Chapter 3
Non-Violent Techniques for Human-Wildlife Conflict Resolution

Contextual Framework Within the ACPB

The main objective of this chapter is to present a framework for approaches to non-violent, safe systems for Human-Wildlife Conflicts (‘HWC’). Such resolution systems, aimed at providing sustainable approaches to balancing wildlife and human existence in shared-landscapes and environments across Bhutan, are tracked within the realm of equally challenging Human-Wildlife Conflicts in other parts of the world. From the outset, but particularly given the Bhutanese Buddhist context, it must be conceded that ‘conflict’ is a strictly anthropogenic and species-specific, self-serving concept. Other species who were here (in Bhutan, as elsewhere), long before humans, do not seek conflict with humans. It is our species’ problem, and one that is crucial we find ways of relieving without injury to all concerned. The philosophical options, and conservation methodologies embraced are a key component to diminishing one of the most critical aspects of the Anthropocene, as human population and development continue to accelerate, as was described in the I=PAT (human impact on the environment is equal to size of human population x its levels of affluence and technology) formula nearly 50 years ago, developed by Paul Ehrlich and John Holdren [1].

Even as a country that embeds the philosophy of Gross National Happiness at the centre of all its policy objectives and actions, HWC remains one of the major challenges in Bhutan for farmers, livestock herders and all those concerned with conservation. HWC has raised significant issues at all levels: for policy makers, in government, NGOs, animal welfare organizations, researchers, religious authorities, students and the public at large; not to mention all those other species for whom human mismanagement, or outright infliction poses the graves of consequences. In this context, the ACPB endeavour has conducted a thorough review of Human-Wildlife Conflict at the national and global levels in order to assess the factual situation affected by the policies, prevention and mitigation practices undertaken in
various geo-political ecosystems. It has taken into account the cultural and socio-economic conditions in various countries, and in Bhutan, reinforcing Bhutan’s review of the situation through multi-stakeholder consultations, a Rapid Assessment tool kit of WWF in different socio-economic strata, incorporating a myriad of ethical principles and efficacious ecosystem management (Fig. 3.1).

The review and results of the assessment have been used to provide empirical evidence for providing innovative, non-violent and deployable measures and techniques towards HWC resolution for Bhutan. The non-violent approach to Human-Wildlife Conflict will be a paradigm shift from conflict to a meaningful coexistence between people and wildlife to protect people, assets, wildlife and habitat. The recommended non-violent approach inculcates for the first time ever the Gross National Happiness (‘GNH’) Index standards for the wildlife and animal kingdom in general;
embracing social, environmental, financial, religious, cultural, governmental and legislative factors holistically; signifying a realistic pathway and framework of coexistence for people and wildlife, and a promising future driven by such concepts as biophilia, physiolatry, ecological ethnography, animal rights/liberation, biosemiotics, deep ethology, and their convergence in the bioculturalism that is the unique window on human affairs instituted by the GNH model, both for Bhutan and beyond.

**Methodology**

A situational analysis of HWC in the global context, and its specific importance to the prevailing circumstances in certain parts of Bhutan, was carried out pertaining to the policies and strategies, preventive, mitigation, and response measures of such conflicts. Simultaneously, a detailed study of HWC was conducted at Jomotshangka Wildlife Sanctuary, which encompasses three types of vegetation (as classified in Grierson and Long, 1983), such as subtropical forest, warm, and cool broad-leaved forests, situated within the Indo-Bhutan border with altitudinal gradients varying from 133 m to 4250 m (above sea level –‘asl’) situated within the Indo-Bhutan border. As the Sanctuary is known for its critical habitat for several wildlife species in various agro-ecological landscapes, the study assessed the level of tolerance and co-existence, HWC and non-violent resolution techniques through preventive and mitigation measures. A Rapid Assessment Tool Kit [2] as indicated in Annexure 3.1 was used to record the information provided by key informants of 60 households living in the sanctuary where agricultural farming is the mainstay of livelihood in the study area. Additional information, not covered within the structured Rapid Assessment Tool Kit, related to agricultural practices and to specific taxa was also recorded during the discussion. All conflict actions have been grouped into six conflict elements: policy, prevention, mitigation, understanding the conflict, monitoring and response (Table 3.1). An integrated approach to HWC recognizes that HWC is a holistic system, and that the six elements must be accounted for in any management programme, and no single element should be implemented in isolation.

The key informants were asked 75 criteria questions (listed in Annexure 3.1) pertaining to human-wildlife conflict in their area. Each criterion was scored 1 to 4 based on effectiveness and results of the HWC criteria context: undesirable result – worst case (score 1); result is negative and not improving (score 2); result is trending positive and improving (score 3), and desirable result – HWC approaching zero (score 4). Scores for each criterion were aggregated corresponding to both the HWC Element and the SAFE Outcome (see Table 3.6). Scores of 3 or 4 are considered to meeting that criterion, and these are used to calculate the percentages for the results:

1. **Percentage scores for Outcomes are derived from:** 
   
   \[
   \text{Percentage} = \frac{\# \text{Criteria scoring } 3-4}{\# \text{Criteria for that Outcome}} \times 100
   \]

2. **Percentage scores for Elements are derived from:** 
   
   \[
   \text{Percentage} = \frac{\# \text{Criteria scoring } 3-4}{\# \text{Criteria for that Element}} \times 100
   \]
The Rapid Assessment of HWC in Jomotshangkhas Wildlife Sanctuary (‘JWS’) is one of the first key steps in a process of developing a Safe Strategy for the sanctuary. Put simply, the rapid assessment results will identify the immediate risk areas resulting from HWC, and be able to suitably design an HWC management programme that will effectively remove those risk areas.

Based on the global and national literature review and the results of the assessment, discussions and recommendations are being made for a non-violent deployable technique to better resolve HWC and conservation challenges in Bhutan. (The MS Excel software package was used to analyse the information.)
Global Context of HWC

HWC has been defined in various scientific articles, often described as conflict between wildlife and humans due to the consequences of negative impacts on human property, prospects for recreation, and human safety. Or, conversely, those myriad retaliatory actions taken against wildlife. It bears repeating: the burden of prudent preventive measures and actions lies exclusively with humanity, not other species, who must be deemed never to have been culpable for any wrongs, given that all these HWC attributions are expressly those of the human world. Animals are obviously innocent, simply engaging in their survival strategies that have been hard-wired for millions of years by evolution. The World Wildlife Fund (‘WWF’) defines Human–Wildlife Conflict as ‘any interaction between humans and wildlife that results in negative impacts on social, economic or cultural life, or on the conservation of wildlife populations, or on the environment’ [3]. HWC is also defined as any interaction leading to negative impacts on the humans or wildlife involved [4].

Historically, there was a certain level of co-existence between local communities and wildlife, but this was possible in a different socio-economic setting than what we are experiencing today. With the swelling global population pressure and associated rush in human activities triggered mostly by extension of agricultural land, deforestation, urban towns, overharvesting and depletion of natural resources, and the serious disturbances of previously pristine ecosystems - wildlife species are often displaced, or deliberately extirpated from their natural habitat. Those species are compelled, obviously, to continue to seek food and water in whatever ways are possible for them, wildlife will necessarily encroach into agricultural lands causing the conflict with humans [5] and leading to a fundamental competition for resources. Due to overwhelming anthropogenic pressure, there is the eminent danger of humanity undermining the total ecological support system for this vast array of taxa. The Earth has not witnessed such a catastrophic occurrence in some 252 million years, the date affixed to the so-called ‘Permian-Triassic Extinction Event’, or P-TR End Permian Extinction, also known instructively as the Great Dying. HWC – in all of its collective manifestations - is a crucial component of this crisis.

Thus, owing to indiscriminate human interference, other species have either become extinct, or threatened, or endangered or vulnerable in their own natural habitat and environment. Threat level definitions vary from country to country, state to state, as well as in the far broader, global identification systems, like those of the IUCN Red List, modified in Japan, Russia, Germany and China; designated the Species at Risk Act in Canada, BE 2535 in Thailand, the Endangered Species Act in the United States, Biological Diversity Act, 2002, in India, the New Zealand Threat Classification System, and the EU Habitats Directive throughout Europe, to take just some of the threat system variations.

HWC has become a global challenge for conservationists, agriculture and livestock production systems. The complexities of the challenge are linked to social, cultural, environmental, political and economic landscape concepts of sovereignty; legal definitions; land tenure presumptions; and – most critically – levels of human
ecological intolerance, hubris, indifference, environmental illiteracy, or outright callousness. Tolerance and compassion training for farmers and their families pale by comparison with competing home-grown anxieties that track global economics and trade imbalances, like those witnessed in the Summer/Fall of 2019 between farmers in the U.S. and China. Extensive experimental studies have been carried out in various regions throughout the world with the goal of finding locally relevant modalities of tenable win/win conflict resolution. In spite of such efforts, the conflict remains as one of the major concerns for all those focused upon the amelioration of Anthropocenic fall-out, as the global human population of consumers approaches 8 billion individuals, with forecasts approaching 10 billion by 2050, with all of the accompanying extrapolations with respect to kilocalorie needs, and the translation of nutrient loads into land size, irrigation needs, and the usurpation of previously wild, or even semi-wild habitat for human use, as measured by Net Primary Production (‘NPP’) and the amounts of chlorophyll-producing indigenous vegetation transmogrified into croplands, monoculture and other biologically depauperate scenarios, as measured by such technologies as NASA’s Moderate-Resolution Imaging Spectroradiometer (‘MODIS’) and its ‘Net Primary Production Yearly L4 Global 1 km’. [6] (Fig. 3.2).

Large vertebrates (those exceeding 50 kg) are at particularly dire risk everywhere (both terrestrially and aquatically). Attrition amongst populations of lion (Panthera leo), tiger (Panthera tigris), snow leopard (Panthera uncia), and Asian elephant (Elephas maximus), Himalayan black bear (selenarctos thibetanus), common leopard (Panthera pardus), wild pigs (Sus scrofa), wolf (Canis lupus), Dhole (Cuon alpinus), and Sambar (Rusa unicolor) are particularly noted from North Africa and the Middle East, to the Himalayas and South Asia [7–11]. Whilst these megafaunal losses represent global biodiversity jeopardy, and painful loss, from much of the human perspective, the many thousands of disappearing individual animal lives are not necessarily correlated. For farmers, their primary focus concerns their ability to feed their families and communities, which translates – not into conservation, necessarily, but the outright realities of crop raids and livestock depredation [11–13]; of disease transmission, collisions with vehicles and aircraft, nuisance behaviour in

Fig. 3.2 Himalayan black bear selenarctos thibetanus laniger, very common predator © Sithar Tenzin, WWF-Bhutan
urban settings, damage to buildings, and attacks on humans [14, 15]. There are countless examples, however, of conservation measures being laid down to preserve unlikely, largely uncelebrated heroes of biodiversity, despite outcries from specific human constituencies. Most national and state-level parks and scientific reserves have endured decades of debate and the legal agitations of advocates versus opponents. Most recently in San Bernardino County, outside Los Angeles, habitat for a 3” tall kangaroo rat – Dipodomys merriami parvus – was granted a unanimous reprieve from the zealous ambitions of local real estate developers who had intended to build 8407 homes on the little-remaining kangaroo rat habitat [16].

Each year globally, thousands of people lose their lives and billions of dollars are erased in property value because of HWC. The major causes are habitat disturbances through human settlement and expansion of farming activities in the vicinity of the protected areas and landscapes, or the combined effects of such causes [17, 18]. In developed countries like the US, agricultural damage roughly amounts to $1 billion, and retaliatory action leads to the killing of approximately 2.5 million wild animals annually, including 107,044 wild carnivores, of which about 3% were threatened or endangered species; or killed inadvertently (the collateral damage of HWC) when other species were targeted [17]. Such data defy easy analysis, however. For example, an assessment of approximately ‘1300 agricultural invasive species’ in ‘124 countries’ necessarily confronts the exacerbated conditions resulting from gene editing, intensive back-breeding and hybridization, the effects of syncretistic chemical adulterants, habituation by pathogens, and the overall umbrella effects of climate change. In that realm, just within the U.S., invasive species fallout was recently calculated at $40 billion per year in damages [19].

Most financial losses for farmers – allegedly from the action of corvids (crows and magpies), rabbits, possums, deer, pigs and elephants - for example, are not readily computed, or globally calculated by official agencies. But for large-vertebrate HWC, ranchers in one U.S. state, Montana, where for well over a century locals have considered brown bears, wolves, coyotes and mountains lions the enemy (of cattle and their human companions), a new model has been engendered and financially detailed within a small region known as the Tim Miner Basin, just outside Yellowstone National Park. There, multiple new ‘coexistence’ strategies have been successfully tested, and the losses compared with previous attrition costs. The techniques for mitigation have included ‘lowstress livestock handling’, ‘cow composting sites (so that carcasses don’t draw predators closer to the herd) to fladry (electric fences tied with pieces of cloth that spook wolves), all of which have shown success’. [20].

For a nation like Bhutan, however, there is an inherent contradiction that must be recognized in such strategies. Those cows (‘livestock’) whose human proprietors are attempting to mitigate loss through wildlife predation, will slaughter them themselves, in the end. For food. If the argument that slaughter is slaughter is ever codified -its fallacious premises overcome - then it will mean that the world has finally adopted the ultimate HWC resolution, namely, veganism. Wall Street’s embrace of such brands as ‘Beyond Beaf’, ‘Boca Burgers’ and ‘Gimme Lean’ is certainly encouraging, but the world nonetheless continues to see the Amazon burning, so
that farmers can grow soybeans to feed cattle that will be slaughtered. While in New Zealand, an embrace of immuno-contraception remains a far-off ideal for coping with predation by possums and mustelids, domesticated dogs and (domesticated and feral) cats upon endemic and threatened wildlife, like kiwis, and Yellow-eyed Penguins, to name just a few of the native victims. Hence, the underlying thrust of HWC takes on an historic importance, with ethical and tactical imperatives mirroring nearly every aspect of the overarching Anthropocene (Fig. 3.3).

**Conflict Management Strategies**

Conflict management strategies have typically comprised lethal weapons, translocation, culling and regulation of population size, and – ultimately – the combined, if often clumsy efforts to effect the preservation of endangered species. With improved scientific research and regulatory policies and laws, recent management approaches are increasingly facilitated by various coping strategies, to be discussed later on. Yet, retaliatory killings, poaching, illegal hunting, trappings and snares, poisoning, and game hunting remain common practices that go unheeded despite serious consequences in largely pristine ecosystems. Many national parks, from Alaska to Italy
to South Africa, allow forms of hunting. As human-wildlife conflicts continue to escalate, inflicting direct, indirect and opportunity costs - against a current backdrop showing the biomass weight of all wildlife on Earth to be but 1%, versus 32% human weight, and 67% domesticated livestock weight (a precise percentage reversal for wildlife versus humans, from the end of the last Ice Age, roughly 9500 years ago) - preventive and mitigation measures of human-wildlife conflict is a crucially important intervention sector in the management of biodiversity and protected areas, particularly in light of ever-escalating studies that emphatically have raised the rallying cry by the global scientific community of the severity of the current sixth extinction spasm and massive losses of wildlife.

**Retaliatory Actions and Violent Approaches**

As one highly provocative retaliatory action to HWC, people have resorted to eradication campaigns to extirpate wildlife species perceived as ‘problem’ animals; a no-win strategy that has resulted in devastating consequences on the ecosystems and the livelihoods of people themselves, not to mention the other species, and the ecosystems of which such species might well be apex predators or other crucial biologically related co-habitants. Habitually, people have reacted to wildlife threats by eradicating such “problem” (a notion that underscores the widespread ecological illiteracy at work, generally speaking, in HWC) animals and destroying natural habitat to thwart further losses, endangering wildlife conservation and natural habitat and biomes [17]. In many developed countries, large carnivores or megafauna have disappeared because of lethal actions, perceived as threats, for agriculture development for the increasing human populations and simultaneous urbanization, a vicious cycle that is guaranteed – at current trends and rates – to inflict ever-increasing genetic cul-de-sacs (genetic squeezes) and further the narrowing margins of life for an abundance of biodiversity [21]. In European countries, species such as wolves have nearly been eradicated, leaving behind just a small endangered population in some areas, from the Carpathians to the Iberian Peninsula [17]. When a single brown bear gently encountered a young boy on a picnic in a mountainous part of Italy recently, the video that happened to be captured of the remarkable encounter (the boy was utterly delighted with the experience) went viral. There is an implicit, steadfast biophilia that remains within the human genome and it only takes a few instances of such interspecies relations to remind all of us how critical such encounters are. HWC, by its very definition, perverts and thwarts such primeval needs in the human community.

The impact of HWC appears to be much more severe in developing countries, particularly among farming communities in rural settlements near the protected areas. Owing to the complex socio-economic challenges, estimates of biodiversity and economic losses resulting from conflicts in these economically marginalized regions are difficult to ascertain despite severe anthropogenic interferences, threats, and outright extinction of species [17]. In Bhutan, however, there are reports on
compensation payments totalling $138,484 for 1692 cases of livestock predation by tiger, snow leopard and Himalayan bear [11]. In the US, for just one year (2004), 107,044 wild carnivores were killed, of which about 3% were either threatened, or endangered species, or killed unintentionally when other species were targeted, as earlier referenced [17] (Fig. 3.4).

In Nepal, 26 tigers have been killed between 1989 and 2009 in Bardia National Park, all tragically occasioned as a retaliatory action in response to 7 human deaths and 4 human injuries allegedly by tigers [8]. It is reminiscent of reprisal killings of at least ten stingrays in Australia, their tails chopped off, the animals left to die on beaches, following the 2006 death by a short-tail stingray of conservationist Steve Irwin. In Botswana, a landlocked country that borders South Africa with the largest elephant population on the Continent, 4843 crop conflicts and 14,933 livestock conflicts with elephants and carnivores, respectively, were recorded between 1994 and 2006 [22].

Retaliatory killings can be a huge concern for iconic and endangered species like tigers, elephants, and snow leopards, which – like gorillas - live in very low-density populations and have slow reproductive rates, yet require large habitat ranges. Owing to harsh challenges and difficulties in so many rural settlements, lethal weapons appear to be a preferred option as an answer to the conflict, while urban populations without much experience of such conflicts generally shy away from using lethal weaponry [23]. In many countries, large megafauna and carnivore species have been targeted because of their perceived threats and risks to human safety and properties, while in reality, smaller species caused much greater damage in terms of collective loss [24]. In many parts of the world, indiscriminate lethal control programmes have caused decline and near or actual extinction of several wildlife species [25]. For example, bison have been removed from the Great American plains for the sake of protecting agriculture and for often contradictory, politically motivated rationales [26]. Yellowstone National Park has long been a heated epicentre of debate regarding conflicting conservation strategies – the delisting of brown bears and wolves; the arguable transmission of Brucellosis to elk and pregnant cattle. Similar controversies and resulting actions had been carried out for wildlife.
removal with the policy of supporting the indigenous communities and opening agricultural land in colonized East Africa [27] and in the Peruvian Amazon [28]. Local populations of red fox, stoat, weasel and other common small carnivores were reduced through trapping, snaring and shooting by professional gamekeepers [29].

The U.S. Environmental Protection Agency allows the pesticide (sodium cyanide and Compound 1080) to be used in the form of a ‘cyanide collar’ strapped around the neck of sheep and goats for wildlife-killing programme in some states with objections from the public, proven to be very effective in the alleged instantaneous death of predators [30]. The predators are lured by the fragrant bait in the strapped collars attached to bladders filled with liquid sodium cyanide; but such heinous methods also endanger imperiled species. Such methods should be deemed cruel and totally obsolete.

When rare or endangered wildlife species come into conflict with humans, government agencies resort to selective removal of wildlife, including translocation to safer habitat [31]. Animal Control (‘Wildlife Services’) in the United States is notorious in this regard. [32]. Several million kills of wildlife (e.g. coyotes, wolves, bears, large cats, etc.) have been documented in the U.S. by animal protection organizations; whilst inside Wildlife Services agencies, the formal reporting is often sketchy at best. So-called ‘invasive pests’ have been slaughtered with the blessing of the U.S., U.K., New Zealand and countless other governments. Sport hunting continues to dovetail with these actions. In small South African reserves alone, over 200 vertebrates are known to have been culled between 2010 and 2012, driven by lack of space and habitat, human population pressure and urbanization [23]. Certain government culling programmes in the past decades in Uganda were driven by the economic value of leopard skins and elephant ivory that promoted widespread active culling far beyond the needs of agricultural protection [27], while private individual culling programmes have often resulted in removing unintended protected species [34].

Legalization of hunting in non-protected areas or multiple use areas could lead to extermination or extinction of mega-fauna species because of poorly regulated hunting [35]. However, in a country like India with a population of over 1.35 billion, the last Asian Gir lions (numbering just over 600 individuals) [36] and the largest population of tigers – over 1400 in some 40 national parks (some estimates place the total Indian tiger population at nearly 2000) – could be protected with careful management; using lethal control only to remove problem species with serious (near-term) threats to human safety and property [37, 38]. Ironically, the most unfortunate part of conflict management strategy is handled by the wildlife management agencies in governments that respond to the protection needs through lethal weapons for agricultural development and human safety. Organized public hunts and culling programmes as conflict-prevention strategies have posed several challenges as hunters are often unable or unwilling to target the precise problem animals [39] because without exact information on the location of past conflicts, culling programmes and their targets can be entirely (and tragically) misleading (Fig. 3.5).
Lethal Control – Counterproductive

Eradication and reduction of the density of top predators will adversely impact the food-web and ecosystems as the population density of meso-predators (wild preys) will increase, leading to unpredictable consequences for prey populations, conflict rates and the services that ecosystems provide to humans [29]. For example, removal of Iberian lynx has led to consequences of increased predation on rabbits by mongoose [40], and rising populations of bush pig and baboon crop-raiding after extensive removal of lions and leopards in Uganda [27]. In some instances in the US, removal of wolves in a given locality conferred better opportunity and lesser competition for coyotes to predate on smaller species of livestock such as sheep. Thus, it is only natural that eradication of one predator species or problem wildlife leads to larger prey populations and unpredictable consequences leading to higher incidences of crop damages and livestock predation, and other unpredictable effects in the long term [27]. In the case of coyotes, it has been established that their survival stratagem all but guarantees the rapid re-occupation of emptied niches by outsider coyotes, who have long been revered by numerous Native American tribes for their pertinacity as a species. But the essential fact of re-occupation highlights the ill-advised and cruel practices carried out by ranchers and government agents, irrespective of long-received wisdom and an impressive weight of empirical ecological data [41]. Such adverse natural responses seemingly apply to all wildlife species. Many years of study on the removal of predators of capercaillie and willow grouse
resulted in higher population of these prey species than in years without their predator removal [42]. Many studies and experiences have indicated that public hunt and culling of cougars, coyotes, redfoxes and wolves have not reduced HWC in developed countries like the US, UK, and Canada [41, 43–45].

