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The Dimensions of Ape–Human Interactions in Industrial Agricultural Landscapes

T. Humle[1]

Definitions and Context

Humans have always shared landscapes and resources with wildlife (Paterson, 2005). It seems fair to assume that such interactions have spanned the entire spectrum from mutually beneficial or benign to harmful. These harmful or conflictual interactions have become a focus for conservation and are frequently referred to as 'human–wildlife conflicts', although recent years have witnessed a notable shift away from the use of the term. Similarly, terms such as 'crop-raiding', 'raider' and 'thief'—which cast wildlife as conscious antagonists of people—are increasingly perceived as detrimental to efforts to foster coexistence between people and wildlife (Peterson *et al.*, 2010).

Unfortunately, this shift in terminology parallels an increase in global demand for arable land. Rapid human encroachment into great ape habitat has significantly increased the likelihood of encounters between great apes and people, or property, including crops (Hockings and Humle, 2009). In particular, recent industrial or commercial development projects have been expediting habitat loss and fragmentation, dynamics that often result in large influxes of people, thus exacerbating negative interactions between people and wildlife.

Such scenarios frequently intensify the spatial overlap between apes and people. Consequently, apes throughout their range increasingly face an erosion of their wild food supplies, restrictions in their access to space, nesting sites, water, mates and safe and familiar habitat, and increased risks to their health—either via heightened exposure to stress or via pathogens. In addition, apes face an increased risk of negative interactions with people and all that such interactions may entail for their long-term survival.

In this context, the human–primate interface poses a mounting challenge for conservation. This is of particular concern not only because the global demand for food crops, agrofuels and other products (such as cosmetics) is rising, but also because most apes—especially chimpanzees in habitat ranges across West and East Africa (Humle *et al.*, 2008; Wilson *et al.*, 2008) and approximately 75% of orangutans—occur outside protected areas, where land is generally managed to meet human needs and its use underpins economic development (Wich *et al.*, 2012).

This paper reviews the pressures faced by apes, especially great apes, in landscapes that are undergoing rapid modification through industrial agricultural development; it also highlights some current mitigation strategies aimed at balancing conservation and agricultural development

[1] The author can be contacted at the Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, University of Kent, Canterbury CT2 7NR, United Kingdom, email: T.Humle@kent.ac.uk.

and issues using certain approaches, such as the translocation of individuals from one area to another.

Adaptations and Direct Threats

Apes, especially chimpanzees and bonobos (*Pan*) and orangutans (*Pongo*), and to some degree gorillas (*Gorilla*), have the adaptive and cognitive capacity to thrive in human-modified landscapes under certain circumstances (Hockings and Humle, 2009). Great apes' ability to solve problems, learn socially, cooperate, incorporate diverse food types into their diets and access embedded or hard-to-process foods—whether by hand or tool use—facilitates their living at the interface with people. Indeed, across their range, great apes can flexibly exploit man-made infrastructure, such as footpaths, and introduced resources, such as cultivars.[2] Cultivars embody large, calorie-dense food resources that tend to be easily digested and patchily distributed in the landscape, rendering them highly attractive to great apes and other wildlife. Hockings and McLennan (2012) revealed that wild chimpanzees are known to consume as many as 36 different species of cultivars and 51 plant parts across their range; among these, banana, cacao, maize, mango, sugarcane, and potentially oil palm and papaya, were identified as 'high-conflict' crops, whose exploitation by apes was often not tolerated by humans.

However, not all ape species, subspecies, populations or groups forage on industrial-scale crops or even other crop types cultivated on a significantly smaller scale for subsistence purposes. Hockings and McLennan (2013) propose that differences in cultivar consumption among chimpanzee communities are culturally determined and therefore socially transmitted among members of a group. Such patterns of social transmission of dietary knowledge are also likely to characterise other ape species. In some cases, the part consumed does not correspond to that harvested by humans; however, if there is an overlap or an eventual impact on harvest productivity, then 'conflict' may arise between apes and landowners or workers.

It is therefore essential to understand 1) whether apes incorporate a particular type of crop in their diet prior to promoting its expansion locally on an industrial scale and 2) which industrialized crops might be attractive or unpalatable to apes (Hockings and McLennan, 2013). In addition, it is crucial to determine if and how apes can survive in highly human-modified landscapes dominated by monocultures, which typically characterise industrial agriculture.

