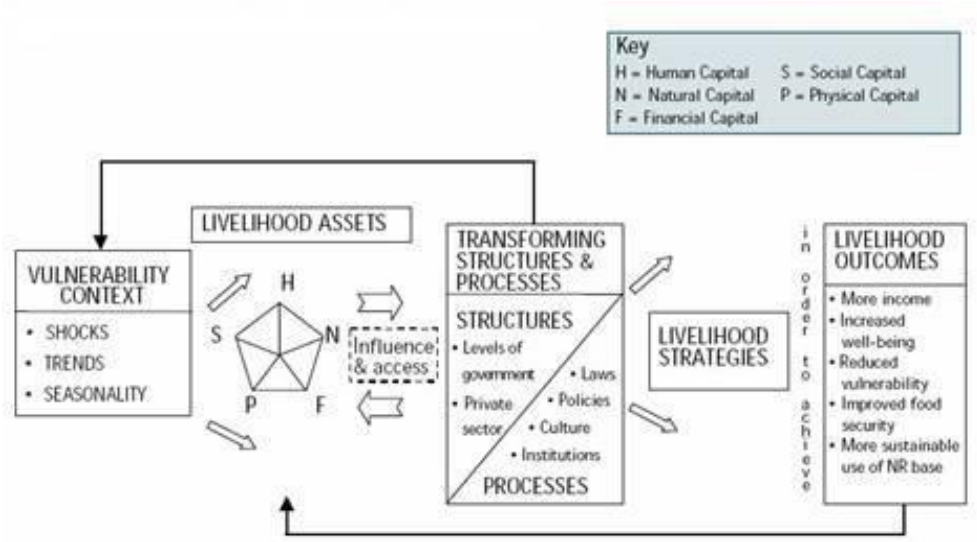
Naughton-Treves (1998) monitored crop losses to wildlife in Uganda and reported that frequency and extent varied markedly within and between villages and between species. The distribution of damage was concentrated around the forest edge, but highly skewed towards certain crops (maize and cassava) which were completely destroyed on occasion.

Hill (2000) used farm surveys and informal discussion groups to show that baboons can cause crop damage according to farms' proximity to the forest edge and the presence or absence of neighbouring farms. Monetary losses due to damage are not the only cost of crop raiding – there are also labour costs to protect crops.

McGuinness & Taylor (2014) used semi-structured interviews to investigate farming practices, raiding losses, and mitigation strategies among farmers in Rwanda near a forest fragment. Farmers reported significant losses, necessitating active guarding and potentially harmful (in terms of diet) changes in farming practices. The authors concluded that HWC impacts on livelihoods can be exacerbated by insecure tenure and population pressures.

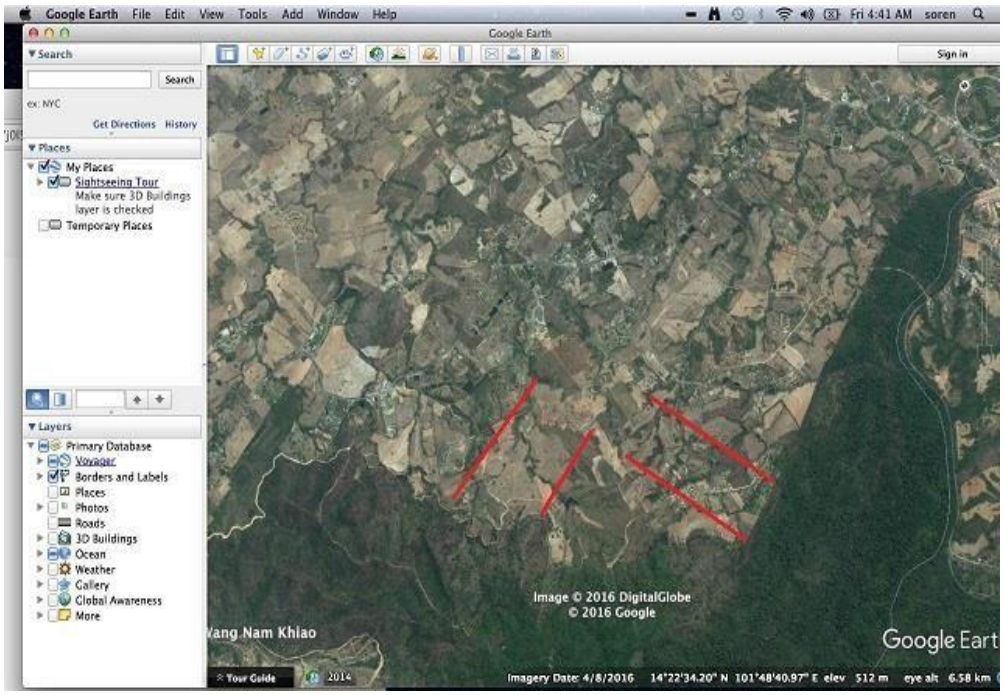
Nath et al. (2015) reported that crop raiding by elephants in India causes negligible economic loss overall, but can be quite high at the individual farmer level, especially for those with fields adjacent to a national park. They recommend the use of buffer zones and crop guarding by farmers.