For example, in the Greater Yellowstone Area, removal of 10 wolf packs due to livestock depredation led to re-colonization of the vacant habitat, suggesting that culling programmes, selective removal, or using lethal weapons can have little or no impact on wildlife populations or HWC [46]. Based on these extensive studies, it can be deduced that minimizing population density of predators slows the over-population pressure only for a relatively short period of time but increases the HWC situation in the long term; while translocation of problem species means other wildlife species soon immigrate and recolonize in the targeted areas to fill up the vacant niches left after removal of previous occupants [47]. Thus, removal of any problem species is clearly in conflict with efforts to promote coexistence of people and wildlife. In sum, we see throughout the world a chaos of presumptive and unethical follies when it comes to fundamental issues pertaining to the underlying critical alliance between humans and all those species who were here long before us.

**From Conflict to Co-existence**

**Violent Approach: Not Viable Option for HWC**

A new study, which examined 25 years of wolf-predations on cattle and sheep in Idaho, Wyoming, and Montana in the US, revealed that the retaliatory actions of killing wolf predators actually resulted in more predations and an increased number of wolf predators [48]. The killing of wolf predators disrupts the pack’s social harmony as the wolf packs that lose the breeding pair or senior members in the pack will inevitably deprive the young ones of learning hunting skills for other wild animals like elk and deer. Age structure shifts within such packs, toward younger, inexperienced predators, may easily result in those younger wolves turning toward predictably easier prey, like domesticated sheep and cattle. In addition, it has been reported that killing one of the alpha wolves could provide freedom to the subordinate wolves for breeding opportunities that further leads to increased breeding individuals and population of hungry wolves for livestock depredation [49].

Ineffectiveness of lethal measures to control human-wildlife conflict has been extensively discussed with references to many scientific publications and empirical evidence in section “Lethal Control – Counterproductive” of this chapter. Tolerance for hunting and culling is generally diminishing in developed countries [50] and so is expected in developing countries, as well; through legislative reforms and effective HWC policies, particularly those targeting preventive and mitigation measures.
Basically, humans need to understand the ‘push, pull and the growth’ factors that lead to HWC (as per the personal communication with Mr Vijay Mokten, Director of WWF-Bhutan Programs). There is a ‘push’ factor because humans have literally displaced the wildlife species through anthropogenic activities in the ecosystems and natural habitat by building cities, roads, dams, pumped water, fences, etc., while the so-called ‘pull’ factor forces the wildlife species to encroach into the extended farming areas due to a shrinkage of their habitat; while the ‘growth’ factor involves the management of increasing populations of wildlife species. Mitigation of these compelling components is central to the sustainable solutions of the HWC, and promotion of ultimate coexistence of wildlife and people in the shared landscapes of natural environments.

In the Eastern Himalayas in Nepal, a study on human-tiger conflicts revealed communities being able to tolerate loss of livestock far more than human casualties [51] indicating the requirement of conservation awareness and better prevention and mitigation measures. Tolerance to HWC will also depend on the collective effort and networking amongst the communities in applying mitigation and preventive measures, while at the individual level it may also depend on the availability of resources. Achieving this coexistence will entail technological innovation, effective non-lethal deterrent methods, capacity for identification of problem animals and conflict sites, and improved monitoring mechanisms of the impacts of control programmes [39].

Safe and Non-violent Approach

Extensive review of human-wildlife conflict studies in previous sections indicates that lethal weapons are not effective in reducing the incidences of conflict. A realistic and holistic approach to conflict prevention and coping mechanisms for better adaptability in the shared landscape would be key to successful moderation. Ensuring the safety of humans and their assets, including crops and livestock, whilst protecting wildlife and their habitat, is deemed as fundamental to the mitigation of conflict situations.

Human-wildlife conflict can be influenced by a combination of numerous causes, including religion, media, ecological, psychological, climatic, political, and economic forces [52]. HWC has turned into one of the greatest global challenges and biggest hurdles in conservation and farming systems, whereby wildlife species can impose significant economic costs and threaten human safety, both in the developed countries and in poverty-stricken rural areas of the developing world (so-called). Abundant scientific reports and findings on tackling HWC challenges have been made in the last two decades. However, an integrated and holistic approach to human-wildlife conflict management that provide safety to the people and their assets, wildlife and habitat should include six elements: policy, prevention, mitigation, understanding the conflict, response, and monitoring; all six elements are of a whole, interdependent. No one component can function in isolation [52].
Human-Wildlife Conflict Policy

In a general context, any decision making requires policy directives that function as a guiding force particularly in conflict situations like those characteristic of most HWC. Providing safety to the people and their assets, and protection of wildlife species and their habitat, and promoting holistic co-existence, will require a very effective public policy that embraces various elements of HWC. The Constitution of Bhutan (2008) and National Forestry Policy of Bhutan (2011) provide adequate policy directives in ensuring the protection of forest cover at a constitutionally mandated minimum of 60% in perpetuity; as well as a declaration on behalf of a robust protected area system – 51% protected at present [53, 54]. In addition, the regulatory framework by way of Bhutan’s Forest and Nature Conservation Act (1995) and the Forest and Nature Conservation Rules and Regulations (2017) – provide, relatively speaking at the global scale, significant protective umbrellas for wildlife species and their habitat, at least in Bhutanese legal terms [55, 56]. Of course, exogenous factors like climate change, and forest fire hazards or flooding are of an entirely different threat status; a global threat that challenges lawmakers within nations like never before.

In addition, while the National Environment Protection Act (2007) [57] serves as an overarching act to provide for the establishment of an effective system to conserve and protect the environment, Bhutan’s Environment Assessment Act (2003) [58] establishes procedures for the assessment of potential adverse effects of various policies, programmes and projects on the environment. Regulation for the Environmental Clearance of Projects and Regulation on Strategic Environment Assessment (2002) [59] also provides additional legislative support for protecting the natural habitat and wildlife species. In the context of HWC, hunting, killing, trapping, transporting, or capturing of wildlife species are not permitted by the law in accordance with the Forest and Nature Conservation Rules and Regulations (2017) [56]. However, for self-defence and protection of crops, livestock and private properties, lethal weapons can be used to remove the wildlife species from the private land. This remains a grey zone of ethically debatable incremental cause and effect that translates into serious challenges for lawmakers and affected civilians. Bhutan has also adopted a National Zero-poaching Strategy (2017–2022) to halt illegal trade related with wildlife species through strict enforcement and prosecution of the offenders [60].

Bhutan is also signatory to the Convention on Biological Diversity and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), fulfilling the international obligations and compliances related to the conservation and protection of species; and also in implementation of adaptation and mitigation programmes associated with climate change impacts on environment through ratification of the United Nation Framework Convention on Climate Change (UNFCCC) [61]. However, Bhutan is yet to ratify the Convention on the Conservation of Migratory Species of Wild Animals. This convention provides a global platform for the conservation and sustainable use of migratory animals and their habitats, and brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.
Bhutan’s sound environmental policies and legislation offer impressive protection to the wildlife species and their natural habitat, while policy and legislation related to the protection and safety of humans and their assets is a gap that needs to be addressed, so as to better engender more effective HWC policies that embrace prevention, mitigation, and understanding of conflict, response, and the monitoring of said conflicts to promote co-existence of wildlife and humans. Fundamental to any HWC Policy is the full realization that said policy should empower the necessary provisions for conflict resolutions in the context of minimizing conflict between wildlife and humans. In Bhutan, where Buddhism and non-violent ethics are deemed to be of critical biocultural importance, this is to be viewed as a fundamental legal and community-standard primacy.

Indeed, it is clear that many of the most important policy provisions could and must propagate wildlife-friendly agricultural policies, compensation and insurance schemes, requisite government budget allocations, response teams, preventive and mitigation measures, including ex gratia payment for human casualties and deaths, alternative livelihoods (e.g. eco- and -sensitive-tourism models), continuously enhanced protected area management, law enforcement and forest wildlife crime, coordination and the concomitant engagement of stakeholders, community education and awareness, and Buddhist perspectives of non-violent approaches to any conflict.

In addition to the policy requirement that defines and addresses so-called problem animals (we say ‘so-called’ because, inherently, no animal is a problem animal – they were here first), effective implementation of human-wildlife-conflict resolution requires specific strategies, guidelines, mandates and protocols for the decision makers, implementers, farmers and the response team(s) for the resolution of any conflict. The burden should never be upon the other species. It is humanity’s duty to figure these issues out ethically and responsibly.

**Implementing Agencies for HWC**

As HWC is a serious national issue, a dedicated agency is required for effective coordination and implementation of the programme. At present the Nature Conservation Division of the Department of Forest and Park Services, Ministry of Agriculture and Forest is the coordinating agency of HWC [2]. The following are the major stakeholder agencies of HWC:

1. Nature Conservation Division, Department of Forest and Park Services/MOAF
2. Department of Agriculture/MOAF
3. National Plant Protection Centre, MOAF
4. Department of Livestock, MOAF
5. Dzongkhag Administrations
6. National-Level Steering Committee
7. Geo-Level Committee
8. WWF-Bhutan
Non-violent Preventive Measures

Many non-violent or non-lethal preventive methods and techniques are practiced to reduce and manage the human-wildlife conflict by the separation of wildlife from human territory using physical barriers (fences, trenches, zoning, etc.); guarding (day and night guarding; dogs) changes in cropping pattern (changes in type and timing, location); repellents (chemical, auditory, visual) and translocation of problem wildlife species [17]. In general, HWC problems arise in undefended property; or when the wildlife find the food sources in human territory more palatable or nutritious than may be found in the wild [17]. Traditionally, preventive methods have been best approaches to prevent human-wildlife conflict through better management of livestock and crops, zoning of areas and reducing possible interaction with wildlife [14, 62]. In many countries, resolution of HWC is undertaken utilizing a combination of multiple fear-provoking deterrent methods such as visual deterrence (including bodily movements and shouting; scare crows, flags, etc.), auditory deterrence (including guard dogs, metal drums, whistles, lighting fires, torch light, sheathing mature maize, etc.) and gustatory deterrence (growing bitter plants, etc.); physical barriers to provide maximum protection as possible [17, 63, 64] and deceptive planting techniques when the wildlife species get accustomed to plantation methods [64]. As wildlife species normally leave their habitat due to lack of adequate feed or wild prey (especially as climate change alters the wild nutritional landscapes), wildlife managers use strategies like increasing wild-prey abundance or improving habitat feed availability to prevent wildlife encroaching upon the human territories [65, 66]. In Karnataka, South India, which is home to a large number of elephants, early warning systems through bulk SMS, voice call alerts and digital sign boards on the movement of elephants have been effective in the mitigation of human casualties (Table 3.2).

Some traditional barriers include permanent structures constructed to separate livestock and wildlife; or ‘living walls’ that combine fast-growing plants (live fencing), wooden poles and bamboo, or the manipulation of habitat by growing buffer

| METHODS                  | TECNIQUES                                       |
|-------------------------|-------------------------------------------------|
| Barriers                | Fences, trenches, buffer zones                  |
| Guards                  | Human guarding, animal (dogs, donkey, etc.)     |
| Repellents              | Chemical, auditory or visual aversive stimuli   |
| Changes                 | Type, location and timing                       |
| Removal of Wildlife     | Capture & translocation, sterilization          |

**Table 3.2** Classification of methods to prevent & mitigate HWC (Ref. [17])

**INDIRECT METHODS**: raise people’s tolerance

- Compensation and Incentives
- Participation
- Research and Environment Education
crops to prevent raiding of primary crops; while chilli plantations have been effective to some extent in preventing elephant attacks [67, 68]. In Botswana, burning chilli pepper bricks that comprise elephant dung, chilli pepper seeds and grease have been found effective in repelling elephants from attacking human territory [69]; or the modification of habitat near crop fields by draining ponds or removing vegetation cover that are palatable to wildlife [68]. In some countries like Kenya and Botswana, beehive fences are placed around the crop fields that repel the elephants trying to cross fences [22, 70].

There is, obviously, an inherently cruel and inauspicious aspect to all such preventive measures. We can do better as a species, and must continually work to find the most non-violent appropriate win/win methodologies. For example, it is important that garbage bins are kept secured in order to prevent bears or wild pigs from getting accustomed to scavenging for food [71]. To avoid possible conflict with carnivores, livestock management is normally practiced outside the protected areas, while in some countries livestock grazing is prohibited in protected area core zones [56]. The habitat adjacent to the livestock is normally cleared of bushes and undergrowth cover to avoid the ambush or prevent the roosting of wild animals [64]. Trained dogs are used in many countries as guard animals to safeguard livestock from the attack of carnivores like cheetah, coyotes, cougars, wolves and black bears [72, 73], while llamas are also used in some countries to provide a level of added safety for livestock from carnivores [14] (they have demonstrated uncanny abilities to react to strange events and disturb the predators, and have been rated the most effective solution to the problem of predation [25]); while 3–7 dogs have been shown to be able to protect about 1000 livestock animals [74].

In countries like Africa and Japan, as well as in Haiti - where traditional voodoo relies upon community reverence for ancestral trees - there have been reports of farmers resorting to divine intervention such as fetish charms, or the worship of wildlife animals as guardian spirits [75, 76], while some farmers in Kenya use curse words to ward off wildlife that damage crops [77]. In Indonesia, some farmers mark surrounding rice fields with plants disliked by spirits of the forest in order to ward off wildlife invaders [78]. From the traditional Lepcha in Sikkim, the Yoruba in Nigeria, to Ainu traditions in Taiwan, a vast literature details ethno-botanical and indigenous relations to wildlife throughout the world, with a myriad of human geographical and cultural approaches to other species providing ecologists and legislators with a treasure trove of HWC resolution resources [79]. When the wild animals get used to planting techniques, deceptive techniques of plantation are used in African countries [64]. Because of frequent wildlife attacks on crops, some farmers use coping strategies such as leasing additional land, abandoning farms for alternative livelihood, limited cultivation of crop varieties on crop types and harvesting immature crops in an attempt to inhibit the loss of an entire harvest [64].

It is important to understand the spatial heterogeneity of conflict areas so as to implement cost-effective preventive measures [12]. However, information on spatial heterogeneity is normally constrained by the lack of long-term spatially explicit conflict data due to lack of resources and uniform approaches to comparative assessment [80] (Table 3.3).
Table 3.3 Different Non-Violent Methods and Techniques (compiled under section non-violent measures)

| Methods                          | Techniques                                                                                                                                                                                                 |
|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chilli Pepper Plant Fences       | Chilli pepper plants surrounding the crops used to deter elephants, as elephants do not like their smell or taste. An added advantage is that people can also sell chilli peppers for additional income. Another version of the Chilli pepper fence is to hang up clothes infused with chilli paste in the periphery of the crops (Fig. 3.6). |
| Live and Wooden Fences/Stone walls | Plantation of trees as live fences along with wooden fences could protect against wild pigs, deer, and other animals, or stone walls in places with abundant stones. At times, trenches are made to prevent elephants and other larger animals from entering; sealing squirrel burrows. |
| Bee Fences                      | Proven effective when bee hives are kept at the fences surrounding crops, to deter the elephants from coming close to the farms (Fig. 3.7).                                                                 |
| Predator-proof fence            | Normally used for preventing animals like tiger, bear, leopard to prevent livestock depredation in the night; tethering of animals in the night to prevent from wandering away and get attacked. |
| Electric predator proof fence kraals | High-enough electric fences to fend off animals looking to prey on crops and livestock (Botswana), Bhutan                                                                                                     |
| Guarding                        | Livestock guard dogs, when well trained, were able to fend off animals in many cases from lion and cheetah attacks. The dogs to be constantly re-evaluated so that the interaction between them and the guarded animals didn't become violent; guarding day and night is found effective and done in almost all countries. |
| Early maturing seeds            | Seeds planted and harvested fast enough to reap a benefit before the migration of the elephants was also an effective way to minimize conflict (Botswana).                                                     |
| Deceptive Planting              | Maize nursery, changing crop plantation, coating seeds with black colour, planting several seeds in one hole to deceive the birds.                                                                              |
| Burning Chilli Pepper Bricks    | Burning chilli pepper bricks sends strong smell of chilli peppers towards elephants – discouraging from coming closer to crops, the smell can reaches long distances through wind. Such bricks comprise elephant dung, chilli pepper seeds and grease that burns longer period of time. They have proven to be very effective. |
| Auditory Repellents             | Fireworks, signal flares, lights, cracker shells, sirens and whistle, shot gun sound, blasting, shouting, beating drums and objects, tying bells on ropes, fluttering flags, mounting plastic papers, whipping sound, barking dogs, donkeys, projectiles (rubber bullets) |
| Gustatory Repellent             | Planting bitter variety of plants as live fencing, example bitter bean variety                                                                                                                             |
| Visual Deterrent                | Frightening bodily movements, mounting plastic papers, flags, scare crows, cassette tapes, video tapes, fires at night, sheathing maturing maize cobs, torch light.                                                |
| Removal of attractants          | Proper management of garbage and securing garbage beans, food waste; clearing bushes around the plantations to remove roosting place for animals like tiger, leopard, bear, wild pigs, etc.              |
| Protection Collars              | King collar that provides protection around the neck of small livestock animals like sheep.                                                                                                                |

(continued)
Table 3.3 (continued)

| Methods          | Techniques                                                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Radio Telemetry  | Telemetry, in general, involves the use of a transmitter that is attached to an animal and sends out a signal in the form of radio waves, tracking the movement of animals, just as a radio station does. |
| Early Warning System | Bulk SMS, voice call alerts and digital sign boards on the movement of elephants have been effective in mitigation human casualties in South India (dawn to earth) |

Note: WWF and the Aga Khan Foundation’s Coastal Rural Support Programme (CRSP) are working to identify practical solutions to combat this human/animal conflict. One method is to make a mixture of oil, used car grease, fresh elephant dung and crushed chilli (piri piri), which is slathered on ropes, which are strung around fields of crops. When elephants run into these ropes, the substance burns their skin and the pungent odour repels them.

Fig. 3.6  Dry chilli, traditional drying method © U. Tshewang

**Immuno-contraception for Population Control**

Population control of wildlife species can be a grave blunder that can lead to devastating consequences of driving ecosystem disruptions, endangering species survival and extinction particularly for endangered and threatened species. However, explosive populations of certain species can also lead to serious impacts on livelihoods of people and habitat destruction; thus, under such compelling circumstances, fertility control can be used as an alternative solution to lethal methods of trappings, poisons, killings, etc. [81]. Immunocontraception is a fertility control technology involving vaccines, which induce immune responses and suppresses fertility. Immunocontraception is unlikely to cause any pain and suffering to the animals and
has the advantage of being less expensive when compared with other possible measures of wild-animal population control. An abundance of empirical evidence suggests that immunocontraceptive vaccines can induce long-term infertility or reversible sterilization in wild animal species. PZP (Porcine Zona Pellucida) has successfully inhibited fertility in 80 species of mammalian wildlife, either free-ranging or captive. The use of Gonadotropin-Releasing Hormone Vaccine, (PZP) or Eppin in horses, elephants, and wild pigs is well documented [82–85]. Adequate scientific proof-of-methods has been accrued for the reproductive functions of mares and stallions using GNRH vaccine causing infertility and reversible sterilization [86] that can be replicated in other mammals and HWC situations for population control of predators.

The efficacy of PZP for inhibiting fertility [81] most assuredly indicates a promising technology in wildlife management and population control, which many conservationists have seen to be one of the biggest hurdles. In Africa, PZP vaccine resulted in roughly 80% success in the sterilizing of free-roaming wild elephants - without altering social behavior or the health of offspring, when administered through a dart rifle, including darting from helicopters (although, clearly, helicopter darting is likely to result in certainly short-term trauma to the animals) [84]. PZP-based vaccines have also been found effective as contraceptives for ungulates [87]. Sadly, the New Zealand authorities continue to argue against the efficacy of PZP-
based vaccines for omnivorous non-native mammalian invasives, like the common brush-tailed possum \((Trichosurus vulpecula)\) [88]. While years of New Zealand R&D expenditures by the government and agricultural agencies have proved time and again that this is an efficacious model, barbaric animal control methods continue to prevail in that country. Australia presents a mixed picture, using immunocontraceptive methods for curtailing some select demographic booms, but also employing at least two viruses, transmitted by flies and fleas, to exterminate hundreds-of-millions of European rabbits that had been introduced as early as 1860 for hunting purposes; and other lethal techniques for dealing with Australian cane toads, some kangaroo taxa and feral horses.