Our knowledge in this area remains patchy, but studies are increasingly shedding light on this issue and identifying factors that affect or favour ape survival in such landscapes. Most of these studies focus on orangutans in Indonesia and Malaysia, two of the largest producers of palm oil products globally, and also major producers of paper pulp, rubber and other types of biofuels. Across Indonesia and parts of Malaysia, the significant development of commercial plantations and the expansion of monocultures, such as oil palm, rubber and acacia or eucalyptus, have already resulted in the marginalization and isolation of orangutans, as these processes often force individuals to become obligate or semi-obligate crop feeders[3] to survive (Campbell-Smith *et al.*, 2011; Meijaard *et al.*, 2010). These orangutans feed on young oil palm saplings, the fruit of mature oil palms and the bark of rubber trees (*Hevea brasiliensis*), thus disrupting latex collection; they also consume the bark of *Acacia mangium*, a quick-growing exotic used in pulp production and reforestation. This damage, even if negligible and minimal, often heightens conflict with plantation owners (Yuwono *et al*., 2007; Hockings and Humle, 2009).

[2] A cultivar is a plant selected by humans for its nutritional, ornamental or other characteristics.
[3] An obligate crop feeder is an individual whose survival depends entirely on foraging on crops; a semi-obligate crop feeder is one who depends partly on crops and partly on other natural food types for survival.

In many cases, orangutans who occupy these rapidly changing landscapes are unable to meet their nutritional needs (Ancrenaz *et al.*, 2008). Consequently, they experience undue stress and starvation; some have to be rescued and placed in rehabilitation centres. Not only are such centres barely able to cope with the influx of individuals, but they also encounter difficulties as they attempt to sustain parallel release efforts across a limited number of suitable release sites (Ancrenaz *et al*., 2008; Robins *et al*., 2013).

Although Meijaard *et al.* (2010) demonstrate that, in the short term at least, orangutans can survive in relatively high densities in plantation landscapes dominated by *Acacia* spp., for example, it remains unknown how long they can persist under these conditions, or at what cost to apes and plantation owners or workers. A more recent study by Ancrenaz *et al.* (2015) reveals that orangutans are able to disperse and travel in oil palm plantations, use oil palms for nesting and consume the fruit. Nevertheless, orangutan presence in landscapes that are dominated by mature, commercially grown oil palm is correlated with the distance to the edge of natural forest patches; this finding highlights the importance of forest patches, whether small, fragmented or even potentially degraded, to sustaining orangutans in such highly modified landscapes. Indeed, Ancrenaz *et al.* (2015) argue that plantations need to incorporate forest patches and corridors (along riparian forest areas, for example) into their management plan; they also encourage the planting of other species of value to great apes for nesting or foraging as a way to help to sustain viable orangutan populations. In addition, Campbell-Smith *et al.* (2011) show that orangutans can adapt to living in agroforestry landscapes, but only as long as they are tolerated by local people.

Naughton-Treves (1997; 1998) demonstrates that in Uganda's Kibale National Park, forest-dwelling wildlife, including chimpanzees, were more likely to forage on crops in fields located near the perimeter of the forest—that is, those within 500 metres of the forest edge—than farther afield. Subsequent research has corroborated that such patterns are common across a wide range of crop-raiding wildlife in protected areas (Sitati *et al.*, 2003; Linkie, Nofrianto and Leader-Williams, 2007).

If ape foraging on crops in fields, plantations and orchards is not tolerated, however, it may represent highly risky behaviour (Hockings, Anderson and Matsuzawa, 2009). Under such circumstances, individual great apes are indeed subject to being chased off, injured or even killed. This pattern explains why adult males tend to be the ones who forage on crops, as they are more likely to exhibit risk-taking behaviour than adult females or subadults, particularly among chimpanzees (*Pan troglodytes*) (Hockings, 2007; Wilson, Hauser and Wrangham, 2007). However, if risk associated with foraging on crops is low—such as when levels of retaliation and intolerance from farmers are low, or when intra-specific competition[4] is negligible—then females may engage in foraging on crops as frequently as males, perhaps even more so because of their need to meet reproductive demands, as exemplified in a study of wild Sumatran orangutans (*Pongo abelii*) in an agroforestry landscape (Campbell-Smith *et al.*, 2011).