5.3. Appendix - Livelihood framework



Source: Department for International Development (1999)

5.4. Appendix - Transect walks



5.5. Appendix - Considerations for questionnaire

For farmers - Agriculture problems and pests

Farming practices - crop type? guarding?

Seriousness of gaur as a pest? Relative to others?

Support for current conservation laws?

Experience of crop raiding? Timing of raids? Seasonal / long term?

For others - Conservation and tourism

Knowledge of the gaur species? Importance in landscape?

Attractiveness / perceived value?

Support for protection?

Assessing costs and benefits:

Using the DFID livelihood framework, we plan to break down the assets into operational categories - of relevance in the case of Mu 4. In the questionnaires we will then ask whether the gaur is perceived to add or strain household livelihood assets.

5.6. Appendix - Fieldwork timeplan

We 01.03	**Th 02.03.**	**Fr 03.03.**	**Sa 04.03.**	**Su 5.03.**	**Mo 06.03**
Morning: Arrival KU-SLUSE	*Morning:* 9-12 Visit Mu 4	*Morning:* Transect walk w. Village Headman: Mu 4 boundaries, Land rights system	*Morning:* Transect walk w. villagers + Casual talk on Gaur: costs and benefits Land use, Land rights Revisit mapping exercises	*Morning:* 9 - 12 Fieldwork presentation	*Morning:* Prepare Q Pilot test Q (3-5) Revisit, improve Q
Afternoon: Departure Base-camp	*Afternoon:* Work on research proposal	*Afternoon:* Transect walk w. Park Rangers SSI Park Rangers	*Afternoon:* Identify and contact participants for Timeline, Gaur-visits and land use mapping Timeline map	*Afternoon:* Prepare questionnaire (Q) Prepare Social mapping exercise Identify and contact participants for Social mapping	*Afternoon:* Prep the interpreters Distribution of Q's (10)
Evening: Research presentation + feedback	*Evening:* Presentation of research proposal + hand in	*Evening:* Prepare participatory mapping exercise: Timeline, Gaur-visits, Land use Group meet.	*Evening:* Gaur-visits map coupled + Focus group on cost/benefits Land use map + Focus group Land-rights Group meet.	*Evening:* Social mapping Prepare Q Plan for Q sampling, choice of method and households (HH) Group meet.	*Evening:* Distribution of Q's (10) Start Q-data analysis Group meet.

Tu 07.03	**We 08.03.**	**Th 09.03**	**Fr 10.03.**	**Sa 11.03**	**Su 12.03**
Morning: Prepare SSI w. Official from LDD	*Morning:* Q-data-analysis	*Morning:* SSI w. Village Headman, follow up on info. from SSI w. LDD official	*Morning:*	*Morning:* Preparation for community meeting	*Morning:* Community meeting
Afternoon: SSI w. Official Distribution of Q's (10)	*Afternoon:* SSI w. villagers at their homes (4) Participatory mapping of HH resource flow and land use	*Afternoon:*	*Afternoon:*	*Afternoon:* Community meeting	*Afternoon:* Community meeting
Evening: Distribution of Q's (10) Q-data-analysis Prepare SSI's w. Villagers Group meet.	*Evening:* SSI w. villagers at their homes (4) Participatory mapping of HH resource flow and land use Group meet.	*Evening:* Group meet.	*Evening:* Group meet.	*Evening:*	*Evening:* Closing ceremony

Note:

1. For most activities we will be divided into two groups, consisting of both Danish and Thai students, each group is assigned an interpreter
2. The last two days of our fieldwork we have kept free of activities, as we know our plans will change, maybe even our research question.