Wild pigs have been a major concern of HWC in many countries, in that they can cause tremendous environmental pollution and are identified as carriers of viral, bacterial and parasites diseases [85]. Their population control continues to be a huge challenge; they have few predators and are prolific breeders with two litters born each year (each litter can comprise up to 12 piglets: in one well-documented case, boars are spreading throughout Canada with great population agility). Research on wild-pig-specific vaccines at the Auburn University of Veterinary Medicine has been reported to be promising for fertility control in wild pigs, which does not affect other wildlife species of animals. Similarly, in most of the South Asian countries, overpopulation of some monkey taxa is posing serious threats, causing crop damages, human injuries and even invading human homes, both in urban towns and rural settings (a situation particularly augmented during the Covid-19 crisis). The Indian state of Himachal Pradesh has declared monkeys (sadly) to be ‘vermin’ under the Wildlife Protection Act, 2017 in 10 districts, and have conducted mass surgical sterilization of at least 1.4 million monkeys since 2006 to reduce their raging populations in State of the Art Monkey Sterilization Centers [89]. It has been reported that Eppin vaccine (a testis/epididymis-specific protein) has been found effective in suppressing the fertility of male monkeys [90]. Using GNRH vaccine as an immunocontraceptive agent, the sexual behavior and fertility of female and male white-tailed deer \((Odocoileus virginianus)\) have been suppressed leading to infertility for a period of up to two years, thus demonstrating an effective means of wildlife population management [91].

For rodents that are often deemed to a virtually uncontrollable ‘pest’ in most of the farming communities, ContraPest (containing two chemicals, 4-vinlycyclohexene diepoxide and triptolide), which is a liquid fertility-control bait for rats, has become available; impairing spermatogenesis in males and ovulation in females [92].

In Canada, OvoControl baits containing Nicarbazin have been used for treatment against diseases and also to control the hatchability and fertility of wild geese and pigeons, which are often seen as a nuisance species in public and private places (and a health risk through droppings [93]. Most of the current studies of immunocontraception for applications of fertility control in wild animals are performed by syringe injection or by remote delivery via darts or bio-bullets using handguns or darting from a helicopter. In order for immunocontraception to be more practical and successful for free-roaming wild life species, an oral form of vaccine would be less expensive, effective and more practical. As in human oral vaccines, recent technological advances in molecular biology and immunology have shown that effective
oral contraceptive vaccines could be a practical and effective approach in immuno-contraception of wild animals. One step further in advancing the cause of the oral vaccine methodology would be the formulation of species-specific vaccines to avoid indiscriminate fertility control of wildlife species and the protection of ecosystems. In the case of species-specific target applications, the scale of utilization could be optimized with computer-controlled drops in aerial broadcasting from helicopter buckets over huge areas (e.g. national parks), thus minimizing the expensive and cumbersome hand-baiting applications, as has been the modus operandi in countries like New Zealand (though with mixed results in terms of frequent resistance by local residents in areas where there are justifiable fears that human companion animals, e.g. dogs, might ingest aerially broadcast baits).

Translocation of Problem Animals

Translocation can be defined as the transport of wild animals from one location to another within their native range because of conflict [94]. Because of increasing public concerns on the use of lethal weapons in HWC situations, translocations, perceived as a non-lethal solution, is found to be a possible option to reduce the conflict through removal of problem animals. However, translocations are likely to cause stress and increased mortality in many species through spread of diseases and pathogens (Gammons et al. 2009 [95]. For example, if ‘nuisance’ armadillos are translocated to different habitat, they will likely return to their original site of capture or disperse into different locations causing similar nuisance-like behavior in the new localities [95]. This is where the variability of human responses to such species is crucial, and often tracks with the very political, economic, or religious affiliations, or outright population-densities of the human downstream communities. Survival of translocated animals depends on adaptability and availability of critical resources such as food, shelter and companions in the new habitat, competing for these resources with residents and predators in an unfamiliar environment [96]. In national parks like Yosemite (in California), so-called problem bears have been successfully re-located via helicopter to areas of the park less frequented by tourists. But often, such problem animals (e.g. the case of a recent mountain lion attack on a young boy in Colorado, or a mountain lion disturbing no one, simply crossing a parking lot at a post office in central California) are simply dispatched quickly, the government agencies involved under no pressure to find non-violent means of reducing potential HWC [97].

Alternative Livelihoods

The impact of losses, incurred from the dependency upon a predominantly single source of income for livelihood by local communities, easily intensifies anger and negative attitudes towards wildlife [98]. Integrating the conservation of natural
eco-Alternative Livelihoods systems with the diversification of socioeconomic development programmes for alternative livelihoods of local communities could be one approach to reducing the losses incurred in HWC [99]. Possibilities for reversing negative behavior and intolerance to wildlife species through planned, rational diversification of income sources for livelihood through strategic programmes and services [99]: (i) intensifying the use of agricultural land through improved technology and good practices in conflict hotspots such as improved seeds, electric fencing, crop defence practices and physical barriers (ii) reducing livestock populations by replacement with improved breeds for better productivity and the promotion of good animal husbandry practices, (iii) promoting alternative income-generating schemes such as sustainable utilization of non-wood forest products (iv) diversifying water sources and separating water supply to livestock and communities from the wildlife water points could minimize the encounter between wildlife and people. In many instances, establishing water points and placing salt licks in wildlife habitats have prevented wildlife entering human-dominated territories. Such forms of conflict mitigation are obvious.

Land-Use Planning and Landscape Management

Land-use planning at landscape levels in conflict areas could provide long-term solutions to HWC through a participatory approach for natural resources management [21]. Reduction of HWC, and in some cases total prevention, can in case by case occur through implementing changes to the agricultural production landscape or to its surroundings. This can include planting crops that are less palatable to wildlife, such as substituting chillies for maize, changing the timing when a crop is planted or harvested, altering animal husbandry practices to reduce risk of predation, and designing and building predator-proof livestock sheds [2]. Damage by wildlife can be reduced by improving land-use planning near the agricultural fields so that the problem wildlife is easier to be spotted by people and dogs, thus encouraging the wild animal to leave an area. For example, a livestock keeper can remove bushes surrounding the livestock areas. Agricultural farms that are scattered in different sites of wildlife habitat landscape are far more prone to destruction than those that are clustered in large communal fields; protected by fences or thorny or spiny hedges, with removal of surrounding bushes. In states like Montana, throughout the Pyrenees, and elsewhere, ranchers have long understood that herds of domestic grazing animals are among the best defence against a potential predator. Certain large dogs have been bred to protect herds (e.g. Great Pyrenees, Anatolian Shepherd dogs, the Polish Tatra Sheepdog, the Tibetan Mastiff, Akbash and Maremma Sheepdogs, for example); and alpha burros -guard donkeys - are known to act as defensive agents for their herds, just as stallions will stay in front to protect their equine harems. Human-bear conflict could be potentially reduced by not growing food crops near the reserve boundary (maintaining the margins, setbacks and buffer zones), or livestock grazing at conflict hotspots [100]. Livestock husbandry prac-
tices have much influence on the likelihood of livestock loss within an enclosure, weaker enclosures being much more vulnerable to depredation by carnivores. Logically, stronger enclosures in high-risk areas would be an effective mitigation strategy. In this instance, history be our guide: Italian castellos or roccas, or the English Motte-and-bailey-style structures; French Bousillage, or Poteaux-en-terre; Board-and-batten structures; belvederes, castle moats. As long as local materials are utilized, and additional exploitation of natural resources are not incurred. As indicated above, dogs have been effective in reducing livestock depredation [101]; they also hunt wild prey, and are able at times to out-compete with wild predators. Land-use planning incorporating canines and equids will be very useful to reduce overlap between people and wildlife species.

Mitigation Measures

In human-wildlife conflict management, mitigation is all about winning hearts and minds of the affected communities in the conflict areas [21]. Mitigation efforts require the careful considerations of human and wildlife dimensions, and a sensitivity to understanding behavioural ecology and basic human needs. In the human-dominated landscape, conflict resolution requires consultation and planning amongst stakeholders, understanding of local people’s perceptions of risk, and their tolerance level. Mitigation mechanisms include compensation, interim relief schemes (IRS), insurance, revenue sharing incentives, conservation payments, and alternative livelihood programmes in order to encourage co-existence and improve the tolerance, reducing retaliatory killing and animosity towards wildlife [12]. Generally, most of the people affected by HWC are the poor who can least afford to bear the loss. As such, providing mitigation measures, including economic incentives, would facilitate coexistence and increase tolerance levels of the communities and the residents of the conflict areas. In one well-known case in the southern Philippines in the late 1990s, a community that for years had engaged in the killing of Whale Sharks in order to sell the enormous fins to Taiwanese on the black market, were converted within a matter of weeks by that country’s Ministry of Agriculture into eco-tourist guides, who would take tourists out on boats to view whale sharks, thus ensuring a non-violent income stream. It proved that the transformation of an entire community could occur; changing the entire character of HWC into a totally positive, win-win for people and for wildlife [102].

Compensation

Many scientific publications illustrate that compensation schemes have been instrumental in promoting conservation programmes and co-existence between human and wildlife despite the many challenges associated with such mechanisms. In the
event when communities are badly affected by wildlife, compensation schemes appear to be widely used as a tenable solution with payment for the loss of livestock, crops, human injury or death [103–105]. With the objective to prevent retaliatory actions by affected communities, compensation schemes are normally confined to livestock depredation caused by specified wildlife species such as tiger, leopard or bear; and typically funded by an international conservation organization for flagship species. It has been reported that compensation schemes are normally associated with difficulties of verifying the cause of damage; high transaction costs; and problems of trust and transparency; bureaucratic and cumbersome process, or insufficient payment, etc. [21, 104, 106]. While claims are for livestock and other associated attrition/claims may take longer, compensation payments for human deaths and injuries are normally paid immediately to the affected people [107]. In China, monetary compensation schemes are funded by provincial or state governments, for the losses caused by wildlife animals listed under National Wildlife Law as nationally protected species [100]. However, compensation payment as low as 20% of the market value has been paid for rubber losses in human-elephant conflicts in China and the overall attitude toward the scheme was nonetheless reported as positive [108, 109].

Clearly, if compensation programmes lead to increased tolerance and reduction of retaliatory killings of wildlife locally, then those compensation schemes can be reasonably linked to behavioural and perceptual changes amongst those members of the affected community, in terms of overall conservation and reduction of HWC [60]. But it is also very likely that compensation schemes may lead to complacency and neglect of preventive measures due to a predictive dependency on government payments [110]. Although compensation schemes provide repayment (at some level) for losses following damages of crops and livestock, a broader perspective of accommodating wildlife in their land or nearby areas means associated risks and psychological stress will still affect the people. There is no escaping this. It has been also reported that menacing aggressive behavior of some predators can cause loss of body weight through stress and fear affecting productivity of livestock, and other associated opportunity costs making it difficult to assess such losses [111]. But again, this, of course, is the fundamental reality of human co-existence with other species. In any post-Ecclesiastes world (the lion, the wolf and the lamb lying down side by side) there is never likely to be a Utopian peacable kingdom. Nature is nature. Humanity has skewed its contours and it is implicitly our duty to re-imagine and re-engineer modes of graceful and grateful accommodation for all concerned.

In this regard, it must also be admitted that compensation schemes can also be problematical in terms of causing fraud, corruption and inequity, and can discourage investment in sustainable solutions to defending proposed solutions to HWC. Hence, the occasional mixed affected community and victim responses [12]. To be eligible for the scheme, compensation programmes normally require good animal husbandry management practices [112], while prompt delivery of funds, transparency, involvement of experts or trained locals, and clear guidelines are the key components of effective compensatory practices; and are suggested for increasing tolerance and cooperation from farmers [80]. However, compensation programmes need to provision reliable information as spatially implicit conflict data
become available for better strategic planning and management of HWC conflict areas [109]. For better transparency, a third-party insurance company with conservation expertise may be engaged for assessing and compensating losses commensurate with market values. This latter approach is that which has been adopted worldwide for nearly all insurance claims in other domains, including natural disasters pertaining to floods, cyclones, avalanches and climate change-related injury or damage to property. This suggests an entirely other realm of HWC, wherein the ‘W’ refers, not to wildlife, but to a human-mediated ‘wild’. Given the costs of premiums by insurance and re-insurance corporations, it remains to be seen whether economically marginalized communities in the Himalayas could ever afford, for example, GLOF insurance, short of total government subsidies.

In a world of global climate change, the cost of precautionary principles (e.g. not building near the clear overflow downstream areas of a lake, might prove – particularly with existing communities – to be difficult, if not impossible). Moreover, increasingly, insurers are refusing to provide any insurance for homeowners who have chosen to build in fire-prone areas, although major international re-insurance corporations have long absorbed a myriad of ecologically related insurance risks. Such principles and practices are likely to accelerate as more and more urban dwellers fan out into high-risk rural and/or wilderness areas, a situation that segues into crop raid insurance schemes, as described below; and also comports with the reality of stockholders demanding much increased socially conscious, transparent reporting by corporations now charged with stewardship of the environment and open acknowledgment of corporate revenue streams vulnerable to a world of vastly new ecological risk.

Insurance Schemes

One favourable alternative to compensation would be adopting Insurance policies for making claims of both the livestock depredation and crop raids caused by wildlife species. Such a concept promotes fair payments when compared with compensation schemes, requiring farmers and communities to make payments of a certain premium by calculating risks into the cost of premiums and scheduled compensations [12, 113]. The scheme possesses many of the structural challenges and fiscal constraints similar to other compensation programmes [2]. In certain instances, supplementary funds are made available through government support or through community funds or conservation organizations when the premium cost is high. Insurance should also be linked to the conservation outcome and be supported by capacity building and incentives for farmers to improve livestock management techniques to reduce loss [2]. Cheng Huang et al. (2018) [100] reported that a 90.6% majority of communities were generally satisfied with the insurance-based scheme in China; while delay or unfair assessment and low compensation ratios were required to be improved upon. Therefore, insurance-based schemes with local participation would ensure more effective management of human-wildlife conflict as it
would allow residents to take greater responsibilities [108]. In the high-conflict area of Corbett, India, livestock lost from HWC is small in number and severity compared to livestock lost to disease [114]. Such knowledge of the relative severity of HWC must be accounted for in the design of any local intervention. Impact assessments for HWC often do not go beyond quantification of area and type of crop lost, numbers of livestock lost, etc. In some landscapes, comprehensive impact assessment methodologies have been developed that look at costs of HWC interventions vs crops and livestock saved. The insurance-based scheme could be replicated at a broader scale with improvement in loss assessment. It appears insurance-based modalities are confined to only some species of wildlife [80] and such insurance-based provisions might well be replicated at a broader scale with improvements regarding unfair, untimely, and improper assessments. In China, an analysis of respondents revealed that a majority of people (60.4%) were willing to pay extra insurance premiums to receive better compensation rates, and the insurance-based programme could be replicated at a broader scale with qualified improvement in unfair, untimely, and improper quantifications [108].

Performance Payments

When there is abundance of wildlife in certain conflict areas, performance payments are made on the basis of achieving the production of desired conservation objectives [12]; however, performance payments are different from traditional subsidies, which are not correlated with conservation outcomes [115]. Normally, such payments are incentive-based schemes that bridge conservation initiatives and community livelihoods, which are often understood as a market-based transaction through financial compensation made by the ecosystem services’ beneficiaries to the providers of such services. For example, the Government of Bhutan established Payment of Ecosystem Services Schemes for conservation of water in community forests upstream to supply water to the downstream residents in the eastern part of the country. At the sectoral level, the Bhutan Sustainable Hydropower Development Policy 2008 authorizes a minimum of 1% royalty energy-revenue to be made available annually for the Ministry of Agriculture and Forests for integrated sustainable water resources management [116]; very much in line with Article 13 of FNCRR [56] that stipulates plough-back mechanisms, including payment for environmental services for various conservation activities to ensure sustainable protection of watershed areas.

The National Forest Policy (2011) [54] and National Water Act (2011) [117] recognize Payment of Ecosystem Services as a potential means for improving conservation and livelihoods in Bhutan. Even though Bhutan is endowed with rich biological resources that provide various ecosystem services to the people, there is widespread evidence – a prime impetus for this entire (ACPB) study - suggesting ecosystem services and the natural environment are increasingly at risk [118]. In this regard, Bhutan is promoting an integrated approach of ecosystem services in development planning in various sectors and programmes.
In one recent study, rapid assessment of community perception on the ecosystem services in Bhutan revealed that forests are seen as a source of rural livelihood with the highest ranking for provisioning services, including water, fuel wood, timber, fodder, and non-wood forest products [119]. On the other hand, supporting services like wildlife species and biodiversity in general received a low ranking in the order of importance indicating the need for community education and awareness on the importance of biodiversity conservation as the source of provisioning services. Such conservation efforts and payment for applied eco-restorative, or maintenance of said services (not unlike the underlying principles of UN-REDD+) could provide the means to alternative livelihood, and indirectly facilitate in mitigating HWC issues and increase the tolerance level of the communities.

**Ecotourism and Revenue Sharing**

Ecotourism and revenue sharing between the government and communities in wildlife areas could perhaps offset the associated cost of human-wildlife conflict not covered by compensatory payments; or reduce the burden of other incentives. For example, The Kenya Wildlife Service has a revenue-sharing mechanism created for the benefits of local communities adjoining national parks [21]. In Namibia, the local communities and stakeholders retain all revenue generated from the establishment of community conservancies of wildlife, which has also resulted in the significant increase in lion populations in the locality [120]. In another instance in Uganda, a revenue-sharing tourism programme in three parks of Uganda produced more than $80,000 funds for schools, clinics and infrastructure, resulting in positive attitudes towards conservation [121]. However, such revenue-sharing mechanisms should be targeted towards the marginalized groups and those most impacted by the HWC so that revenue sharing results in positive outcomes for conservation and benefit to those affected communities. Even under favourable circumstances, unless there are specific regulations in place, people might migrate to wildlife areas in view of improved income through ecotourism, thereby leading to habitat conversion and competition for resources. Under such circumstances, a well-regulated sphere of ecotourism regulations, coupled with spatial landscape planning and zoning for

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**Dr Lungten Norbu, Senior Specialist of the Ministry of Agriculture and Forest of Bhutan says:**

In Bhutan, Payment for Ecosystem Services (PES) in Biodiversity Conservation has a huge potential to address the national issue of human-wildlife conflict, tourism, hydropower and food security. Bhutan’s experience with PES is still limited, and suggests learning through global lessons, engaging local communities and wider stakeholders including policy makers.
human and wildlife territories, wildlife friendly landscape with eco-lodges, eco-trails and nature education, would positively contribute towards meaningful conservation and economic opportunities for the local population facing HWC challenges.

One of the world’s great examples of this has been at Andasibe-Mantadia National Park in central Madagascar. Better sharing of income from wildlife tourism generates revenue streams in many developing countries, which could be one of the most significant sources of national revenue generation, as is the case in New Caledonia, Australia, Fiji, Norway, Kenya, the Bahamas, Antarctica, as well as obvious tourist destinations like France, Switzerland and Spain. The ecotourism industry – including (arguably) the tour ship industry - can also enhance employment within local communities by creating job opportunities. The post-Covid-19 fate of ecotourism is yet to be assessed; while the cruise ship industry continues to incite a host of pollution, wildlife-inflicted stress, and over-tourism issues. In the US, annual national park visitations exceed 700 million visitors annually. The ecotourism industry worldwide represents between 5 and 7% of all tourism, generating over $77 billion in direct revenue [122] and an estimated USD 3 trillion in overall global secondary and tertiary-related services. Tried-and-true ecotourism approaches may go a long way towards compensating the cost of maintaining wildlife and fostering positive attitudes of the resident communities of parks and reserves towards conservation behavior. Insurance companies that explicitly work towards ecological non-violence can also benefit from the very real branding prospects within that international ecotourism arena.

Community Education

Educating communities, at different levels, on the ethical and economic values of wildlife conservation and ecological significance, and safe approaches to human-wildlife conflict is among the most critical of all modes for effectively minimizing HWC. Local school budgets must ensure a proportion of expenditures targeting students and parents for the overall raising of local awareness pertaining to the critical ecological role of wildlife; disseminating basic principles of ecological stewardship and biology; and providing practical know-how with respect to safe approaches and methods of preventing and mitigating HWC, along with the importance of conservation of wildlife in any ecosystem. Such educational opportunities begin in pre-school, with the mentoring of compassion and non-violent approaches to every sentient being co-existing within the human community. Local schools and farmer field schools are obvious primary loci for such dissemination, and the realization of locally tailored, innovative techniques of conflict resolution and the building up in a whole new generation, the pre-conditions of an ethical livelihood; a non-violent understanding of human beings within a newly defined public space that incorporates all beings, not just human.

Building local capacity in conflict resolution and the exploration and teaching of practical skills in dealing with potentially dangerous predators is fundamental at a rural, local level; the burden is particularly acute on communities that are, in any sense, faith-related, whether Buddhist in Bhutan, or Judeo-Christian in the West, or affiliated with any of the thousands of locally indigenous spiritual traditions span-
ning communities throughout the world. Education materials, guidelines and advocacy on conservation benefits of wildlife species, national laws and protected area systems, and wildlife-friendly agriculture practices are all crucial tools towards the goal of productively engaging students, communities and the public at large towards co-existence and HWC resolution. This is as true in largely rural Bhutan, as it is in major cities, where more and more large vertebrates are being detected, like black bears in Pasadena, California; or hawks, coyotes and raccoons in Manhattan; parrots from Sarasota, Florida to Chicago to San Francisco.

Field staff and stakeholder agencies need capacity development in dealing with education materials and the informed application of mitigation methods for human-wildlife conflict. Such community education programmes will inevitably result in the behavioural change entire of local populations, reduction of risks and vulnerability, improvements of livelihoods and conservation outcomes. Field research on public perception, behavioural changes and tolerance towards wildlife and human-wildlife conflict methods need to be conducted on a regular basis. Successful programmes in this realm include those at Gombe Reserve in Tanzania; Fjordland National Park in New Zealand; and at research/eco-tourist sites in Peru (at Tambopata and Manu), Ecuador (Yasuní National Park) and throughout the tourist sites of the Antarctic, most notably at the Polish Arctowski Station and US Palmer Base; but also at nearly every Native American and First Nations sanctuary in the US and Canada, and throughout the vast array of moss garden temples in the Kyoto Green Belt (Japan)[123].