For some populations, feeding on crops can promote reproductive success, as long as there is no retaliation from people and the landscape is a mixed agriculture–forest mosaic rather than one dominated by monocultures. In fact, a crop-feeding community of chimpanzees (*Pan troglodytes verus*) in Bossou, Guinea, West Africa, which occurs in a mixed landscape where people are relatively tolerant of their primate relatives, shows significantly shorter inter-birth intervals and higher infant survival rates than do conspecifics[5] who are more dependent on wild foods for their survival (Sugiyama and Fujita, 2011). It should be noted that chimpanzees at Bossou have an extremely diverse diet that comprises more than 200 plant species, representing 30% of all

[4] Intra-specific competition takes place among members of the same species.
[5] Conspecifics are members of the same species.

available plant species in their habitat (Humle, 2011). Nevertheless, they also demonstrate social adaptations that reflect a cautionary approach to human landscape features and areas. Indeed, they behave more cohesively during crop-feeding and road-crossing events (Hockings, Anderson and Matsuzawa, 2006; 2012).

In spite of demonstrating a high reproductive output, this community of chimpanzees currently suffers from reproductive senescence[6] and genetic inbreeding linked to its semi-isolation from nearby communities, which are located approximately 6–8 km away. In addition, the group's elevated proximity to human presence and activity may dissuade unhabituated young females from immigrating into this community (Matsuzawa, Humle and Sugiyama, 2011). Nevertheless, the case study of Bossou, a landscape not currently dominated by industrial agriculture, illustrates that great apes are capable of a high level of behavioral and social plasticity, especially when they live in human-modified landscapes.

Another major threat to great ape populations across sub-Saharan Africa is the transmission of disease (Köndgen *et al.*, 2008). Increased encounters between people and great apes can increase the risk of inter-species disease transmission. In addition, industrial-scale activities across ape ranges can intensify the level of hunting in an area, as employees engage in hunting wildlife for food, or road infrastructure development facilitates hunter access and the bushmeat trade; these dynamics further compromise ape survival and exacerbate their apprehension of humans (Wilkie and Carpenter, 1999; Wilkie *et al.*, 2000; Poulsen *et al.*, 2009).

People's intolerance of apes—whether based on real or perceived costs—may result in the 'deliberate killing', 'lethal control', 'retaliation', 'persecution' or 'retributive or defensive killing' of individuals. With respect to endangered species, such actions are not only illegal, but they also create conflicts between farmers, landowners, labourers, the government or protected area authorities, and conservationists.

Meijaard *et al.* (2011) carried out social surveys across several hundred villages and amassed nearly 7,000 responses from across Borneo, Indonesia. Nearly 25% of those who reported 'conflict' with orangutans also reported personally killing an orangutan, as opposed to 7% of respondents who reported no 'conflict'. However, there was no significant relationship between killing rates and the frequency of conflict; the likelihood that an orangutan will be killed is therefore not related to the magnitude of ape foraging on crops or economic losses incurred by farmers.

Studies show that retaliatory or retributive killings can significantly affect the local survival of a species, especially among apes who exhibit a slow reproductive rate linked to long inter-birth intervals and the slow maturation of youngsters to adulthood (Rijksen, 2001; Meijaard *et al.*, 2011). Such killings can also exacerbate the risk of disease, as elevated levels of stress can impair the ability of an individual's immune system to combat disease and infection (Muehlenbein and Bribiescas, 2005).

Indirect Threats and Managing Perceptions

As Knight (2000) argues in the introduction to his edited volume *Natural Enemies*, most issues between people and wildlife can be attributed in some shape or form to conflict between people and differences in how people value a species. While the expansion of industrial agriculture will in most cases result in significant habitat loss and have an effect on apes, other wildlife and

[6] Senescence is the end of cyclic reproductive activity among primates.

ecosystems, it may also severely impact land access and tenure systems among local small-scale farmers (Mukherjee and Sovacool, 2014).

If apes can no longer meet their nutritional requirements via foraging on natural foods and if dominant monocultures are palatable, it is highly likely that individuals or groups of apes will modify their ranging behaviour (if possible) and seek to consume crops. For example, the loss of forest habitat in southern Gombe Stream National Park, Tanzania, apparently led one chimpanzee community to forage on bananas, mango and oil palm fruits at the forest edge (Greengrass, 2000). Although chimpanzees in parts of the Kahuzi-Biega National Park, in the Democratic Republic of Congo, persist at low densities, hostility among local people has worsened due to increased chimpanzee foraging on staple foods, such as plantain bananas and corn (Yamagiwa et al., 1992).