Understanding the Conflict Profile

Contextually, resolution of conflicts warrants understanding of the conflict to begin with; and a critical assessment of both the human and wildlife situations in the respective conflict areas for developing strategic plans to maintaining healthy ecosystem for the benefit of both humans and wildlife. As such, understanding the human-wildlife conflict as to where, when and how the hostility is likely to occur is of paramount importance for making appropriate and effective responses. The underlying principle should be: All conflict should be mollified and the boundaries of tolerance and compassion vastly expanded. Through research, the forces and severity, the progressive events and dimensions, and the social characteristics of the conflict need to be analysed and documented for better, informed responses [2]. It is often reported that a proper spatial modelling of conflict zones need to be conducted for effective management and mitigation but most of the spatial modelling studies are done poorly [124]. Attack risk modelling and ‘hotspot mapping’ provide multiple benefits for HWC management, including allocation of resources to conflict hotspots; targeted planning of preventive measures such as habitat restoration, location of barriers, focusing on education and awareness in specific areas and villages. Hotspot mapping is followed by further research and studies to determine the characteristics and practices that relate to high-conflict scenarios (Fig. 3.8).
For example, spatial mapping of livestock and crop loss can provide information on how best to support land-use planning, improved grazing practices, building trenches and selective fencing in priority areas [125]. Understanding temporal characteristics may lend improved insights towards establishing baselines crucial to better delineating seasonal variations in HWC and direct actions to protect crops during peak HWC periods, or to more finely address water supply management needs for livestock and prey, etc. [126]. It is recommended that spatial information be provided on the site coordinates and for specific dates of conflicts. Training of GIS experts in such realms is an obvious essential corollary of these HWC actions. Such information should enable the development of hotspot mapping and allocation of resources at the most vulnerable areas for the communities [100]. Appropriate systems and mechanisms for rapid reporting as well as the training and deployment of Response Teams can also be set up in known hotspots [124]. It should also be pointed out that the majority of human strife (including actual civil wars and other large-scale hostilities) throughout the world is occurring within many of the 36 terrestrial biological hotspots.

In certain incidences, communities may lose tolerance and enact retaliatory actions against wildlife, depending upon the circumstances and severity of the problem. There is a long and tragic history of reprisal killings throughout the rural Americas and Mexico, in part driven by a culture of fear and ecological illiteracy regarding apex predators. This continues to be the case throughout much of the world with regard to shark species. In this context, understanding community’s perceived risk and tolerance level is of tremendous importance in conflict management. It has been reported that antagonistic behavior and killing of animals is driven by perceived risk by local communities [127], while in some cases there is reportedly a mutual co-existence of humans and wildlife with some level of tolerance of conflict [15, 128]. Widely fluctuating statistics (rural communities in New York State and their perception of the co-existence of deer or black bear; black birds, crows,
European starlings and migratory geese in U.S. farming communities in Minnesota and Iowa; perception of African wild dogs and hyenas in Namibia, for example). In this regard, a community’s participation should be construed as instrumental to effectively determining the HWC management plan in any specific human-populated area.

**Reporting**

While some major incidences of HWC are reported, most of the incidents go unreported for any number of causes, e.g. lack of awareness, lengthy red tape, loss of confidence in bureaucracy or the fact compensation payments are not disbursed as per entitlement [52]. Under such circumstances, it becomes difficult for the government and decision makers to mobilize and allocate targeted resources and organize Response Teams, which often leads to further retaliatory killing [129]. This has certainly been the case in nations like Nigeria and Mauritania, where, by the 1930s, nearly every large charismatic vertebrate had been wiped out. Complicating HWC in many under-reporting nations are the underlying poverty and hunger issues, about which countless tomes have been written. With nearly 900 million humans still malnourished, or suffering from so-called nutritional illiteracy, or micro-nutrient deficiency, the killing of wildlife for food transcends conventional HWC, and enters a realm that is all but intractable, short of significant government financial inputs and appropriate openness to donor aid programmes, a crucial aspect of the United Nations 17 Sustainability Development Goals (‘SDGs’). Without adequate HWC reportage, there remains an information gap on the nature of conflict, the sites, severity, timing and even the verification of insurance whereby any possible compensation claims becomes difficult. In certain areas where compensation and insurance schemes function well, there tend to be better reporting systems. A regular and systematic information system should be established across all the areas for capturing the conflict situation. Where poverty motivates the killing of wildlife, multiple agencies must be factored into the equations of human suffering and wildlife attrition.

This complex of motivations and crises are key to much conservation biology throughout the world. It bears repeating: there can be no successful conservation efforts without full community engagement.

**Information Compilation, Management and Use**

Information networking with various stakeholders and relevant information sources is a very important process in HWC management to generate a central data bank accessible for research, planning and management. Primary information sources of HWC are the local communities, the affected people. And, in turn, the social media and government project reports that are generated. There is a lack of centralized
accessible databases on HWC in most countries across Asia [2]. To conduct proper research for an effective management response to HWC, documentation of a balanced and standard format of information should be adopted by all the stakeholder organizations that is fed to a central portal of information systems. Many animal welfare and conservation portals throughout the world already exist in terms of citizen watchdog reporting (e.g. the Humane Society and RSPCA, PETA, WWF’s TRAFFIC and many other agency anti-poaching and animal cruelty hotlines, not unlike National Domestic Violence hotlines). Such information associated with HWC could include the location and habitat, time and dates, livestock and crop, predator, affected communities, severity of the conflict and the actions taken on the conflict (e.g. safety and injury of people, predator being captured, removed or killed; or translocated). Accessibility to such information can be centralized as an HWC portal or conduit for information that can be useful for hotspot mapping and identification of locations for low- and high-risk areas, assignment and fielding of Response Teams, preparedness for prevention and mitigation action plans and strategies [2].

**Response Measures Taken to Alleviate a Specific or Ongoing HWC Incident**

Response Teams (first responders) play the most critical role at the conflict site in dealing with the HWC by mitigating the perceived and real threats to human safety and that of crops, livestock and wildlife as well [130]. Response measures to the HWC will depend upon the nature of conflict and the local conditions, and the response teams need to act rapidly in the conflict areas; the type of response teams may be determined preferably at the vicinity of the conflict hotspots [130]. It is extremely vital that the Response Team is well equipped and well trained in dealing with conflict situations (comparisons with the many weeks - in late May/early June, 2020 - of national protests, and calls for unified restraint training by US police forces, in the wake of their well-documented systemic abuse and profiling, come to mind). Response teams should be given clear mandates for making decisions at the site to enable swift and effective response to any friction. Essentially, Response Teams should be an indispensable element of the HWC policy, whereas the local participation needs to be a part of the Response Team efforts for ensuring local context and appropriate mitigation actions [52].

**Monitoring and Evaluation – Measuring the Performance of HWC Management**

Monitoring the performance of HWC management is poor across all conflict areas in Asia, and HWC monitoring and evaluation frameworks do not exist in most of the countries in the region [2]. Effective monitoring and evaluation is of tremendous
importance to measure the success of any HWC management system. Therefore, HWC monitoring and evaluation frameworks should be able to provide the necessary information for allocation of resources to the right locations, developing conflict profiles, adopting the most effective preventive measures, a deep and culturally sensitive understanding of tolerance levels for wildlife by the communities, and protocols for effectively informing government for the policy dialogues [2]. Such frameworks should be formulated based on the progress-monitoring indicators of each Safe Outcome for People, Assets, Wildlife and Habitat [2] that measure the incidence, frequency, severity of incidences; tolerance level of communities and co-existence; and the incidences of retaliatory killings. In this context, obtaining robust information for each indicator of the Safe Outcomes [2] is crucial.

**Human-Wildlife Conflict in Bhutan**

‘…violence may destroy one of more bad rulers, but …others will pop up in their places, for, the root lies elsewhere. It lies in us’. - Gandhi

**Underlying Forces of Human Wildlife Conflicts in Bhutan**

Bhutan has 70.7 % of its land under forest cover, with 51% of its land under protected areas systems that provide home to immense biological diversity of flora and fauna [131], including some of the iconic wildlife species like tigers, elephants and snow leopards, and a huge diversity of other mammalian species that come in conflict with humans when crops and livestock animals are attacked, and the safety of people threatened or the wildlife habitats are disturbed by human interferences.

Characterized by rugged and mountainous terrain, Bhutan’s fragile ecosystem provides very limited agricultural landscape, 2.9 % of the total land is currently registered for agriculture production most of which is located in the protected areas and government reserved forests [131], exposing the vulnerable farming communities to the wildlife predators. However, the impact of human-wildlife conflict can be inordinately huge by comparison with the country’s small economy, as more than 60% of the Bhutanese population depend on agriculture and livestock for their livelihood.

By 2030, 50% of Bhutanese will be urban, according to UN population statistics. Rural-urban migration occurs at a rapid pace leading to abandonment of farms, improving the wildlife habitat but thereby ironically increasing the human-wildlife conflict incidences for the people in the rural areas. Nomadic herding is on the decline, and reduced grazing has resulted in the juniper forest expanding into old grazing lands, thereby increasing woody biomass and wildlife habitat [132]. On the other hand, with rapid socio-economic progress in the country, expansion of urban towns, infrastructure developments such as construction of highways and farm
roads, hydropower development projects, transmission lines of electricity, mobile towers, deforestation, etc. could possibly displace the wildlife species from their localized habitat areas, thereby forcing out the wild animals to human settlements in certain areas of the country. This I=PAT (impact equals population x affluence x technology) syndrome corresponds to the increasing GDP of every country as discussed earlier. The impact on wildlife, and probability distributions of increased stressors and other human-induced consequences is inevitable, underscoring the critical importance of robust HWC recommendations that are in sync with well-studied global patterns of such conflict.

Impact of global warming and rising temperatures, or unpredictable weather conditions could lead to migration of wildlife species into various parts of the country, thereby increasing the possibilities of more human-wildlife conflict. This fact has already been borne out in almost every nation on earth, particularly amongst avifauna, and migratory ungulates.

Lack of an effective coordination and HWC policy in view of multiple stakeholder agencies and the complexities of the conflict could lead to mismanagement and failure in implementation. In addition, inadequate financial resources and technical capacity could be a major constraint resulting in HWC situations. Unresolved HWC could possibly create negatives attitudes toward the conservation policies that can and will seriously undermine conservation.

**Current HWC Situation in Bhutan**

Various reports through social media, scientific publications, government reports, etc. indicate that incidences of all forms and intensities of HWC have been occurring across the whole of Bhutan. Not uncommonly, crop depredation, livestock predation, attacks on humans, and wildlife presence near human settlements inducing fear and psychological distress have been of major concern to the people [133]. Wildlife species that attack livestock animals and humans mainly include the apex-predators such as tiger, snow-leopard, common leopard and Himalayan black bear; while Sambar deer, barking deer, wild dogs and pigs, porcupine and monkeys are also common species that attack crops. One of the main causes of food shortages in Bhutan could be attributed to wildlife damage to crops as per the report of the Planning Commission of Bhutan (2007). According to the State of the Nation Report (2017) [135], 70% of farmers in the country reported some level of crops damaged by wildlife, while 12% of farmers reported loss of livestock to wildlife. This figure is three to four times that of similar types of attrition in the United States and European Union. Some other aspects of HWC involves the opportunity costs associated with guarding, leaving fallow land, abandoning agricultural practices, the imposed psychological disturbance, transaction costs incurred when pursuing compensation, family disruption, livelihood and food insecurity due to crop and livestock losses [2]. In these respects, Bhutan is in the front trenches of humanity’s rapid experiment: over-population resulting in the historic changeovers from wild to
The reality of the world’s nearly thirty megacities - each with ten-million or more occupants, and thousands of large towns (Core Based Statistical Areas and Metropolitan Statistical Areas, each with aggregates of between 10,000 and 50,000 or more residents) - has implicated a conservation problem that is a global issue of human eco-psychology: How do people relate to wildlife? How may they do so - approaching, collectively, 9.5, 10, 11, even 12 billion members of a largely ungainly species – when, by definition, the human presence poses increasingly insurmountable challenges for nearly every large (50 kg+) wild vertebrate on the planet? (Fig. 3.9).

Social media have constantly expressed serious concerns through national newspapers and news broadcast raising serious challenges of HWC. Reportedly, HWC has been increasing over the years and the problem got worse in 2018 in the Punakha district, where it was determined that at least two people are required to guard a paddy field against wild boars, monkey and deer [136]. Farmers need to guard their fields day and night because different species attack their field crops in groups at different times. Monkeys attack the crops during the day while the wild boars and deer attack during the night [137, 138]. While some of the houses remain locked at night (taken for granted in most developed countries, but not in Bhutan), given the necessity of having to guard the crops, some parents fear for their children who are frequently the ones sent outside to guard the family’s veritable livelihood. Parents
worry about bear or other animals harming the children [137]. Because of such difficulties, some farmers have chosen to leave their land fallow [138] or use only a small portion of their land for wheat and vegetables, which are not even spared by wildlife at times [139]. This has occurred among some farms where the proprietors used to grow a diversity of crops (Fig. 3.10).

In some cases, HWC has forced farmers to abandon their village due to excessive attacks on their crops; or from having lost most of their livestock animals due to leopard attacks, only to join others who left the same village [136]. When international agencies report rural-to-urban migrations, the cold calculus of such economic statistics are usually perceived to have resulted because of the lure of better-paying jobs in big cities. Missing from such equations are the very real, down-to-earth basics that result from so many of the aforementioned HWC situations. It is a situation almost impossible for conservationists in wealthy countries to ethically grapple with.

Because some of the wildlife species act stubbornly, so called (it is their nature to do so) and do not easily get deterred by attempted human interventionism, it has been difficult to chase them away from the crop fields. Some species are so tactical and insistent that they have prompted farmers to erect guardian huts around the crop fields thereby increasing the household members needed to guard their crops, a human resources crisis than often results in the keeping of children out of school [137, 139]. Over time, monkeys seem to get habituated to visual deterrents and dummy tigers, and do not easily get deterred by sounds and noises [140]. When a particular village gets electric fencing around their crop fields, it is reported wildlife species shift to nearby crops fields and cause yet more damages [136, 137, 139].

The bottomline: Farmers, like everyone else, underestimate the extraordinary intelligence, and survival needs, of other species only at their peril. Some people have left the land fallow and become dependent on imported rice [139]. In southern Bhutan, one rainy midnight in 2016 a woman faced a terrifying encounter with two

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**Fig. 3.10** Grey Langur (Semnopithecus species) © M. C. Tobias
elephants that raided and destroyed her kitchen [141]. Wild pigs have been reported to be the major annoyance for farmers, followed by elephant, barking deer, monkeys and porcupine. In parts of southern Bhutan, the elephant is often the major problem for agriculturalists [142]. Throughout northeastern India, including border areas with Bhutan, human conflicts with elephants has been a huge source of grievance and the authorities have not yet endeavoured systematically to find non-violent methods of interceding, or of educating afflicted human communities.

Patterns of livestock predation by large mammalian carnivores during a three-year period (2003–2005) in Bhutan indicated that leopards are the topmost predator, followed by tigers, bears and snow leopards [143], with cattle being the major prey [142, 143]. Livestock predation generally occurs during the cropping season as livestock animals are kept out of the farms, and grazing in the forest increases the accessibility to the predators. Additionally, human casualty is not uncommon in Bhutan. Social media reported five lives being lost each year to wildlife within a period of 5 years (January 2010 until September 2015) as per the records of the Nature Conservation Division of Department of Forest and Park Services, Bhutan. The Himalayan Black Bear has been the biggest threat to human lives while tigers, wild boars, elephants and common leopards have also claimed human lives [144].

As reported elsewhere in this report, livestock predation in central Bhutan by wild carnivores, including leopard (Panthera pardus), tiger (Panthera tigris), Himalayan black bear (Ursus thibettanus) and dhole (Cuon alpinus), accounts for an average annual financial loss of 17% of farmers’ total per-capita cash income, leopard and tiger causing the maximum loss [13]. In a recent study, livestock depredation by snow leopard and Tibetan wolf led to 10.2% loss of the total per capita income of herders each year – leading to decreasing number of resident herders at Wangchuk Centennial Park of Bhutan [145]. However, crop damages resulting from HWC appear to be much more than livestock depredation. The Department of Agriculture, Bhutan, records from July 2013 to June 2015 indicated wild animals ravaged 8058 acres of fields across the country causing a crop loss of 7542 metric tonnes [144].

Conflict mitigation planning would benefit from an improved understanding of the spatial pattern of livestock kills by the predators such as tiger and leopard [146]. It has also been reported that the risk of livestock depredation by tigers and leopards was high in areas with high-edge density between forest and open habitats in proximity to protected areas (within 16 km of a protected area). In eastern Bhutan, in one incident, a farmer lost 30% harvest of paddy and maize to wild pigs and monkeys, which have been commonly reported as the major afflictors of crops [140]. Predators come very close to homes and the incidence of HWC during the last two documented decades has increased, leaving lands fallow, growing into forest [140].

While reporting systems are essential to generate information for mitigation planning, some studies indicate a lack of proper reportage, or appropriate compensation for the losses in Bhutan, which in turn adds to the syndrome of poor conveyance of data [142]. In 1970, less than 3% of Bhutanese could be described as urban. In fact, Bhutan was – after Tuvalu – the least urban nation in the world. So its farmers have had a long experience with HWC. The only comparable, in terms of a
‘developed’, nation would be the farming relationships in the UK with badger con-

flicts. In that instance, public opinion (largely urban animal protection sentiment) resolved the conflict through force of legislation: badger protection. In Bhutan, other countervailing forces are obviously at work in the many challenges of mitiga-

tion, not to mention an immeasurably more complex landscape of wildlife and pre-
dation. On the other hand, Bhutanese Buddhism promotes a firm fundamental sense of what and can be done in accord with a predominantly non-violent attitude towards life, rendering HWC all that more challenging.

Preventive Measures

Mr Sonam Ganzin, ex-government official, shared his experiences on various defense methods against wild elephants in his 6-acre beetle nut plantation, located in the buffer zone of Manas Wildlife Sanctuary at the Indian border in south-east Bhutan. A combination of barbed wire fencing, loudspeakers, burning of chillies and chemicals, different lighting systems and beating drums have been found useful to ward off elephants. He has further plans to install electric fencing and conduct innovative research to defend his property.

Although traditional fencing methods using wooden poles and some live fences are not uncommon, electric fencing is proving to be effective in preventing crop damages by wildlife species. Electric fencing to cover 1 acre costs around Nu 30, 000 in Bhutan, and the fences are erected on a cost-sharing basis between the gov-

ernment and farmers. The National Plant Protection Center of the Department of Agriculture serves as a national focal point for crop protection from wild animals providing necessary technical assistance like monitoring, procurement of quality electric fences, issuing guidelines, standards and equipments like energizer. The total agricultural land protected by electric fencing as of February 2018 is 31,665 acres, representing approximately 11.3 % of the total registered agricultural land of 2,77,998.5 acres in Bhutan. The total length of electric fencing stands at 2773 km [147]. Electric fencing of argicultural land as a means of protection of crops from wildlife damage began since the year 2006; however, the practice was legalized only in April 2013 and ever since a substantial amount of rural land has been brought under the scheme. Electric fencing has not served its purpose especially in southern Bhutan where elephants ravage fields [148]. The human-elephant conflict report of the Divisional Forest Office, Sarpang reiterates the problems as constituting one of the most challenging issues confronting the local communities with the occurrence of many incidences through crop raiding and property damage [149]. Currently, the Division has initiated several mitigation interventions such as community-based insurance/relief schemes, fencing, trenches, deterrents (e.g. noise, lighting); and
legal protocols for dealing with stray wildlife, active management, community awareness, conflict hotspot mapping, deploying Quick Response Teams following conflict events, monitoring of results and studying the behavior and monitoring the movements of the GPS-radio-collared elephants to address the conflict. Further, the Divisional Forest Office participates in consultation with the wildlife authorities of the neighbouring Indian states of Assam and West Bengal through the platform of the Trans-boundary Manas Conservation Area (TraMCA) initiative that provides trans-boundary collaboration to address the conflict.

In 2018, a Norwegian company brought on to the market virtual fencing [150]. Whether the longstanding laser-guided fencing technologies can be employed not just to keep animals in, but to keep predators out, is yet to be demonstrated. But this does represent fertile ground for new innovative technologies being developed by Bhutanese researchers, working with farmers, and could actually represent a major future area of R&D and eventual revenue streams for conservation technologies being generated from years of on the ground Bhutanese first-hand experience.

Some farmers have experienced a breakdown in effectiveness of solar fencing during the rainy season (due obviously to less sunlight), and the siren used as auditory defence is barely audible during heavy rainfall [151]. These problems require a greater number of sirens to be audible. Hence, new R&D for HWC in the acoustical realm could also prove promising. A nation like Bhutan has the long-time experience – the informed collected database – to justify intensive IT innovation for conservation biology and HWC resolutions through advanced, non-violent (Buddhist) technologies.

Part of that so-called database includes knowledge that elephants from across the international border come to attack farmers’ crops in southern parts of Bhutan. Community members in those regions have volunteered to join and support the foresters during night patrolling. Solving HWC has become a national issue and the farmers are likely to vote for politicians who make pledges to resolve HWC [138] (Table 3.4).

**Mitigation Approach in Bhutan**

With the objective to prevent retaliatory killings against the endangered wildlife species, compensatory mechanisms for livestock losses to Tiger, Snow leopard, Asiatic Black Bear and Common Leopard were made during previous political times, but suffered from a pronounced lack of funding and inability to compensate those farmers affected by crop losses [152]. A Human-Wildlife Conflict Endowment Fund Scheme was initiated by DoFPS in 2008, thereby providing seed money of up to 500,000 per Geog (block), which is to be managed by a committee at the community level, guided by the Endowment Fund Scheme policy – that compensation be made from the interest of the fund.

The Snow Leopard Conservation Group has been formed with some seed money from the government, and collection of fees for registered animals. The idea is that
compensation from the interest accrued from seed money for animals killed by leopards will be paid out to the farmers who have suffered animal attrition. Meanwhile, the government has collected Nu 40 million which is just above half a million USD, while the HWC endowment fund target is USD 35 Million [153].

The National Newspaper Kuensel: Sangay Chezom (2019) Reported:

‘Of the total 1500 yaks owned by Yagsa community, with 26 households under Tshento Geowg in Paro District, 17 yaks are lost to snow leopards every year. Instead of setting traps and resorting to retaliatory killings as in the past, the community has formed Snow Leopard Conservation Group for conservation of snow leopard. With the seed money of Nu 500,000 provided by the Jigme Dorji National Park (JDNP) and Nu 100,000 provided by Thangthangka Campsite, and Nu 130 for registration of every yak, every yak killed by snow leopard is now compensated with Nu 3000 through the interest accrued from seed money besides the meat of the dead yak’. The whole community is pleased with the scheme.
It has been reported that about 48 compensation and insurance schemes are being implemented in the country. In addition, various mitigation approaches have been enacted, including the promulgation of awareness about HWC, with programmes for the forming of rapid response teams in any given community; the enrichment of habitat through plantations; the creation of waterholes and the removal of invasive species. [154].

**Strategic Outcomes**

The strategic outcomes expected through the compliance and implementation of the safe system approach in human-wildlife conflict management and resolution are: safe person, safe wildlife, safe assets, safe habitat, and effective monitoring Brooks (2015) [155]. The approach is well integrated and inclusive of all strategic practices and intent providing holistic outcomes desirable for co-existence of humans and wildlife, as outlined in Table 3.5.

**Effective Monitoring and Evaluation**

HWC-monitoring systems are central to the success of HWC resolution and co-existence of humans and wildlife. Without the inclusive monitoring programmes in place, the managers are unable to allocate required HWC resources or provide

| Desired & Strategic Outcome | Strategic Practice & Intent |
|----------------------------|----------------------------|
| Safe Person                | Does not hunt wildlife; Wildlife-friendly farming practice; availability of funds for preventive measures; alternative livelihood opportunities; avoid and reduce economic activities in conflict areas; insurance schemes; support of Response schemes; timely reporting; receive conflict education and awareness; follow HWC management plan; |
| Safe Wildlife              | Protected by law and safe from hunting and habitat loss; access to adequate habitat, fodder and wildlife prey; no access to livestock and crops, separated by barriers, deterrents and land-use plans; positive contribution to communities; supported by Response Teams. |
| Safe Assets                | Separated from wildlife by barriers, deterrents and land-use plans; wildlife-friendly cropping and grazing plans; well guarded; livestock graze in agreed and safe areas; cropping has buffer zones; protected against invasive species through active management and buffers; |
| Safe Habitat               | Protected under law; houses wildlife that are protected; managed under spatial plan; large areas; well connected and not diminishing in size |
| Effective Monitoring       | Conflict hotspot areas known, mapped and modelled regularly; clear understanding of financial cost of conflict |
guidance to the communities for adopting the most effective preventative measures. An effective monitoring framework will be employed to evaluate the expected goals of HWC resolution: A decrease in incidence and severity of the conflict, increased tolerance of wildlife and, ultimately, a harmonious co-existence for all involved, notwithstanding the increasing pressures exerted by the human collective. In this challenging context, Bhutan’s conservation and agricultural sectors require detailed monitoring indicators with empirical evidence relating to the safety of people and assets; and data specific pertaining to the wildlife and habitat implicated in the HWC. Such baselines of information are absolutely essential for effectively analysing the improvement in resolution of such evident conflicts [2]. This proposed country-wide database would necessitate the establishment of a centralized information portal on HWC and monitoring frameworks (Best HWC Standards) at the national level; supplemented by the procedures and systems for establishing hotspot maps of conflict areas, annual impact and severity monitoring systems and cumulative surveys of the farmers’ perspectives and their tolerance levels.

It should also be recognized that ‘tolerance’ quotients (basic opinions, fears, hopes of the Bhutanese in general) are altogether relevant to other arenas of HWC that include wild or feral dogs, cats and pigs. Such surveys are key to understanding Bhutanese perspectives on animal rights in general, and their opinions regarding the relationship of their spiritual and ethical traditions as Buddhists with all other sentient beings. HWC is not merely an economic set of priorities to be resolved, but an animal liberation philosophy, core to traditional Buddhism, that promotes compassion, tolerance and forgiveness. Given Bhutan’s standing among nations as the country, which invented GNH (a factor not to be ignored when it comes to one of the fascinations with Bhutan by non-Bhutanese, and subsequently, tourism) it is clear that one of the great gifts that Bhutan had given to the world is a generalized belief in the value of other species as spiritual, ethical, beautiful, inviolate beings, in and of themselves, irrespective of economic ‘value’. Every life-form is a moral being within the Buddhist universe. Hence, how Bhutan confronts HWC in the future – the non-violent techniques by which it employs methods of conflict resolution – will be watched by all those who look to the Bhutanese for answers to help people cope with HWC issues in their own countries. As biodiversity loss and climate change escalate, Bhutan is increasingly viewed by many in the world as an existing conservation and spiritual leader, its national choices, and the resulting statistics, of great importance to global conservation and the future of the planet.

Results and Recommendations

Safe Outcomes

Table 3.5, Figs. 3.1 and 3.2 show the results of the Rapid Assessment at JWS. The data reveal a disproportion across the site with varied scores for the Outcomes, which indeed yield a typical schematic pattern expected in Bhutan – where there is
current conflict events, but high adherence to national laws and religious norms of respecting and protecting nature. The number of criteria being met for Safe People (50%) and Assets (33%) is relatively low. This shows straightaway that there is conflict currently underway across the communities; there is a high possibility that people will or already have lost tolerance to wildlife; and that there is the ever-present possibility of retaliatory killing, however contrary to Buddhist ethics. Immediate measures are required to be taken to support and minimize such reaction from the communities. The results also show high scores for Wildlife (85%) and Habitat (78%). This is typical for Bhutan where compliance with national environmental law and respect for religious traditions respecting nature are strong. An imbalance such as this case study – between low people and assets scores, and high wildlife and habitat scores – typically indicates that there is a high reliance on such externalities as law enforcement, tradition, or religious norms and practices in the protection of species and their habitat (Fig. 3.11).

Fig 3.11 Illustration of Percentage Score of the Safe Outcome indicating better protection of Habitat and Wildlife and weaker protection of assets, people and ineffective monitoring of HWC in Jomotshangkha Wildlife Sanctuary, the smallest protected area in Bhutan, with 334.73 km²
Conflict Elements

The percentage score of six conflict elements illustrated in Table 3.6 and Fig. 3.2 indicates the current suite of human-wildlife-conflict actions currently occurring in JWS; there is a lack of uniformity in the implementation of these conflicts elements. High scores for Policy (90%) indicate that Bhutan has very strong national environmental laws and policies in place (Fig. 3.2). The weak scores for the remaining elements mean that implementation of HWC actions on the ground is relatively weak. The score for prevention (58%) is positive, indicating that many actions are already in progress to stop crop raiding and livestock depredation at JWS. However, high prevention score coupled with low scores for other elements indicate a short-term solution for HWC management system that cannot be a sustainable solution. 38% score for Response suggests that some form of response team network is in place to respond and verify incidents. However, a low-monitoring score (25%) means that basic HWC data and information collected by response teams are not being passed back to site managers. The low score for mitigation (25%) also reflects the low score for Safe Assets above whereby support mechanisms to reduce the impact of HWC after the occurrence of HWC is relatively weak. This means that livelihood diversification, alternative livelihoods, and insurance and compensation schemes are small, or are currently not effective. Most emphasis is seemingly required in the understanding of conflict through development of a research profile of each conflict element (see Table 3.1).

The results are also very instructive for necessary responsive actions required towards low-safety levels of human and asset in JWS. As summed up in Table 3.5, responsive action to maintain ‘Safe Person’ in the sanctuary would be to prevent illegal hunting (hunting being against the law in Bhutan) and reduce economic

| Item                        | Number of criteria in the assessment (a) | Number of criteria scoring 3 or 4 (b) | Percentage score (b/a) × 100 |
|-----------------------------|------------------------------------------|--------------------------------------|-----------------------------|
| Safe Outcome                |                                          |                                      |                             |
| Safe Person                 | 38                                       | 19                                   | 50%                         |
| Safe Assets                 | 12                                       | 4                                    | 33%                         |
| Safe Wildlife               | 13                                       | 11                                   | 85%                         |
| Safe Habitat                | 9                                        | 7                                    | 78%                         |
| Monitoring                  | 4                                        | 1                                    | 25%                         |
| Element of Conflict         |                                          |                                      |                             |
| Mitigation                  | 4                                        | 1                                    | 25%                         |
| Policy                      | 10                                       | 9                                    | 90%                         |
| Prevention                  | 48                                       | 28                                   | 58%                         |
| Response                    | 8                                        | 3                                    | 38%                         |
| Understanding the Conflict (UtC) | 2                                | 0                                    | 0%                          |
| M & E                       | 4                                        | 1                                    | 25%                         |
activities in the conflict areas; establishing wildlife-friendly farming practices, alternative livelihood farming practices, insurance and response schemes; and advocacy of wildlife education and awareness and adoption of effective HWC management plan. The low level of safety for asset would mean strategic protection of assets through effective separation from wildlife using preventive measures such as barriers, deterrents, guarding, and land-use plans for cropping and grazing, and protection against invasive species (see Table 3.5), as discussed further in this section. Low levels of safety for people and assets could also indicate that the HWC management system in general is not effective, and as such HWC policy (currently lacking) needs to be formulated for effective policy direction in implementation of conflict resolution measures. The results are very instructive in that they give a clear indication of the types of actions that need to be developed across the site as part of an HWC SAFE Strategy (Fig. 3.12).

If only the weakest parts of the system at the site are addressed (Annex 3.4), then we begin to get a clear picture of the main areas of work that need to be implemented across JWS to reduce the immediate risks to households, and the long-term risks to biodiversity (Fig. 3.11). Table 3.1 shows these main areas according to each element of conflict.

**Non-violent and Safe Approach**

Bhutan’s agriculture-based society currently reveals some 60% of the population is dependent upon farming systems for its livelihood. Given the country’s stellar conservation track record, ironically, most of the rural settlements are actually located in the protected areas, and typically within forested regions. This is an inevitable
formula for continued HWC. It will pose certain challenges not only for farmers, but for conservationists and policy makers, if sustainable management solutions are to be implemented, and those regulations already in place – many admirably dating back several decades - to be sustained. Given its predominantly Buddhist population, coupled with effective national conservation policies and the philosophy of Gross National Happiness as a key to all national development objectives - envisioned by His Majesty the King - Bhutan needs a holistic approach to HWC. This is a crucial, undeniable fact. Ensuring the safety of wildlife and habitat, people and their assets, and given the complexities of the conflict, the preventive measures of HWC, as herewith elaborated upon, will need various supporting combinations of mitigation approaches. These include site-specific socio-economic and geographical applications, compensation and insurance schemes, alternative sources of livelihood, wildlife-friendly agriculture and livestock management practices, research and scientific management of habitat and wildlife species and the conflict areas, including ‘hotspot’ mapping, governed by effective coordination and active engagement of multi-stakeholders.

An extensive review of HWC conflict in other affected countries reveals lethal weapons and retaliatory killings from the conflict areas have not reduced human-wildlife conflict or livestock depredation and crop losses. For example: there are reports that removal of mesopredators like wolves increases the HWC incidents because removal of an experienced predator in a wolf pack leads to societal disruptions, lack of leadership and training of younger members with skills of killing wild prey. This results in remaining younger members of the group beginning to attack livestock and domesticated animals, which are much easier prey than the wild habitat prey. Retaliatory killing of iconic and dominant species also results in the disruption of entire ecosystems and an abundance of wild prey increasing further conflict with humans, not to mention the ever-increasing diminution of species. IUCN Red Listed large carnivores are among the most seriously (‘Critically Endangered’) at risk species in the world. In absence of enlightened HWC policies, the tragic fate of most large carnivorous vertebrates throughout the Himalayas is all but sealed. In this regard, the safe system approach to HWC that holistically and inclusively embraces effective Policies, Prevention, Mitigation, Understanding of Conflict, Responsive and Effective monitoring measures [2] should be thought of as essential, dynamic, guiding principles of resolving human-wildlife conflict situations and the enabling of an harmonious co-existence of human communities and magnificent, precious wildlife in Bhutan.

**Institutional Arrangement**

Owing to the complexities of the human-wildlife conflict situations, numerous agencies that are governmental, non-governmental organizations, communities and farmers, conservationists, researchers and the general public all need at some practical level, to be engaged in resolution, whether in Bhutan or parts of Europe, where
there has been a recent resurgence of carnivores. Such large multi-stakeholder groups require a well-organized consultation process for well-informed policy formulation that enable effective preventive, mitigation and response measures through a coordinated institutional arrangement, without which there could be a lack of proper coordination and initiatives, or the duplication of efforts and thus wastage of resources. By example, back in the early 1990s it was determined that literally dozens of agencies throughout East Africa were all seeking funding to do the exact same work within the family-planning areas. None of those agencies had been communicating with one another. A similar problem of redundancy was discerned within the environmental arena in the United States in the late 1970s, and published under President Jimmy Carter’s Administration, Barney; Global 2000 Report [156]. In Bhutan, the Ministry of Agriculture and Forest has the mandate as a focal agency to coordinate the policy implementation and response-related field-activities; the multi-stakeholders include Wildlife Conservation Division of the Department of Forest and Park Services, National Plant Protection Center of the Department of Agriculture, Dzongkhags (Districts) and Geogs (Blocks), Thromdes (Municipal), communities and farmers, financial institutions, WWF-Bhutan and RSPN, and even the Ministry of Works and Human Settlement, and RSTA have important relevance. For a well-coordinated HWC management, a dedicated agency could be established as Secretariat to the HWC Board, under the aegis of the Ministry of Agriculture and Forests, with broad representation of all the stakeholders and clear Terms of Reference that embraces GNH and coexistence. Following this, implementation arrangement amongst the agencies and at the field level, including the Response team and Geog-Level HWC Committees, could be developed.

**Human-Wildlife Conflict Policy & Legislation**

Policy directions for HWC management have critical gaps due to a lack of HWC policy, given that currently the Forest and Nature Conservation Act of Bhutan is the only legal tooth that supports conservation and protection of wildlife species. But it does not address conflict management issues. There is also a need for a Wildlife Act that stands to back up wildlife species for critical ecosystems and management of ‘problem animals’ for coexistence of people and wildlife. The HWC Policy needs to embrace necessary specific elements such as wildlife-friendly practices, alternative livelihood opportunities and revenue-sharing options through tourism; economic responses such as finance, endowment funds, subsidized micro-credits and loans, sustainable compensation/insurance schemes, ex gratia payment for casualties and deaths, alternative livelihoods and revenue sharing options; institutionalization and dedicated organization for coordination, Response Team Centers in conflict hotspot areas. In effecting such all-encompassing HWC, it is important that Bhutanese legislators be forewarned that the experience from many other countries have associated compensation payments with corruption, lack of transparency, unsustainable, and often bureaucratic and undervalued payments.
Bhutan’s sound environmental policies and legislation offers adequate protection to the wildlife species and their natural habitat. However, policy and legislation related to the protection and safety of the humans and their assets is a gap that needs to be addressed, as it quite obviously can backfire in the HWC arena. Hence, a very effective HWC policy that embraces various areas relating to the prevention, mitigation, and deep sensitivity to, and understanding of the conflicts, appropriate responses, and overall monitoring of said problems is urgently required in order to fully safeguard the efficacy of current conservation policies in Bhutan, whilst efficiently and effectively promoting co-existence between wildlife and human life at those core, agricultural areas of most vulnerability. HWC Policy should empower necessary provisions for conflict resolutions in the context of minimizing conflict between wildlife and humans. This is a conservationist, economic, biocultural and thus geopolitical given. In Bhutan it should be viewed, we believe, as an ethical maxim.

In sum, many of the most important policy provisions could be wildlife-friendly agricultural policies, compensation and insurance schedules, budget allocation, well-informed (and inspired) response teams, preventive and mitigation measures, including ex-gratia payment for human casualties and deaths, alternative livelihoods and ecotourism, protected area management, law enforcement, and forest wildlife crime coordination, and the engagement of stakeholders, promulgation of community education and awareness, and emphasis upon Buddhist perspectives of non-violent approaches to such conflicts. In addition to the policy requirement that defines and addresses problem animals, effective implementation of human-wildlife-conflict resolution requires specific strategies, guidelines, mandates and protocols for the decision makers, implementers, farmers and the response teams for the resolution of the conflicts. Most importantly, there is a need for a Wildlife Act that empowers the prudent conservation of endangered wildlife species, including endangered, threatened and vulnerable plant species; and the continuing restoration of ecosystems and habitat, as potently spelled out in dozens of existing Bhutanese laws, regulations and decrees; and according to the signatory status of Bhutan to such international platforms as the Convention on Biological Diversity, with its mandatory five-year plans.

**Coping Techniques and Mechanisms**

Wildlife species commonly associated with human conflict in Bhutan are reportedly tigers, elephants, common leopard, snow leopard, Himalayan black bear, deer, cheetah, wild pigs, monkeys and wild dogs; although birds and rodents are not uncommon in their capacities to inflict significant economic loss to the people. In consideration of diverse environmental landscape and climatic conditions that characterize Bhutan’s socio-economic and agro-ecological systems, preventive and
mitigation measures have to be location and species-specific instead of applying broad, diluted measures and techniques all across the country. Techniques that are effective against some wildlife species in certain parts of the country may not be applicable to other regions, depending on the altitude and agro-ecological conditions. Defence methods such as physical barriers, guarding, repellents, landscape zoning, changes of cropping systems, deceptive techniques and removal of problem animals, population control through sterilization (as dealt separately in this section) applied in other countries have been reviewed, as indicated in this report. In Bhutan, traditional and electric fencing, lighting and sound systems have been found effective in some areas, but not all. For example, notwithstanding the potential suitability of effective combinations of various techniques in any given conflict situation, electric fencing seems to be most widely preferred as an efficient barrier technique to defend crops and livestock from wildlife attacks throughout the country. However, electric fences are not able to deter a wild elephant’s sheer force of attack, as repeatedly evidenced in southern parts of the country. Linking to such defence failures means adopting alternative solutions from experiences of other countries or proven techniques such as beehive-fences or chilli plantations situated near the fences, demonstrated as effective deterrents against elephants, meeting the dual objectives of defending farms and engendering income streams through, for example, the harvest of honey and chillies.

Likewise, in certain areas of the country, an abundance of stones in agricultural fields argues for the erection of permanent stone walls as possible barriers while, at the same time, improving in situ of soil conditions for crops. Using well-trained livestock guardian dogs to replace people guarding their fields day and night could save on otherwise labour-intensive syndrome, liberating tremendous opportunity costs associated with guarding of crops and livestock for almost 4 months every year.

Many non-lethal techniques exist to help reduce livestock and livelihood losses, including livestock husbandry strategies, physical deterrents and financial incentives for communities [14, 73]. Yet, effective implementation of these tools requires detailed knowledge of the precise timing and locations of carnivore attacks upon livestock; and how risks differ between livestock species and/or breeds. Understanding carnivore-livestock interactions is a crucial step towards mitigating human-carnivore conflict and ultimately enabling coexistence between people and carnivores [14, 62]. One spatial predation risk model for cattle revealed high-risk hotspots around the core zone boundary, confirming the significant risks to livestock grazing illegally in the core. Such ecological insights on carnivore–livestock interactions may help improve species-specific livestock husbandry for minimizing livestock losses and enabling coexistence between people and carnivores [157]; but also maintaining the very integrity of protected areas from vagrant grazing. While it is always easier said than done, this is one area where IT and the stored data of on-the-ground scientific investigations can work to solve critical problems faced by a majority of Bhutanese.
Hotspot Mapping

With limited resources available to mitigate HWC, it is imperative that areas are identified where livestock and crops are at risk of depredation and damage, respectively. Focusing mitigation measures on high-risk areas can reduce the conflicts and lead to a decrease in retaliatory killings of predators. We note that the repeated use, in this chapter, of the word ‘conflict’ should be viewed not simply as a glass half-empty. Rather, it is propounded and repeated to highlight a critical conservation inflection point: What was conflict can and should become absence of conflict through smart conservation; non-violence; ahimsa; compassion; common sense, the rich experience of farmers gleaned from centuries of hard work; and science, all merging to comport with traditional Bhutanese Buddhist ethics and twenty-first century Best Environmental Practices.

To the point, spatial predation risk modelling tools can help in the forecasting and mapping of hotspots of livestock depredation and crop losses using locations where carnivores and other pests attacked livestock and damaged crops in the past [125]. Such modelling has been applied to detect and identify the high-risk zones for human populations dwelling, for example, within the Chitwan National Park in Nepal. In Bhutan, the pattern of ungulate distribution in Royal Manas National Park was studied using GPS and pellet droppings of those ungulate species of interest [158]. Such GPS modelling and spatial distribution information systems could provide understanding of the conflict hotspots for effective planning of preventive and mitigation measures.

Physiological Sterilization of Wildlife

With over 70% of the land under forest cover and more than half of the land under protected area systems regulated through effective conservation policies and laws, reinforced by Buddhist philosophies of compassion towards animals, strong sentiments against killing, it is highly expected that the population of wildlife species can steadily increase over the coming years, but not unless the Bhutanese rise to the challenges posed by HWC. For example, Bhutanese farmers have been experiencing problems with large groups of emboldened (and most likely, hungry) monkeys even raiding their homes and (not surprisingly) flocking along highways where tourists frequently toss food out the windows for them; deer inhabiting the backyards and monasteries, large flocks of wild pigs raiding their potato fields, huge numbers of pigeons gathering near their homes and cultivated fields; while the large populations of stray dogs are becoming a daily concern for everyone in urban areas. Under such existing scenarios, effective intervention through population control via non-lethal measures will undoubtedly prove to be a viable and sustainable option for co-existence and a balanced approach inherent to any true and sustainable conservation success. Sterilization through immunocontraceptive methods and chemi-
Physiological Sterilization of Wildlife

cal fertility control has been found to be extraordinarily effective in many mammalian species, including rodents that are associated with human-wildlife conflict. There has even been illuminating research conducted with respect to avian GnRH fertility control.