Affected farmers who are already in conflict over land rights and tenure may be more prone to express intolerance of great apes and to kill individual apes in retaliation. Although there is to date no direct evidence to this effect, the potential of such risks can serve to emphasize the need to address land ownership and land tenure issues to the satisfaction of local people prior to the initiation of any agricultural development, as a way of mitigating negative indirect impacts on wildlife, including apes. It is thus vital not only to predict the environmental and social impact of industrial agricultural development on an area, but also to understand how the social and human conflict dimensions could affect people's tolerance and attitude towards great apes and other wildlife.

Misconceptions can also aggravate interactions. Across Borneo and Sumatra, for instance, the false notion that orangutans significantly affect oil palm productivity and pose a risk to labourers has led to the intentional killing of many of these apes across industrial agricultural landscapes and a consequential surge in emergency rescues of many other vulnerable orangutans (Rijksen, 2001; Meijaard *et al.*, 2011; Ancrenaz *et al.*, 2015). However, around Kinabatangan in Eastern Sabah, Malaysia, most workers across large commercial plantations refute the idea that orangutans have any effect on oil palm fruit productivity (Ancrenaz *et al.*, 2015). Similarly, there is no evidence to date that chimpanzee foraging on wild or feral oil palm parts, even if extensive and in some cases invasive (such as the consumption of oil palm heart), has any impact on oil palm survival or fruit productivity (Humle and Matsuzawa, 2004; Soumah, Humle and Matsuzawa, 2014).

Wild apes who exhibit aggression against humans tend to be habituated to the human presence or perceive people as threatening (Hockings and Humle, 2009). Indeed, all aggressive events reported between 1995 and 2009 between habituated chimpanzees and people at Bossou, Guinea, have been linked to some sort of human provocation (Hockings *et al.,* 2010). These acts of aggression were concomitant with a growing loss of fear of humans, which potentially exacerbated chimpanzee crop damage events and their use of roads and paths, with the consequence that encounter rates between humans and chimpanzees increased (Hockings *et al.,* 2006; Hockings and Humle, 2009).

Wilson *et al.* (2014) demonstrate that, across long-term study sites, chimpanzee communities that experience high levels of human encroachment into their natural habitat also tend to suffer more harassment by people. McLennan and Hill (2013) note that unhabituated chimpanzees at Bulindi in Uganda started 'stalking' researchers and their field assistants soon after an outbreak of small-scale logging in the forest, which was undertaken in response to a misconception by people that the forest would be set aside for protection and that human access to resources would be restricted and regulated. The chimpanzees vocalised and drummed extensively, possibly to impress the human intruders, including loggers, researchers and local assistants. This situation coincided with a reported chimpanzee attack on a child in the area (McLennan and Hill, 2013).

Indeed, provocation and feelings of insecurity appear to be clear drivers of aggression, whether on the part of great apes against people or vice versa. Such cases exemplify why it is primordial to discourage great ape habituation at all costs, especially in areas that may be targeted for future industrial agricultural development. The abovementioned examples also highlight how great ape populations, groups or individuals, including humans, may display different tipping points in tolerance capacity and how people's perceptions, values and misconceptions can influence their interactions with great apes.

Agricultural Practices and Land Use Management

Understanding the requirements of displaced and isolated populations of great apes is essential for land use management and conservation planning (Sha et al., 2009; Hoffman and O'Riain, 2012). Indeed, Wich *et al.* (2012) argue that it is vital to understand where wild great apes and other threatened wildlife overlap with protected areas and areas propitious to large-scale development, such as industrial agriculture, to inform conservation planning. Although expansion of industrial activities into orangutan range breaches national laws on species protection, more than 50% of orangutan distribution currently lies in undeveloped forest and oil palm and tree crop concessions. Wich *et al.* (2012) therefore suggest that efforts urgently need to focus on improving yields in current plantations and on expanding concessions in already deforested areas absent of orangutans.

In some African countries propitious to oil palm and other large scale agricultural development—such as Angola, the Democratic Republic of Congo, Gabon, Ghana, Ivory Coast, Liberia, the Republic of Congo and Sierra Leone—great ape distribution overlaps with more than two-thirds of areas that are both suitable for oil palm development and located outside protected areas (Wich *et al.,* 2014). Many of these landscapes, especially across West Africa, are already degraded, although some chimpanzee communities have survived in them for generations. Ironically, their survival may be dependent on the presence of wild oil palms, which possibly serve as a keystone species for some of these communities (Brncic *et al.,* 2010).