In this context, Bhutan’s serious challenges in controlling explosive wildlife populations can be controlled through non-lethal approaches of sterilization, which, may, in turn, be scaled to the optimum levels of ecosystem functioning, ensuring that wild prey populations do not decline beneath the threshold levels. For example, in Africa, the population of wild elephants is being controlled through immunocontraceptive vaccines, while populations of pigeons and wild geese are effectively managed through chemical fertility controls in the US and Canada. To cite a challenging example from Indian experience, although monkeys are worshipped by people in Himachal Pradesh, the state has declared monkeys as ‘vermin’ because of their perceived overpopulating within urban towns and around homes. Computed agricultural losses compelled HP authorities there to sterilize millions of monkeys. Indian scientists are currently working on finding suitable contraceptive vaccines to do away with surgical castration that has been very expensive and challenging (each person catching a monkey for surgical castration is paid Rs. 500, with the overall budgetary burden representing tens of millions to the state government).

Sterilization using immunocontraceptive vaccines will go a long way for Bhutan in its effort for conservation and co-existence with wildlife species, and the possible utilization in Bhutan is indicated in this report. The success, however, will depend upon finding a practical delivery method of the contraceptive vaccines and navigating a balancing act of population control for ecosystem functioning. Currently, most of the vaccines are delivered through darts and handguns that could be feasible for predators like wild elephants, sambar and barking deer (for dogs it is outlined in our Chapter under ‘Animal Rights and Protection’); and yet other tools for large animals, including monkeys and Himalayan black bear. But for elusive and agile (smaller) wildlife species, the needed methods of delivery will necessitate precise or species-specific vaccines through oral administration. Scientists have already discovered oral forms of chemical infertility treatment for birds, rodents and wild pigs, and such oral forms of vaccines that are species-specific require further research and exploration for other predators. In southern Bhutan, darting of PZP vaccines to elephants could be practiced to lower the elephant fertility rates in problem areas, as has been proven successful in South Africa, while population control of pigeons and rodents using chemical treatment as baits has shown great success in the US and Canada. Surgical sterilization in dogs has been time consuming and labour intensive, requiring a veterinary surgeon and assistants, and associated costs as explained in the earlier chapter. But this process can be replaced by immunocontraceptive vaccines.

HWC in Bhutan is envisaged to increase over the years. With as yet more than 60% of the population depending on agricultural farming and livestock production (as of 2020), innovative solutions are required – given that contraceptive vaccines can also affect untargeted species. If oral forms of vaccine are to be employed, then the allocation of research funds for species-specific oral forms of immunocontraceptive vaccines in HWC solutions could and should be a priority (Table 3.7).
Normally, the farmers have the best information and experience of HWC situations in their respective localities as HWC is part of their day-to-day experience. Researchers in general are very much dependent on the farmers for their research. As mentioned elsewhere in this report, the nature of conflict is location specific based on the type of agro-ecological zone. As such, uniform applications of preventive methods will not be effective. Against such a realistic geographical backdrop, innovative research on preventive methods can be piloted in different agro-ecological conditions as collaborative/participatory research between the researchers and farmers. Besides, farmers would be in the best position to experiment on the wildlife-friendly practices such as cropping patterns and landscape management, livestock husbandry, and the necessary information documentation of HWC hotspots.

### Table 3.7 Immunocontraceptive vaccines used in different animals

| Species                        | Immuno-Contraceptive Vaccine Or Chemical & Authors                                                                 |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Elephants, antelope, Sambar deer, Asian Black Bear, Himalayan Tahr (mountain goat), Asian water buffalo, Black Rhinoceros | Porcine Zona Pellucida (PZP) vaccine administered through a dart rifle, no side effects, high degree of efficacy and the complete absence of long-term debilitating effects; does not alter social behaviour, or pregnancy [81]. |
| Horses and Wild pigs          | Anti-GnRH Vaccine [82] Fertility-control vaccine GonaCon™ GnRH vaccine (measured as raised levels of GnRH antibodies) [159] |
| White tailed deer             | GNRH Vaccine suppressed fertility of female and male white-tailed deer for a period of up to two years [91]          |
| Wild Geese and Pigeons        | Ovo-control baits containing Nicarbazin has been used in food to control hatchability and fertility in Canada (Oral Contraceptives: [https://www.aphis.usda.gov/publications/wildlife_damage/content/printable_version/fs_oovocontrol.pdf](https://www.aphis.usda.gov/publications/wildlife_damage/content/printable_version/fs_oovocontrol.pdf) [160]) |
| Monkeys (Macaca radiate)      | Immunized with Eppin, a testis/epididymis-specific protein, 78% success in controlling reversible fertility [161] |
| Dogs (wild and domestic) and cats | GonaCon™ NWRC; GnRH vaccine injection 1-5 years, some site reaction Alliance for Contraception in Cats & Dogs [162] |
| Rats and Rodents              | ContraPest (containing two chemicals, 4-vinylcyclohexene diepoxide and triptolide), a liquid fertility-control bait impairs spermatogenesis in males and ovulation in females; it may also be effective in other mammals [92] |

### Innovative Research Fund for Farmers

normally the farmers have the best information and experience of HWC situations in their respective localities as HWC is part of their day-to-day experience. Researchers in general are very much dependent on the farmers for their research. As mentioned elsewhere in this report, the nature of conflict is location specific based on the type of agro-ecological zone. As such, uniform applications of preventive methods will not be effective. Against such a realistic geographical backdrop, innovative research on preventive methods can be piloted in different agro-ecological conditions as collaborative/participatory research between the researchers and farmers. Besides, farmers would be in the best position to experiment on the wildlife-friendly practices such as cropping patterns and landscape management, livestock husbandry, and the necessary information documentation of HWC hotspots.
**Economic Responses to HWC**

Most commonly, compensation and insurance schemes are being followed in many countries, including Bhutan, as a measure of promoting co-existence through compensation of losses and assurances. However, as mentioned, compensation schemes in many countries have been challenged by fraud and corruption, lack of transparency, cost effectiveness, lengthy procedures, complacency resulting in weak preventive measures, and sustainability of funding sources. Often, compensation schemes have been donor-driven and project-tied in Bhutan and even suspended due to exhaustion of funds. On the other hand, insurance schemes have increased tolerance levels and better understanding of HWC, particularly for livestock depredation, while crop insurance schemes and compensation are not yet well established in most countries. One success story involves the Leopard Conservation Group in Paro, Bhutan. It has demonstrated how the government, in concert with a conservation organization has been able to contribute certain seed money/endowment funding, while the communities contribute a nominal insurance payment of their Yaks, and this particular arrangement has been functioning effectively with remarkable co-existence of the communities and leopards. Similar arrangements could be instituted in relation to HWC in crops, and replicated in other parts of Bhutan. Recently, an endowment target fund of USD 35 Million for crop losses due to HWC was announced [153]. This might be a superb strategy to replicate in various regions of the country.

**Alternative Livelihoods**

Where communities are severely affected and all possible or exhaustive preventive measures are overcome by excessive wildlife pressure on human territory, special focus on alternative means of livelihood could be considered by the government. ‘Hotspot Conflict Area Mapping’ initiatives could be conducted in spatial dimensions country wide (Swedish conservationists have been employing multi-spatial mapping for forest analysis for many decades), and as such, locations that are abundant in wildlife species could be declared as ‘eco-tourist destinations’ for very high-end tourism solely to be managed by the local residents (as in the case of protected areas from northeastern Ecuador, park sites within Native American lands, i.e. Canyon de Chelley, to central Madagascar), along with the provision for adequate training and amenities. Other supplementing alternatives, depending on the potential scope of the specific localities, could be explored and intensified. For example, non-wood forest products like mushroom, cane products, medicinal plants, culture-related products, etc. could be promoted through various management strategies and technical assistance on a priority, and fiduciary (socially responsible) basis. It is very much envisaged there will be a paradigm shift where co-existence and harmony prevail in such severe conflict areas (Fig. 3.13).
Regional Transboundary Conservation

At the policy level, there is regional cooperation in South Asia and this has always been a cornerstone of foreign policies in the Eastern Himalayan Region endowed with immense biological diversity in a shared landscape (one of the 36 biodiversity hotspots). Within this policy framework of cooperation, transboundary conservation and management is one area of mutual cooperation that is yet to be taken earnestly and much more professionally given the shared concerns and responsibilities. For example, shrinkage of natural habitat on either side of the border can escalate the HWC through transboundary movement of wildlife species. Transboundary Manas Conservation Area (TraMCA) cooperation between India and Bhutan is one case in point that could help better illustrate challenges in conservation and HWC. This specific site also intimates prospects for replication in many other border areas. A dedicated joint venture -some version of transboundary conservation tactical and strategic collaborations - in concert with programmes sufficiently funded, could go a long way towards resolving many conservation-related crises embedded, ultimately, within what we have termed HWC.

Fig. 3.13 Great pied hornbill buceros bicornis in Jomotshangkha wildlife sanctuary © NCD, DOFPS
Annexes

Annexure 3.1: Indicators of the strategic outcomes of people, wildlife, assets and habitat

| People                      | Number of wildlife killed in retaliation |
|-----------------------------|-----------------------------------------|
|                             | Number of humans killed or injured      |
|                             | Number of wildlife crime cases recorded  |
|                             | (snaring, trapping, poisoning, electrocution, hunting, etc.) |
|                             | Human population, density and growth    |
|                             | Number and cost of livestock killed or injured |
|                             | Area, cost and type of crops lost or damaged |
|                             | Number of reported incidents            |
|                             | Number of verified conflict incidents   |
|                             | Average time to respond to an event     |
|                             | Number of insurance claims made         |
|                             | Number of innovation grants             |
|                             | Number of national policy mechanisms enacted to support HWC |
|                             | Proportion of areas/landscapes/sites effectively covered by trained Response Teams |

| Wildlife                    | Endangered species occupancy and density |
|-----------------------------|-----------------------------------------|
|                             | Prey density                             |
|                             | Number of endangered species killed in poaching |
|                             | Number of endangered species injured through poaching attempts |
|                             | Number of problem animals removed/euthanized |
|                             | Number of wildlife crime cases recorded  |
|                             | (snaring, trapping, poisoning, electrocution, hunting, etc.) |
|                             | Number of straying species outside the protected area |
|                             | Number of verified conflict incidents   |
|                             | By midway mark (end 2019)               |
|                             | Revenue accruing for site-based management through a local green economic mechanism |
|                             | Cost of barriers installed              |
|                             | Community attitudes towards wildlife     |