Wherever apes can survive and thrive on natural resources available to them and share the landscape with people, agricultural development should focus on maintaining natural resources, forest patches and ecosystem services; this approach helps to preserve and promote connectivity to ensure population viability and to manage negative attitudes towards apes and crop losses (Koh and Wilcove, 2008; McShea *et al.,* 2009; SWD, 2012; Ancrenaz *et al.,* 2015). Management strategies and schemes may have to vary according to the growth stage of the commercial plant. As Ancrenaz *et al.* (2015) argue, once oil palms reach maturity in a plantation, measures such as trenches and strips of bare land that act to protect oil palm saplings from orangutans can be removed and bridges may be put in place so as to promote orangutan dispersal, nesting and low-impact foraging on fruit in order to promote species conservation. The effectiveness of trenches and bare strips of land in protecting plantations from apes and other wildlife is yet to be ascertained, however. Further research is also required to assess the value of implementing other types of buffers around plantations, especially with regard to ape species-specific plant species composition and recommended width.

Another way of preventing crop loss or damage is to switch land use activities or promote zero- or low-risk crops instead (Hockings and McLennan, 2012). While such strategies may not always result in equal or greater economic benefit to farmers or landowners, some crops can help balance both economic and conservation objectives. Hockings and Sousa (2012) demonstrate that cashew (*Anacardium occidentalis*) production across a forested agricultural matrix around the Cantanhez National Park in Guinea-Bissau, West Africa, can benefit both wild chimpanzees and people, providing an example of co-utilization. While this tree species is of high economic value, it is also nutritionally beneficial to wild chimpanzees; the apes focus on the fleshy part of the fruit and leave behind the valuable casing that contains the seed (that is, the cashew nut) for farmers to harvest. Although this crop species appears to meet both livelihood and conservation objectives, it must be noted that unmanaged expansion of cashew plantations or any other low-conflict crop of high market value could result in significant habitat loss for wild chimpanzees and other great apes; in addition, such expansion could affect market prices, and thus the crops' value to farmers.

Translocation and Other Mitigation Strategies

Any future industrial agricultural development should uphold no-impact policies with respect to great apes and other endangered species, such as by following the best practices of the Roundtable on Sustainable Palm Oil (RSPO, n.d.). However, some large-scale plantations have already affected or continue to have a severe impact on certain populations (Rijksen, 2001). In areas where orangutans occur, wildlife translocations—that is, the 'human-mediated movement of living organisms from one area, with release in another' (IUCN, 2012)—have generally been implemented as a last recourse to save individual great apes (Yuwono *et al.*, 2007).

Such rescue missions often concern orangutans in extremely poor physical and psychological condition (Hockings and Humle, 2009). These individuals often require veterinary support and are therefore placed in rehabilitation centres to facilitate their recovery and potential future release back into the wild. Other individuals are sometimes may be rescued when plantation workers or local people signal their presence to local non-governmental organizations or authorities (G. Campbell-Smith and I. Singleton, personal communication). In some cases, they are translocated elsewhere directly, without thorough prior assessment of whether the situation at the site of origin is truly unmanageable and the impact on both great apes and people cannot be mitigated or prevented by any other means (S. Wich, personal communication). The danger inherent in such initiatives is that they may foster quick-fix solutions to mitigating issues between people and endangered wildlife, rather than promoting consultations among all stakeholders and expert assessments aimed at understanding and mitigating issues over the long term.

Unplanned and mismanaged translocations often fail to assess the survival chances of released individuals and the impact of their presence on wild conspecifics and other wildlife at the release site. The release of individuals into areas that are already populated by conspecifics could indeed result in mortalities due to intra-specific aggression, especially among male chimpanzees (Goosens *et al.*, 2005; Humle *et al.*, 2011). In addition, they could lead to the transmission of disease if at-risk individuals are not appropriately quarantined and tested prior to being released (Beck *et al*., 2007; Kavanagh and Caldecott, 2013). Such translocations might also disseminate 'conflict issues', should relocated individuals habitually forage on crops or approach human settlements. Such 'bad habits' could get passed on to other individuals at the release site and cause issues with people elsewhere.

It is clear that any post-release monitoring or pre-release site assessments and translocation initiatives are financially and logistically costly. It is therefore essential to develop a coherent strategy around orangutan translocation; such a strategy should ensure sustained funding, involve expert assessments of suitable release sites that are unlikely to undergo future large-scale development and conflict issues with people, and apply adequate post-release monitoring techniques and methodologies. However, translocation or relocation is rarely a useful or feasible option, given that suitable habitats are often scarce and the process is ethically and logistically complicated, especially for great ape species that live in complex social groupings, such as chimpanzees, bonobos and gorillas (Hockings and Humle, 2009).