| Assets                      | Number of wildlife killed in retaliation |
|-----------------------------|-----------------------------------------|
|                             | Number of humans killed or injured      |
|                             | Number of wildlife crime cases recorded  |
|                             | (snaring, trapping, poisoning, electrocution, hunting, etc.) |
|                             | Human population, density and growth    |
|                             | Number and cost of livestock killed or injured |
|                             | Area, cost and type of crops lost or damaged |
|                             | Number of reported incidents            |
|                             | Number of verified conflict incidents   |
|                             | Average time to respond to an event     |
|                             | Number of insurance claims made         |
|                             | Number of innovation grants             |
|                             | Number of national policy mechanisms enacted to support HWC |
|                             | Proportion of areas/landscapes/sites effectively covered by trained Response Teams |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|-------------------|------------------|----------|---------------|-----------------|
| Safe Person       | Does not hunt wildlife | Laws are enacted to protect wildlife. | 1: Laws are by personal agreement only with no means to be enforced; 2: Laws are in place and with minimal physical, financial and human resources for effectiveness enforcement and punishment, and are generally known by affected people 3: Laws are in place with less than 75% of the physical, financial and human resources needed for effective enforcement and punishment and laws are well known by affected people 4: Laws are stipulated and recognized by national government, and have extensive means to be enforced everywhere. | Policy |
| Safe Person       | Does not hunt wildlife | Laws enforced by any officially recognized entity: rangers, citizen scientists, patrol units, military, etc. | 1: Patrolling is seldom done 2: Patrolling is up to 4 days p/mth 3: Patrolling is 5–14 days p/mth 4: Patrolling is 15 days or more p/mth | Prevention |
| Strategic Outcome         | Strategic Intent                      | Criteria                                                                 | Effectiveness                                                                 | Primary element |
|--------------------------|---------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------|
| Safe Person              | Does not hunt wildlife                | People are complying with the law.                                       | 1: Wildlife crime incidents have increased over time                          | Prevention      |
|                          |                                       |                                                                          | 2: Are steady                                                                |                 |
|                          |                                       |                                                                          | 3: Have decreased over time                                                  |                 |
|                          |                                       |                                                                          | 4: Minimal to zero wildlife crime occurs                                     |                 |
| Safe Person              | Does not hunt wildlife                | Judicial processes are fair.                                             | 1: Following arrest judicial processes ensure fair trials and prosecution in 0–25% of cases | Policy          |
|                          |                                       |                                                                          | 2: … in 25–50% of cases                                                     |                 |
|                          |                                       |                                                                          | 3: … in 50–75% of cases                                                     |                 |
|                          |                                       |                                                                          | 4: … in 75–100% of cases                                                   |                 |
| Safe Person              | Participates as partners for protection | Communities participate in patrolling, policing, and monitoring of community forest areas. | 1: 0–25% local participation                                                | Prevention      |
|                          |                                       |                                                                          | 2: 25–50% of communities have people participating                          |                 |
|                          |                                       |                                                                          | 3: 50–75% of communities have people participating                          |                 |
|                          |                                       |                                                                          | 4: 75–100% of communities have people participating                        |                 |
| Safe Person              | Participates as partners for protection | A locally applicable insurance/relief/compensation programme for HWC is operational. | 1: 0–25% local participation                                                | Mitigation      |
|                          |                                       |                                                                          | 2: 25–50% of communities have people participating                          |                 |
|                          |                                       |                                                                          | 3: 50–75% of communities have people participating                          |                 |
|                          |                                       |                                                                          | 4: 75–100% of communities have people participating                        |                 |
| Safe Person              | Participates as partners for protection | Personal informant networks are operational.                             | 1: Zero patrols are conducted based on intelligence each month               | Prevention      |
|                          |                                       |                                                                          | 2: 5% of patrols are conducted based on intelligence from the informant network each month |                 |
|                          |                                       |                                                                          | 3: Up to 10% of patrols are conducted based on intelligence from the informant network each month |                 |
|                          |                                       |                                                                          | 4: More than 10% of patrols are conducted based on intelligence from the informant network each month |                 |
| Safe Person              | Participates as partners for protection | An anonymous or public informant network is in place and operational.  | 1: Low usage and knowledge of it locally                                     | Prevention      |
|                          |                                       |                                                                          | 2: Local knowledge of it and low usage                                      |                 |
|                          |                                       |                                                                          | 3: Good local knowledge and growing use of it and leading to seizures        |                 |
|                          |                                       |                                                                          | 4: High usage and leading to an increase in seizures or patrols              |                 |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|-------------------|------------------|----------|---------------|----------------|
| Safe Person       | Does not venture into, forage, or conduct livelihoods activities inside designated PAs | Are people venturing into, foraging, or conduct livelihoods activities inside the PA? | 1: Illegal activities inside the PA have increased over time | Prevention |
|                   |                  |          | 2: … have remained steady over time | |
|                   |                  |          | 3: … have decreased over time | |
|                   |                  |          | 4: … are minimal or non-existent | |
| Safe Person       | Uses non protected forest resources sustainably | Is resource extraction and use sustainable in the buffer zone or community forest? | Livelihoods activities for subsistence or income OUTSIDE the PA: | Prevention |
|                   |                  |          | 1: Are increasingly intense and have led to extensive forest and species loss | |
|                   |                  |          | 2: Are steady and are leading to gradual forest and species loss | |
|                   |                  |          | 3: Have decreased over time, with forest resources able to recover from losses | |
|                   |                  |          | 4: Are minimal and forest and resource use is balanced with recovery | |
| Safe Person       | Is not directly exposed to conflict | Are people safe from injury or death by wildlife? | Incidents of human injury or death by wildlife is: | Prevention |
|                   |                  |          | 1: … increasing over time | |
|                   |                  |          | 2: … steady | |
|                   |                  |          | 3: … decreasing | |
|                   |                  |          | 4: … minimal or zero | |
| Safe Person       | Conducts wildlife-friendly farming | Livestock are guarded and herded during the day (6 am–6 pm) | 1: Number of livestock killed during the day has increased over time | Prevention |
|                   |                  |          | 2: … has remained steady over time | |
|                   |                  |          | 3: … has decreased over time | |
|                   |                  |          | 4: … is almost non-existent now | |
| Safe Person       | Conducts wildlife-friendly farming | Are livestock fenced / enclosed / tethered at night? (6 pm–6 am) | 1: Number of livestock killed during the night is increasing | Prevention |
|                   |                  |          | 2: … has remained steady over time | |
|                   |                  |          | 3: … has decreased over time | |
|                   |                  |          | 4: … is almost non-existent now | |
| Safe Person       | Conducts wildlife-friendly farming | Locally applicable grazing areas are complied with. | 1: No agreed grazing area exists | Prevention |
|                   |                  |          | 2: Number of livestock killed outside grazing areas has increased over time | |
|                   |                  |          | 3: Number of livestock killed outside grazing areas has decreased over time | |
|                   |                  |          | 4: Minimal or zero livestock are killed or injured outside grazing areas. Grazing areas are in place, have herding, and guarding at night. | |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|------------------|-----------------|----------|---------------|----------------|
| Safe Person      | Conducts wildlife-friendly farming | Crops are consistently guarded. | 1: Crop loss has remained high or is increasing over time  
2: … has remained steady over time  
3: … has decreased over time  
4: … is almost non-existent now | Prevention |
| Safe Person      | Conducts wildlife-friendly farming | Do crops have barriers separating them from habitat? | 1: 75–100% of crops raided do not have barriers  
2: 50–75%  
3: 25–50%  
4: 0–25%. The majority of crops have effective barriers and are not being raided. | Prevention |
| Safe Person      | Conducts wildlife-friendly farming | Are crops given extra protection during peak HWC times? | 1: Crop loss during peak conflict times has increased over time  
2: … has been steady over time  
3: … has decreased over time  
4: … is minimal or almost zero | Prevention |
| Safe Person      | Has the ability, means and right to implement preventative measures | Do communities have the skills to put in place preventative measures? | 1: People use only their existing skills knowledge  
2: use mostly their existing skills but have access to some information and lessons from elsewhere using local means  
3: have access to some lessons and ideas and techniques from other places using media sources and online  
4: have extensive access to lessons and techniques from external sources using media, online sources, and also have access to training and workshops | Prevention |
| Safe Person      | Has the ability, means and right to implement preventative measures | Funds are available for local people to develop their own solutions in prevention. | 1: People use their own money  
2: People use mostly their own money and borrow from relatives or micro-credit  
3: People combine their own money with micro credit loans, and have access to some grants for prevention  
4: People can readily access micro credit, grants from innovations funds or from government, to put in place preventative measures | Prevention |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|-------------------|------------------|----------|---------------|----------------|
| Safe Person       | Has the ability, means and right to implement preventative measures | Farmers and communities have the right to modify the land for prevention. | 1: People are not able to make any modifications to the land at all | Prevention |
|                   |                  |          | 2: People can make only few modifications to the land | |
|                   |                  |          | 3: People can make many modifications to the land based on local agreement | |
|                   |                  |          | 4: People have complete rights over their land and can do whatever they choose on it | |
| Safe Person       | Has the ability, means and right to implement preventative measures | There are channels / mechanisms to exchange and expand successful preventative measures locally to be demonstrated & are supported to be expanded locally and/or applied elsewhere. | 1: Preventative measures stay just at a household or village level; | Prevention |
|                   |                  |          | 2: A few measures have been expanded within the immediate area; | |
|                   |                  |          | 3: Some measures have been replicated outside the immediate area; | |
|                   |                  |          | 4: Some measures have been given further grants and expanded locally, adopted by other villages, or adopted by government or private sector as a solution. | |
| Safe Person       | Has safe working environments, agricultural fields and life styles | Managers and employers of plantations have committed to safe working practices. | Human injury or death inside plantations or the adjacent habitat | Prevention |
|                   |                  |          | 1: has increased over time | |
|                   |                  |          | 2: is steady | |
|                   |                  |          | 3: has decreased over time | |
|                   |                  |          | 4: is minimal or zero | |
| Safe Person       | Has safe working environments, agricultural fields and life styles | Managers and employers of National Park, military or police staff have committed to safe working practices. | Human injury or death inside National Parks and protected areas for employed staff: | Prevention |
|                   |                  |          | 1: has increased over time | |
|                   |                  |          | 2: is steady | |
|                   |                  |          | 3: has decreased over time | |
|                   |                  |          | 4: is minimal or zero | |
| Safe Person       | Has safe working environments, agricultural fields and life styles | People avoid high-risk areas and high-risk times in their daily lives to minimize HWC events and exposure to contact. | Human injury or death when doing non-livelihoods activities (going to school, bathroom, playing, etc.) has increased over time | Prevention |
|                   |                  |          | 1: Human injury or death when doing non-livelihoods activities (going to school, bathroom, playing, etc.) has increased over time | |
|                   |                  |          | 2: has remained steady over time | |
|                   |                  |          | 3: has decreased over time | |
|                   |                  |          | 4: is now minimal or zero | |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|-------------------|------------------|---------|--------------|----------------|
| Safe Person       | Has household incomes not significantly sensitive to conflict | Income diversification activities are underway across communities. | 1: HWC incidents negatively impact 75–100% of household incomes | Mitigation |
|                   |                  |         | 2: 50–75% of household incomes | |
|                   |                  |         | 3: 25–50% of household incomes | |
|                   |                  |         | 4: 0–25% of household incomes | |
| Safe Person       | Has household incomes not significantly sensitive to conflict | Alternative livelihood programmes are in place. | 1: 75–100% of people depend on livelihoods, which are prone to HWC | Mitigation |
|                   |                  |         | 2: 50–75% | |
|                   |                  |         | 3: 25–50% | |
|                   |                  |         | 4: 0–25% of people depend solely on livelihoods prone to HWC. They have several other income streams to fall back on | |
| Safe Person       | Has household incomes not significantly sensitive to conflict | Projects or programmes are underway to help local communities access markets, or do training, or access jobs. | 1: Very few people are participating in any programmes other than basic subsistence livelihoods | Mitigation |
|                   |                  |         | 2: Participation in non-natural resources related livelihoods is low | |
|                   |                  |         | 3: Participation in non-natural resources related livelihoods is high and people are increasingly getting jobs outside or selling goods to markets further afield | |
|                   |                  |         | 4: Many people derive incomes from jobs and services that are not linked to HWC | |
| Safe Person       | Participates in a conflict-reporting mechanism | A locally applicable reporting mechanism is in place. | 1: Reports are either never made or made 1–6 months from event | Response |
|                   |                  |         | 2: Reports are made 1 week-1 month from event | |
|                   |                  |         | 3: Reports are made 1–7 days of the event | |
|                   |                  |         | 4: Reports are made within 0 hours–1 day of the event | |
| Safe Person       | Participates in a conflict-reporting mechanism | All human injuries and death events reported. | 1: 0–33% of events are reported | Response |
|                   |                  |         | 2: 33–66% of events are reported | |
|                   |                  |         | 3: 66–90% of events are reported | |
|                   |                  |         | 4: 90–100% of events are reported | |
| Safe Person       | Participates in a conflict-reporting mechanism | All livestock loss events reported. | 1: 0–33% of events are reported | Response |
|                   |                  |         | 2: 33–66% of events are reported | |
|                   |                  |         | 3: 66–90% of events are reported | |
|                   |                  |         | 4: 90–100% of events are reported | |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|-------------------|-----------------|----------|---------------|----------------|
| Safe Person       | Participates in a conflict-reporting mechanism | All crop loss events reported. | 1: 0–33% of events are reported | Response |
|                   |                 |          | 2: 33–66% of events are reported |               |
|                   |                 |          | 3: 66–90% of events are reported |               |
|                   |                 |          | 4: 90–100% of events are reported |               |
| Safe Person       | Participates in a conflict-reporting mechanism | All structural damage and loss events reported. | 1: 0–33% of events are reported | Response |
|                   |                 |          | 2: 33–66% of events are reported |               |
|                   |                 |          | 3: 66–90% of events are reported |               |
|                   |                 |          | 4: 90–100% of events are reported |               |
| Safe Person       | Participates in a conflict-reporting mechanism | All retaliatory killing events reported. | 1: 0–33% of events are reported | Response |
|                   |                 |          | 2: 33–66% of events are reported |               |
|                   |                 |          | 3: 66–90% of events are reported |               |
|                   |                 |          | 4: 90–100% of events are reported |               |
| Safe Person       | Is supported by locally based Response Teams | Response Teams are in place, equipped, trained and functioning. | 1: Response times are over 1 week | Response |
|                   |                 |          | 2: 2–7 days |               |
|                   |                 |          | 3: 1–2 days |               |
|                   |                 |          | 4: 0–24 hours |               |
| Safe Person       | Has access to a conflict information system | Information system is in place, is linked to Effective Monitoring, and regular public reports are made available. | 1: Information on conflict events and trends is disseminated to local people once a year | UtC |
|                   |                 |          | 2: 1–3 times per year |               |
|                   |                 |          | 3: 3–12 times per year |               |
|                   |                 |          | 4: More than once a month |               |
| Safe Person       | Contributes to or adheres to an HWC management system / plan | A recognized (by communities and government) HWC management is in place. | 1. There is no coordination for HWC. Individuals just do their own protection measures. | Policy |
|                   |                 |          | 2: There is coordination within village level only |               |
|                   |                 |          | 3: There is coordination between villages |               |
|                   |                 |          | 4: There is coordination at the district or higher level for HWC through a plan |               |
| Safe Person       | Participates in community events for conservation | Ongoing education programme is in place re conservation and species. | 1. 0–33% of people in target areas participate | Prevention |
|                   |                 |          | 2: 33–66% of people in target areas participate |               |
|                   |                 |          | 3: 66–90% of people in target areas participate |               |
|                   |                 |          | 4: 90–100% of people in target areas participate |               |
| Strategic Outcome | Strategic Intent | Criteria                                                                 | Effectiveness                                                                                                                                                                                                 | Primary element |
|-------------------|------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Safe Person       | Does not feel fearful undergoing their daily lives | A system is in place to understand and reduce local sentiments around conflict. | 1. Communities have multiple areas off limits and daily activities are increasingly curtailed due to fear.  
2. Communities have multiple areas off limits and daily activities are sometimes curtailed due to fear.  
3. Communities have a few areas off limits and daily activities are rarely curtailed due to fear.  
4. Communities have very few areas off limits and daily activities are never curtailed due to fear. | UtC |
| Safe Wildlife     | Wildlife are not hunted, and their habitat secured | Laws are enacted to protect wildlife. | 1: Laws are by personal agreement only with no means to be enforced;  
2: Laws are in place and with minimal physical, financial and human resources for effectiveness enforcement and punishment, and are generally known by affected people  
3: Laws are in place with less than 75% of the physical, financial and human resources needed for effective enforcement and punishment and laws are well known by affected people  
4: Laws are stipulated and recognized by national government, and have extensive means to be enforced everywhere. | Policy |
| Safe Wildlife     | Wildlife are not hunted, and their habitat secured | Laws enforced by any officially recognized entity: rangers, citizen scientists, patrol units, military, etc. | 1: Patrolling is seldom done  
2: Patrolling is up to 4 days p/mth  
3: Patrolling is 5–14 days p/mth  
4: Patrolling is 15 days or more p/mth | Prevention |
| Safe Wildlife     | Wildlife are not hunted, and their habitat secured | People are complying with the law. | 1: Wildlife crime incidents have increased over time  
2: Are steady  
3: Have decreased over time  
4: Minimal-to-zero-wildlife crime occurs | Prevention |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|------------------|------------------|----------|---------------|----------------|
| Safe Wildlife    | Wildlife are not hunted, and their habitat secured | Judicial processes are fair. | 1: Following arrest judicial processes ensure fair trials and prosecution in 0–25% of cases 2: … in 25–50% of cases 3: … in 50–75% of cases 4: … in 75–100% of cases | Policy |
| Safe Wildlife    | Are separated from people, livestock and crops and rarely stray into human habitation | Locally applicable barriers, fencing, early warning systems and zoning are in place and functioning. | 1: Conflict events outside PA have increased over time 2: Have remained steady over time 3: Have decreased over time 4: Are minimal or almost zero | Prevention |
| Safe Wildlife    | Can co-exist with people | Wildlife is perceived positively locally and support for their protection is linked to livelihoods or community development. | 1: Zero livelihoods actions are linked to wildlife, habitat or services; 2: Some actions are linked to wildlife, and habitat; 3: Many actions are linked to wildlife and habitat; 4: Almost all actions are linked to wildlife and habitat conservation. | Prevention |
| Safe Wildlife    | Can co-exist with people | Wildlife are not being killed in retaliation for, or to prevent conflict events. | 1: Wildlife are increasingly killed, poisoned 2: Wildlife killings are steady 3: …are decreasing 4: …are zero or minimal | Prevention |
| Safe Wildlife    | Are supported by locally based Response Teams | Response Teams are in place, equipped, trained and functioning. | 1: Response times are over 1 week 2: 2–7 days 3: 1–2 days 4: 0–24 hours | Response |
| Safe Wildlife    | Have a secure, connected and healthy habitat | Wildlife habitat is protected under law or local agreement. | 1: Laws are by personal agreement only with no means to be enforced 2: Laws are in place and with minimal structure for enforcement and punishment, and are generally known by affected people 3: Laws are in place with substantial means for enforcement and punishment and well known by affected people 4: Laws are stipulated and recognized by national government, have extensive means to be enforced. | Policy |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|------------------|-----------------|----------|---------------|----------------|
| Safe Wildlife    | Have a secure, connected and healthy habitat | Linear infrastructure (fences, train lines, roads, etc.) are not exacerbating HWC. | 1: Wildlife are increasingly being killed or injured on or at linear infrastructure <br> 2: Wildlife deaths or injury at linear infra are steady <br> 3: Wildlife deaths or injury at linear infra are decreasing over time <br> 4: Wildlife deaths or injury at linear infra are minimal or zero. | Prevention |
| Safe Wildlife    | Have a secure, connected and healthy habitat | Movement corridors are present that allow wildlife to move safely between habitats | 1: Wildlife are increasingly being killed or injured in unprotected areas they are moving in <br> 2: Wildlife deaths or injury in unprotected areas are steady <br> 3: Wildlife deaths or injury in unprotected areas are decreasing over time <br> 4: Wildlife deaths or injury in unprotected areas are minimal or zero. | Prevention |
| Safe Wildlife    | Have a secure, connected and healthy habitat | Habitat is healthy and supports maintenance of wildlife populations. | 1: Wildlife are increasingly straying into human fields and settlement areas <br> 2: … straying is steady <br> 3: straying is decreasing over time <br> 4: straying is minimal or zero. | Prevention |
| Safe Wildlife    | Are no less secure as they exit the area or cross borders | Wildlife have similar level of protection and habitat as they move between the immediate area and outside. | 1: Wildlife are highly vulnerable and almost certain to come into conflict / be killed / hunted / poached if they leave the site. <br> 2: Some individuals will come into conflict / be killed/ hunted / poached if they leave the site. <br> 3: Few individuals will come into conflict / be killed / hunted / poached if they leave the site. <br> 4: No individuals are likely to come into conflict nor vulnerable to be killed if they leave the site. | Policy |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|-------------------|-----------------|----------|---------------|----------------|
| Safe Assets       | Are supported by government policy | Household incomes protected by government in the event of natural disaster, disease, or HWC through a compensation / relief / insurance scheme. | 1: No national policy or mechanism is in place to compensate for loss of assets 2: A national policy is in place but resources are lacking for its effective delivery 3: A national policy is in place and resources available, but delivery is: not comprehensive; inconsistent; or is delayed in many cases 4: A national policy is in place and resources available and delivery is effective and timely | Policy |
| Safe Assets       | Are wildlife-friendly | Livestock are guarded and herded during the day (6 am–6 pm) | 1: Number of livestock killed during the day has increased over time 2: … has remained steady over time 3: … has decreased over time 4: … is almost non-existent now | Prevention |
| Safe Assets       | Are wildlife-friendly | Are livestock fenced / enclosed / tethered at night? (6 pm–6 am) | 1: Number of livestock killed during the night is increasing 2: … has remained steady over time 3: … has decreased over time 4: … is almost non-existent now | Prevention |
| Safe Assets       | Are wildlife-friendly | Locally applicable grazing areas are complied with. | 1: No agreed grazing area exists 2: Number of livestock killed outside grazing areas has increased over time 3: Number of livestock killed outside grazing areas has decreased over time 4: Minimal or zero livestock are killed or injured outside grazing areas. Grazing areas are in place, have herding, and guarding at night. | Prevention |
| Safe Assets       | Are wildlife-friendly | Crops are consistently guarded. | 1: Crop loss has remained high or is increasing over time 2: … has remained steady over time 3: … has decreased over time 4: … is almost non-existent now | Prevention |
| Safe Assets       | Are wildlife-friendly | Do crops have barriers separating them from habitat? Consider the crops that are most exposed – i.e. those next to the natural habitat. | 1: 75–100% of crops raided do not have barriers 2: 50–75% 3: 25–50% 4: 0–25%. The majority of crops have effective barriers and are not being raided. | Prevention |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|-------------------|------------------|----------|---------------|----------------|
| Safe Assets       | Enhanced farming practices are supported | There is exploration of improved livestock breeds, management, and crops and techniques. | Livestock that are new, or managed in new ways: 1: Have been increasingly lost over time 2: … have been lost steadily over time 3: … have been lost decreasingly over time 4: … are minimally lost or not at all | Prevention |
| Safe Assets       | Enhanced farming practices are supported | There is exploration of using improved management, and crops and techniques. | Crops that are new, or managed in new ways: 1: Have been increasingly lost over time 2: … have been lost steadily over time 3: … have been lost decreasingly over time 4: … are minimally lost or not at all | Prevention |
| Safe Assets       | Invasive species are cleared or managed | A programme or management plan for weeds is in place. | 1: is ad hoc and rarely done; 2: is planned and sometimes done; 3: is planned and done seasonally; 4: is planned, done regularly and sometimes is a source of revenue for local people | Prevention |
| Safe Assets       | Invasive species are cleared or managed | A policy is in place to actively control invasive animal species. | 1: No agreed policy or mechanism is in place to allow for active management 2: An agreed policy or mechanism is in place but is never acted on 3: … is sometimes activated 4: … is activated based on local agreements or as per national policy | Policy |
| Safe Assets       | Invasive species are cleared or managed | Activities to actively control invasive wildlife species is in place. | 1: Invasive species are never actively controlled 2: A national policy is in place but is never acted on 3: A national policy is in place and is sometimes activated 4: A national policy is in place and is regularly activated | Prevention |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|-------------------|------------------|----------|---------------|-----------------|
| Safe Assets       | Structures are wildlife friendly | Physical structures, property and equipment are constructed, situated and managed to minimize damage from, and attractiveness to wildlife. | 1: Structures are increasingly damaged by wildlife; 2: Wildlife damage to structures is steady; 3: Wildlife damage to structures in decreasing; 4: Wildlife damage to structures is minimal or almost zero. | Prevention |
| Safe Habitat      | Is protected     | Laws are enacted to protect habitat. | 1: Laws are by personal agreement only with no means to be enforced; 2: Laws are in place and with minimal structure for enforcement and punishment, and are generally known by affected people; 3: Laws are in place with substantial means for enforcement and punishment and well known by affected people; 4: Laws are stipulated and recognized by national government, have extensive means to be enforced. | Policy |
| Safe Habitat      | Is protected     | Laws are enforced through recognized means. | 1: Patrolling is seldom done; 2: Patrolling is 0–4 days p/mth; 3: Patrolling is 5–14 days p/mth; 4: Patrolling is 15 days or more p/mth | Prevention |
| Safe Habitat      | Is protected     | Habitat protection is effective. | National park: 1: Habitat loss has increased over time 2: Habitat loss has remained stable 3: Habitat loss has decreased over time 4: Habitat loss is zero | Prevention |
| Safe Habitat      | Is protected     | Natural habitat is not being converted. | Natural forest and habitat: 1: Rate of conversion of remaining natural habitat has increased over time 2: Conversion rates are stable 3: Conversion rates have decreased over time, with patches of reforestation 4: Conversion is minimal or zero, with multiple areas of reforestation exist | Prevention |
| Strategic Outcome | Strategic Intent | Criteria | Effectiveness | Primary element |
|-------------------|------------------|----------|---------------|----------------|
| Safe Habitat      | Is represented in a Spatial Plan for the area | A spatial or land-use plan is operational for the area. | 1: No spatial plan exists.  
2: Exists, but only at village/community level, but has not been formalized by relevant government planners and decision makers;  
3: Is at right scale and is accepted by government and communities but not incorporated within planning or sector plans;  
4: is accepted and reflected in government and sector plans. | Prevention |
| Safe Habitat      | Is not shrinking or fragmenting | Habitat size is staying the same. | The area of natural habitat: | Prevention |
| Safe Habitat      | Is not shrinking or fragmenting | Forest connectivity is maintained. | The total number of natural forest patches: | Prevention |
| Safe Habitat      | Is not shrinking or fragmenting | Clearings and perforations are not emerging. | The total area of perforations in natural forest patches: | Prevention |
|Safe Habitat      | Is not shrinking or fragmenting | The forest edge is stable. | The total perimeter/edge of natural forest: | Prevention |
| Monitoring        | Hotspot mapping | Hotspots are mapped. | 1: mapped only once;  
2: mapped and updated every 5–10 years;  
3: mapped and updated every 1–2 years and fed into management;  
4: mapped and updated every year and fed into management decisions and actions | M & E |
| Strategic Outcome | Strategic Intent | Criteria                                                                 | Effectiveness                                                                                       | Primary element |
|-------------------|------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------|
| Monitoring        | Impact and severity monitoring | There is a clear understanding of the human and financial cost of conflict locally. | 1: surveyed only once; 2: surveyed every 5–10 years; 3: surveyed every 1–2 years; 4: surveyed and collated every year and fed into management. | M & E           |
| Monitoring        | Community attitude tracking | Community attitudes and tolerance to wildlife are known. | Surveys conducted: 1: once; 2: every 5–10 years; 3: every 1–2 years; 4: ongoing and fed into management | M & E           |
| Monitoring        | Performance measurement | Managers and decision makers know if their programmes are achieving desired goals. | 1: 0–25% decisions are based on M&E; 2: 25–50% made based on M&E; 3: 50–75%; 4: 75–100%. | M & E           |

### Annex 3.3: Criteria scores

#### Safe Person
- Laws are enacted to protect wildlife. 4
- Laws enforced by any officially recognized entity. 2
- People are complying with the law. 3
- Judicial processes are fair. 4
- Crops are consistently guarded. 2
- Funds are available for local people to develop their own solutions in prevention. 3
- Farmers and communities have the right to modify the land for prevention. 4
- There are channels / mechanisms to exchange and expand successful preventative measures locally to be demonstrated & are supported to be expanded locally and/or applied elsewhere. 2
- Managers and employers of plantations have committed to safe working practices. 2
- People avoid high-risk areas and high-risk times in their daily lives to minimize HWC events and exposure to contact. 3
- Income diversification activities are underway across communities. 3
- Alternative livelihood programmes are in place. 2
- Projects or programmes are underway to help local communities access markets, or do training, or access jobs. 2
- All human injuries and death events reported. 2
- All livestock loss events reported. 2
| Safe Assets                                                                                                                                                                                                 | Score |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Crops are consistently guarded.                                                                                                                                                                           | 2     |
| Livestock are guarded and herded during the day (6 am–6 pm)                                                                                                                                               | 3     |
| Are livestock fenced / enclosed / tethered at night? (6 pm–6 am)                                                                                                                                        | 3     |
| Locally applicable grazing areas are complied with.                                                                                                                                                     | 3     |
| Household incomes protected by government in the event of natural disaster, disease, or HWC through a compensation / relief / insurance scheme.                                                               | 3     |
| There is exploration of improved livestock breeds, management, and crops and techniques.                                                                                                                  | 2     |
| There is exploration of using improved management, and crops and techniques.                                                                                                                              | 2     |
| A programme or management plan for weeds is in place.                                                                                                                                                  | 2     |
| A policy is in place to actively control invasive animal species.                                                                                                                                       | 1     |
| Activities to actively control invasive wildlife species is in place.                                                                                                                                    | 2     |
| Physical structures, property and equipment are constructed, situated and managed to minimize damage from, and attractiveness to wildlife.                                                             | 1     |
| Crops have barriers separating them from habitat.                                                                                                                                                       | 1     |

| Safe Wildlife                                                                                                                                                                                              | Score |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Laws are enacted to protect wildlife.                                                                                                                                                                      | 4     |
| Laws enforced by any officially recognized entity.                                                                                                                                                         | 2     |
| People are complying with the law.                                                                                                                                                                         | 3     |
| Judicial processes are fair.                                                                                                                                                                              | 4     |
Response Teams are in place, equipped, trained and functioning.  
Locally applicable barriers, fencing, early warning systems and zoning are in place and functioning.  
Wildlife are perceived positively locally and support for their protection is linked to livelihoods or community development.  
Wildlife are not being killed in retaliation for, or to prevent conflict events.  
Wildlife habitat is protected under law or local agreement.  
Linear infrastructure (fences, train lines, roads, etc.) are not exacerbating HWC.  
Movement corridors are present that allow wildlife to move safely between habitats.  
Habitat is healthy and supports maintenance of wildlife populations.  
Wildlife have similar level of protection and habitat as they move between the immediate area and outside.

**Safe Habitat**

- Laws are enacted to protect habitat.  
- Laws are enforced through recognized means.  
- Habitat protection is effective.  
- Natural habitat is not being converted.  
- Habitat size is staying the same.  
- Forest connectivity is maintained.  
- Clearings and perforations are not emerging.  
- A spatial or land use plan is operational for the area.  
- The forest edge distance is stable.

**Monitoring**

- Hotspots are mapped.  
- There is a clear understanding of the human and financial cost of conflict locally.  
- Community attitudes and tolerance to wildlife are known.  
- Managers and decision makers know if their programmes are achieving desired goals.