To date, very few studies have tested alternative mitigation approaches and deterrent techniques; these have focused on small-scale farming, which is more vulnerable to damage than are large-scale commercial plantations. Nevertheless, their results may still inform mitigation approaches applicable to industrial agriculture.

Hill and Wallace (2012) experimented with and developed different locally appropriate techniques aimed at reducing crop damage by primates, including chimpanzees, around Budongo Forest Reserve in Uganda. Their collaborative effort with local farmers implemented four categories of deterrents: barriers, alarms, repellents and systematic guarding. Systematic guarding proved highly successful. Impenetrable living Jatropha hedges, multi-strand barbed-wire fences combined with camphor basil (*Ocimum kilimandscharicum*) planted along the bottom of fences, and rope fences coated with chili paste were also helpful in reducing primate crop damage. On their own, however, barbed-wire fences were not always effective and simple ropes with bells were entirely ineffective.

These measures varied in their costs and practical implementation. Barbed-wire fence is expensive and a hedge cannot readily be moved around in a landscape characterised by shifting agriculture, although such an approach could potentially be highly effective in protecting permanent gardens. That said, the large-scale use of hedges or barriers, such as fences, may be problematic for wildlife and could interfere with their ranging and dispersal behaviours (Hayward and Kerley, 2009). Their implementation thus requires careful analysis and prior understanding and knowledge of local ape ecology and ranging.

Hill and Wallace (2012) also reveal that the implementation of tested measures leads wildlife to shift attention to unprotected neighbouring farms, displacing the issue; the study thus highlights the importance of implementing mitigation schemes simultaneously across all neighbouring farms or agricultural developments. The authors conclude that persistent efforts could eventually lead to a significant decrease in crop damage events, as long as individual apes have adequate natural forage available. Year-round availability of and access to natural foods should therefore be assessed in advance, to avoid scenarios in which preventing access to crops could nutritionally compromise ape survival.

In Sumatra, Campbell-Smith, Sembiring and Linkie (2012) trialed noise deterrents and netting of trees to deter orangutans from foraging on fruit orchards in an agro-forestry landscape. The implementation of these measures improved local farmers' attitudes towards orangutans. Netting of trees and noise deterrents proved highly effective across farms where these approaches were tested, as shown by a comparison of pre-trial and post-trial raiding events, while there was no difference in crop damage incidents between pre-trial and post-trial control farms, where no deterrents were employed. Although netting trees proved most effective, as it resulted in a significant increase in crop yield, farmers failed to persist in employing this technique after the trials ended, probably because it was more expensive and logistically more complex to put in place.

Another way to mitigate instances of aggression is to change people's behaviour towards great apes (Hockings and Humle, 2009). In some cases, it is possible to prevent surprise encounters and, potentially, to reduce aggressive incidents by maintaining shared paths to increase visibility (Hockings and Humle, 2009). Educating plantation workers and people in the locality about great apes and advising them on how to behave when they see a great ape may also help to minimise the likelihood of aggression and the risk of escalation during encounters.

Conclusion

Across ape ranges, agricultural expansion, especially at the industrial scale, clearly runs the risk of prompting or exacerbating negative interactions between people and apes; the risk is particularly high among ape species or populations that are most likely to utilise cultivated species and venture close to human areas and modified landscapes. In countries that harbour wild apes, there is an urgent need to balance industrialised agricultural development and law enforcement pertaining to endangered species protection. In that regard, it is vital that reliable, national-level empirical data on ape distribution and occurrence, especially outside protected areas, inform land use planning to help balance agricultural development and ape conservation.

At the local level, it is essential to assess the needs of both humans and apes. On the one hand, there must be an understanding of human dimensions of conflict that could impact people's livelihoods as well as changes in people's attitudes towards apes to help prevent and manage any escalations and retaliatory behaviour. On the other hand, there is a need to understand ape ecology and ranging behaviour to pre-empt conflict linked to industrialised agricultural activities across targeted areas.

A broad perspective that accounts for the impact of all potential industrial-scale and related developments should also be encouraged, so as to minimise any cumulative impacts and risks to both people and apes. Clearly, such efforts require appropriate interdisciplinary and cross-disciplinary expertise, as well as strong local participation and engagement of all stakeholders involved.

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