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**Annex 3.4: Criteria within each element scoring only 1 or 2**

**Prevention**

- Laws enforced by any officially recognized entity.  
- Crops are consistently guarded.  
- There are channels / mechanisms to exchange and expand successful preventative measures locally to be demonstrated & are supported to be expanded locally and/or applied elsewhere.  
- Locally applicable barriers, fencing, early warning systems and zoning are in place and functioning.  
- Communities participate in patrolling, policing and monitoring of community forest areas.  
- There is exploration of improved livestock breeds, management, and crops and techniques.  
- There is exploration of using improved management, and crops and techniques.  
- A programme or management plan for weeds is in place.
Activities to actively control invasive wildlife species is in place. 2
Physical structures, property and equipment are constructed, situated and managed to minimize damage from, and attractiveness to wildlife. 1
Habitat protection is effective. 1
Natural habitat is not being converted. 1
People do not venture into, forage, or conduct livelihoods activities inside the PA. 2
Crops have barriers separating them from habitat. 1
Crops given extra protection during peak HWC times. 2
Communities have the skills to put in place preventative measures. 1

Mitigation

Alternative livelihood programmes are in place. 2
Projects or programmes are underway to help local communities access markets, or do training, or access jobs. 2
A locally applicable insurance / relief / compensation programme for HWC is operational. 1

Response

All human injuries and death events reported. 2
All livestock loss events reported. 2
All crop loss events reported. 2
All structural damage and loss events reported. 2
All retaliatory killing events reported. 2

Policy

A policy is in place to actively control invasive animal species. 1

M & E

Hotspots are mapped. 1
There is a clear understanding of the human and financial cost of conflict locally. 1
Community attitudes and tolerance to wildlife are known. 1

UtC

Information system is in place, is linked to Effective Monitoring, and regular public reports are made available. 1

A system is in place to understand and reduce local sentiments around conflict. 2

References

1. Ehrlich PR, Holdren JP (1971) Impact of Population Growth. Science 171(3977):1212–1217. https://doi.org/10.1126/science.171.3977.1212. Bibcode:1971Sci...171.1212E. JSTOR 1731166. PMID 5545198
2. WWF-Bhutan (2016) Human Wildlife Conflict SAFE Strategy, WWF-Bhutan
3. SARPO, WWF (2005) Human wildlife conflict manual. WWF-Southern African Regional Programme Office (SARPO), Harare, Zimbabwe
4. Pettigrew M, Xie Y, Kang AL, Rao M, Goodrich J, Liu T, Berger J (2012) Human-carnivore conflict in China: a review of current approaches with recommendations for improved management. Integ Zool 7(2):210–226. https://doi.org/10.1111/j.1749-4877.2012.00303.x. [PubMed] [CrossRef] [Google Scholar]
5. Jones DN, Nealson T (2003) Management of aggressive Australian magpies by translocation. Wild Res 30:167–177. https://doi.org/10.1071/WR011102. NASA, 2014, https://modis.gsfc.nasa.gov/data/dataprod/mod17.php

6. NASA (2014) https://modis.gsfc.nasa.gov/data/dataprod/mod17.php

7. Bagchi S, Mishra C (2006) Living with large carnivores: predation on livestock by the snow leopard (Uncia uncia). J Zool 268(3):217–224. https://doi.org/10.1111/j.1469-7998.2005.00030.x. [CrossRef] [Google Scholar]

8. Bhattrari BR (2009) Human-Tiger (Panthera Tigris Tigris) Conflict in Bardia National Park, Nepal. A thesis for partial fulfilment of Master of Science.

9. Maclean SD, Groom RJ, Macdonald DW, Frank LG (2009) Evaluation of a compensation scheme to bring about pastoralist tolerance of lions. Biol Conserv 142(11):2419–2427. https://doi.org/10.1016/j.biocon.2008.12.003. [CrossRef] [Google Scholar]

10. Chen S, Yi ZF, Campos-Arceiz A, Chen MY, Webb EL (2013) Developing a spatially-explicit, sustainable and risk-based insurance scheme to mitigate human-wildlife conflict. Biol Conserv 168:31–39. https://doi.org/10.1016/j.biocon.2013.09.017. [CrossRef] [Google Scholar]

11. Sangay T, Vernes K (2014) The economic cost of wild mammalian carnivores to farmers in the Himalayan Kingdom of Bhutan. Proceedings of the Bhutan Ecological Society 1:98–111

12. Dickman AJ, Macdonald EA, Macdonald DW (2011) A review of financial instruments to pay for predator conservation and encourage human-carnivore coexistence. Proceedings of the National Academy of Sciences of the United States of America 108(34):13937–13944. https://doi.org/10.1073/pnas.1012972108. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

13. Wang SW, Macdonald DW (2006) Livestock predation by carnivores in Jigme Singye Wangchuck National Park, Bhutan. Biological Conservation 129:558–565

14. Treves A, Karanth KU (2003) Human–carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology 17:1491–1499. CrossRef google Scholar

15. Athreya V, Odden M, Linnell JDC, Krishnaswamy J, Karanth U (2013) Big cats in our backyards: persistence of large carnivores in a human dominated landscape in India. PLoS ONE 8(3)

16. Sahagun L (2019) See State steps in for rat species as U.S. weakens protections, by Los Angeles Times, August 31, 2019, https://www.pressreader.com/

17. Treves A (2007) Balancing the needs of people & wildlife: when wildlife damage crops and prey on livestock, In Tenure, No 7; 2007: University of Wisconsin-Madison

18. Amaja LG, Feyssa DH, Gutema TM (2016, May) Assessment of types of damage and causes of human-wildlife conflict in Gera district, South Western Ethiopia. Journal of Ecology and the Natural Environment 8(5):49–54. https://doi.org/10.5897/JENE2015.0543

19. Paini DR, Sheppard AW, Cook DC, DeBarro PJ, Worner SP, Thomas MB (2016, July 5) Global threat to agriculture from invasive species. Proceedings of the National Academy of Sciences of the Unites States of America, PNAS 113(27):7575–7579. https://doi.org/10.1073/pnas.1602205113. First published June 20, 2016, https://www.pnas.org/content/113/27/7575, Accessed 31 Aug 2019

20. Johnson K (November 28, 2017) These montana ranchers are helping grizzlies, wolves and cattle coexist. Ensia: Https://Ensia.Com/Features/Predators/

21. Muruthi P (2005) Human wildlife conflict: lessons from AWF’s African heartlands: the AWF working paper series, www.awf.org

22. World Bank (IBRD –IDA) (2016) A feature story: 5 things you may not know about Human – wildlife conflict in Botswana; https://www.worldbank.org/en/news/feature/2016/03/03/5-things-you-may-not-have-known-about-human-wildlife-conflict-in-botswana

23. Manfredo MJ, Zinn HC, Sikorowski L, Jones J (1998) Public acceptance of mountain lion management: a case study of Denver, Colorado, and nearby foothill areas. Wildlife Society Bulletin 26:964–970. Google Scholar

24. Woodroffe R (2000) Predators and people: using human densities to interpret declines of large carnivores. Animal Conservation 3:165–173
References

25. Breitenmoser U (1998) Large predators in the Alps: the fall and rise of man’s competitors. Biological Conservation 83:279–289. CrossRef | Google Scholar
26. Isenberg AC (2000) The destruction of the Bison – an environmental history (1750–1920), Princeton University; Cambridge Press
27. Naughton-Treves (1999) Whose animals? A history of property rights to wildlife in Toro, western Uganda; https://doi.org/10.1002/(SICI)1099-145X(199907/08)10:4<311::AID-LDR362>3.0.CO;2-3
28. Naughton-Treves L, Mena JL, Treves A, Alvarez N, Radeloff VC (2003) Wildlife survival beyond park boundaries: the impact of swidden agriculture and hunting on mammals in Tambopata, Peru. Conservation Biology 17:1106–1117. CrossRef | Google Scholar
29. Reynolds JC, Tapper SC (1996) Control of mammalian predators in game management and conservation. Mammal Review 26:127–156. CrossRef | Google Scholar
30. Humane Society (2018) See also, https://www.researchgate.net/publication/32562767_ Patterns_of_humwildlife_conflict_and_compensation_practices_around_Daxueshan_Nature_ Reserve_China. Accessed 29 Aug 2019.
31. Jorgensen CJ, Conley RH, Hamilton RJ, Sanders OT (1978) Management of black bear depredation problems. Proceedings of the Eastern Workshop on Black Bear Management and Research 4:297–321. Google Scholar
32. Bale R (February 12, 2016) This Government program’s job is to kill wildlife. National Geographic, https://www.nationalgeographic.com/news/2016/02/160212-Wildlife-Services-predator-control-livestock-trapping-hunting/
33. Schwartz M (February 25, 2016) Culling to conserve: a hard truth for lion conservation. National Geographic, https://blog.nationalgeographic.org/2016/02/25/culling-to-conservehard-truth-for-lion-conservationmightbeavailable
34. Nemtzov SC (2003) A short-lived wolf depredation compensation program in Israel. Carnivore Damage Prevention News 6:16–17. Google Scholar
35. Naughton-Treves L, Grossberg R, Treves A (2003b) Paying for tolerance: the impact of depredation and compensation payments on rural citizens’ attitudes toward wolves. Conservation Biology 17:1500–1511. CrossRef | Google Scholar
36. Kaushik H (2017) Lion population roars to 650 in Gujarat forests. The Times of India
37. Karanth KU (2002) Nagarahole: limits and opportunities in wildlife conservation. In: Terborgh J, Schaich C, Davenport LC, Rao M (eds) Making parks work: identifying key factors to implementing parks in the tropics. Island Press, Covelo, CA, pp 189–202. Google Scholar
38. Karanth KU, Madhusudan MD (2002) Mitigating human–wildlife conflicts in Southern Asia. In: Terborgh J, Schaich C, Davenport LC, Rao M (eds) Making parks work: identifying key factors to implementing parks in the tropics. Island Press, Covelo, CA, pp 250–264. Google Scholar
39. Jackson P, Nowell K (1996) Problems and possible solutions in management of felid predators. Journal of Wildlife Research:304–314. Google Scholar
40. Palomares F, Gaona P, Ferreras P, Delibes M (1995, April) Positive effects on game species of top predators by controlling small predator populations. Conservative Biology 9(2):2015–2305
41. Bekoff M (ed) (2001) Coyotes: biology, behavior and management. Blackburn Press
42. Cote IM, Sutherland WJ (1997) The effectiveness of removing predators to protect bird populations. Conservation Biology 11:395–405. CrossRef | Google Scholar
43. Evans W (1983) The cougar in New Mexico: biology, status, depredation of livestock and management recommendations. New Mexico Department of Game and Fish, Santa Fe, NM. Google Scholar
44. Conner MM, Jaeger MM, Weller TJ, DR MC (1998) Effect of coyote removal on sheep depredation in northern California. Journal of Wildlife Management 62:690–699. CrossRef | Google Scholar
45. Bjorge RR, Gunson JR (1985) Evaluation of wolf control to reduce cattle predation in Alberta. Journal of Range Management 38:483–486. CrossRef | Google Scholar
3 Non-Violent Techniques for Human-Wildlife Conflict Resolution

46. Treves A, Naughton-Treves L (2005) Evaluating lethal control in the management of human–wildlife conflict. In: Woodroffe R, Thirgood S, Rabinowitz A (eds) People and wildlife: conflict or coexistence? Published by Cambridge University Press. The Zoological Society of London, pp 89–103

47. Osborn FV, Parker GE (2003) Towards an integrated approach for reducing the conflict between elephants and people: a review of current research. Oryx 37:80–84. CrossRef | Google Scholar

48. Morell V (2014, December 3) Killing wolves to save livestock may backfire, AAS; Science; https://www.sciencemag.org/news/2014/12/killing-wolves-save-livestock-may-backfire

49. Niki Rust (2014) Wolf cull backfires as wild canines feast on farm animals, PhD studies in Carnivore Conservation University of Kent; December 4, 2014 6:40am AEDT. http://theconversation.com/wolf-cull-backfires-as-wild-canines-feast-on-farm-animals-34997

50. Bennett EL, Robinson JG (2000) Hunting for sustainability: the start of a synthesis. In: Robinson JG, Bennett EL (eds) Hunting for sustainability in tropical forests. Columbia University Press, New York., pp 409–499. Google Scholar

51. Bhattarai B, Fischer K (2014) Human–tiger Panthera Tigris conflict and its perception in Bardia National Park, Nepal. Oryx 48(4):522–528. https://doi.org/10.1017/S0030605313000483

52. Brooks A (2014) Human tiger conflict discussion paper, WWF Tigers Alive Initiative, WWF International.

53. RGOB (2008) Constitution of Bhutan, Royal Government of Bhutan

54. MOAF (2011) National forest policy, Department of Forest and Park Services, Ministry of Agriculture and Forest.

55. RGOB (1995) Forest and nature conservation act of Bhutan, MOA, RGOB

56. MOAF (2017) Forest and nature conservation rules and regulations, Ministry of Agriculture and Forest, Bhutan

57. RGOB (2007) National environmental protection act 2007. National Environment Commission, Bhutan

58. RGOB (2000) Environmental assessment act, 2000. National Environment Commission, Bhutan

59. RGOB (2002) Regulation for the environmental clearance of projects and regulation on strategic environment assessment. National Environment Commission, Bhutan

60. WWF-Bhutan (2018) National Zero-poaching Strategy (2017–2022) to halt illegal trade related with wildlife species through strict enforcement and prosecution of the offenders

61. Tshewang U, Morrison J, Tobias M (2018) Bionomics in the Dragon Kingdom. Springer, Geneva, Switzerland

62. Goodrich JM (2010) Human-tiger conflict: a review and call for comprehensive plans. Integrative Zoology 5(4):300–312. https://doi.org/10.1111/j.1749-4877.2010.00218.x. [PubMed] [CrossRef] [Google Scholar]

63. Gary GG (1993) Wildlife and people: the human dimension of wildlife ecology. University of Illinois Press, Urbana

64. Musyoki C (2014) Crop defense and coping strategies: wildlife raids in Nyeri district. Kenya African Study Monographs 35(1):19–40

65. Mishra C, Allen P, Mccarthy T, Madhusudan MD, Bayarjargal A, Prins HHT (2003) The role of incentive programs in conserving the snow leopard. Conserv Biol 17(6):1512–1520. https://doi.org/10.1046/j.1523-1739.2003.00092.x. [CrossRef] [Google Scholar]

66. Guo XM, He QC, Wang LX, Yang ZB, Li ZY, Zhu ZY (2012) Effects of Asian elephant food source base on the mitigation of human-elephant conflict in Xishuangbanna of Yunnan Province, Southwest China. Chinese Journal of Ecology 31(12):3133–3137. (in Chinese) [Google Scholar]

67. Hedges S, Gunaryadi D (2010) Reducing human-elephant conflict: Do chillies help deter elephants from entering crop fields. Oryx 44:139–146

68. Lichtenfeld L, Trout C, Kisimir E (2014) Evidence-based conservation: predator-proof bomas protect livestock and lions. Biodivers Conserv 24:483–493
References

69. WWF-Botswana (2012, October 2) Using chilies to protect maize fields and elephants; https://www.worldwildlife.org/stories/using-chilies-to-protect-maize-fields-and-elephants
70. Hamilton I, Vollrath F (2011) Bee hive fences as effective deterrents for crop-raiding elephants: field trials in northern Kenya. Afr J Ecol 49:431–439
71. Elfstrom M, Zedrosser A, Steen O-G, Swenson JE (2014) Ultimate and proximate mechanisms underlying the occurrence of bears close to human settlements: review and management implications. Mamm Rev 44:5–18
72. Marker LL, Dickman AJ, Macdonald DW (2005) Perceived effectiveness of livestock-guarding dogs placed on Namibian farms. Rangeland Ecol Manag 58:329–336
73. Shivik JA (2006) Tools for the edge: what’s new for conserving carnivores. BioScience 56:253–259
74. Landry J-M (1999) The use of guard dogs in the Swiss Alps: a first analysis I; KORA report No. 2 english, ISSN 1422-5123
75. Ezealor AU, Giles RH (1997) Vertebrate pests of a Sahelian wetland agro-ecosystem: Perceptions and attitudes of the indigenous and potential management strategies. International Journal of Pest Management 43(2):97–104
76. Knight J (2004) Wildlife in Asia: cultural perspectives. In: Knight J (ed) Wildlife in Asia: cultural perspectives. Routledge-curzon, Taylor & Francis Group, London/New York, pp 1–12
77. Leo FK (1994) Humanisation of wildlife management: a case study of Ol Donyo Sabuk National Park, Kenya. Phd, Clark University
78. Bakels J (2004) Farming the forest edge: perceptions of wildlife among the Kerinci of Sumatra. In: Knight J (ed) Wildlife in Asia: cultural perspectives. Routledge- Curzon, Taylor & Francis Group, London/New York, pp 147–164
79. FAO, UN Food and Agricultural Organization, Indigenous peoples are key to protecting wildlife and rural livelihoods, http://www.fao.org/news/story/en/item/472575/iCode/
80. Pettigrew M, Xie Y, Kang AL, Rao M, Goodrich J, Liu T, Berger J (2012) Human-carnivore conflict in China: a review of current approaches with recommendations for improved management. Integrative Zoology 7(2):210–226. https://doi.org/10.1111/j.1749-4877.2012.00303.x. [PubMed] [CrossRef] [Google Scholar]
81. Kirkpatrick JF, Rowanb A, Lamberskic N, Wallaced R, Franka K, Lydaa R (2009) The practical side of immunocontraception: zona proteins and wildlife. Journal of Reproductive Immunology 83(2009):151–157
82. Tshehwang U, DowsettKF, Knott L, Jackson A (1999) Effect of GnRH immunization on testicular function in colts effect. Asian-Australasian Journal of Animal Sciences 12(3):348–353
83. Hobbs RJ, Hinds LA (2018) Could current fertility control methods be effective for landscape-scale management of populations of wild horses (Equus caballus) in Australia? Wildlife Research 45:195–207. Review https://doi.org/10.1071/WR17136
84. Delsink A, Kirkpatrick JF (2015) Free-ranging African elephant immunocontraception: a new paradigm for elephant management. Research Gate Publications; University of KwaZulu-Natal; Durban, KwaZulu-Natal, South Africa https://www.researchgate.net/institution/University_of_KwaZulu-Natal
85. Emmons M (2017) Auburn University, College of Veterinary Medicine; Researchers developing immunocontraception for wild pig population control; January 26, 2017, https://www.vetmed.auburn.edu/blog/cvm-news/researchers-developing-immunocontraception-wild-pig-population-control/
86. Tshewang U (1994) PhD Thesis; Immunocontraception and immunospeying in horses; Life Sciences; Department of Farm Animal Medicine and Production; The University of Queensland Brisbane, 4027; Australia 1994
87. Garrott RA (1995) Effective management of free-ranging ungulate populations using contraception. Wildlife Society Bulletin 23:445–452
88. Tobias M, Morrison J (2011) God’s country: the New Zealand factor, a dancing star foundation book, Los Angeles, CA, 2011.
3 Non-Violent Techniques for Human-Wildlife Conflict Resolution

89. Hindustan Times (Nov 16, 2018 23:24 IST); Himachal Pradesh Forest Department, India: Monkey sterilization program https://www.hindustantimes.com/india-news/centre-plans-immuno-contraception-for-monkeys-as-attacks-on-humans-rise/story-6p13DT8ogOX4pnhY47dDMI.html, reported by JEN MONNIER: https://hpforest.nic.in/pages/display/NjU0c2RhiHFzZGZhNQ==-monkey-sterilization-programmehttps://action.ifaw.org/page/34766/action/1?ms=UONDV200001100&cid=7012A000018Vx8&gclid=EAIaIQobChMI88fJv_iv5AIVBdbACh0q-AuZEAAYASAAEgLFFqy_D_BwE

90. O’Rand MG, Widgren EE, Sivashanmugam P, Richardson RT, Hall SH,French FS, VandeVoort CA, Ramachandra SG, Ramesh V, Jagannadha Rao A (2004) Reversible immunocontraception in male monkeys immunized with EPPIN. Science 306. https://doi.org/10.1126/science.1099743. Source: PubMed (Include in text)

91. Miller LA, Johns BE, Killian GJ (2000, November) Immunocontraception of white-tailed deer with GnRH vaccine. American Journal of Reproductive Immunology 44(5):266–274

92. Siers SR, Pyszyna BR, Mayer L, Dyer C, Leinbach IL, Sugihara HT, Witmer GW (2017). Laboratory evaluation of the effectiveness of the fertility control bait contraPest® on wild-captured black rats (Rattus rattus). QA-2570 Final Report; USDA APHIS Wildlife Services National Wildlife Research Center

93. Bynum K, Eisemann JD, Weaver GC, Miller LA, Yoder CA, Fagerstone KA (2007) Nicarbazin OvoControl G Bait reduces hatchability of eggs laid by resident Canada Geese in Oregon. Journal of Wildlife Management 71(1):135–143. https://doi.org/10.2193/2005-603

94. Craven S, Barnes T, Kania G (1998) Toward a professional position on the translocation of problem wildlife. Wildlife Society Bulletin 26:171–177

95. Gammons DJ, Mengak MT, Conner LM (2009) Translocation of nine-banded armadillo. Human-Wildlife Interactions 3(1):14–21

96. Letty J, Aubineau J, Marchandeu S, Clobert J (2003) Effect of translocation on survival in wild rabbit (Oryctolagus cuniculus). Mammalian Biology - Zeitschrift fur Saugetierkunde 68(4):250–255. https://doi.org/10.1087/1616-5074-00092

97. Meilhan P, Silverman H (August 27, 2019) The mountain lion that attacked a boy in Colorado has been euthanized. CNN

98. Distefano E (2005) Human-wildlife conflict worldwide: collection of case studies, analysis of management strategies and good practices. Food and Agricultural Organization of the United Nations (FAO), Sustainable Agriculture and Rural Development Initiative (SARDI); Rome, Italy. [Google Scholar]

99. MOA (2008) National human wildlife conflict management strategy, MOA, RGOB

100. Cheng H, Li X-Y, Shi L-J, Jiang X-L. (2018) Patterns of human-wildlife conflict and compensation practices around Daxueshan Nature Reserve, China. Zoological Research 39(6):406–412

101. Broekhuis F, Cushman SA, Elliot NB (2017, December) Identification of human–carnivore conflict hotspots to prioritize mitigation efforts. Ecol Evol 7(24):10630–10639. https://doi.org/10.1002/ece3.3565

102. National Geographic Channel (2001) Whale-shark hunters of the Philippines

103. Mishra C, Allen P, Mccarthy T, Madhusudan MD, Bayarjargal A, Prins HHT (2003) The role of incentive programs in conserving the snow leopard. Conservation Biology 17(6):1512–1520. https://doi.org/10.1111/j.1523-1739.2003.00092.x. [CrossRef] [Google Scholar]

104. Nyhus PJ, Ososfky SA, Ferraro P, Fischer H, Madden F (2005) Bearing the costs of human-wildlife conflict: the challenges of compensation schemes. See Ref. 2:107–121

105. Li XY, Buzzard P, Chen YC, Jiang XL (2013) Patterns of livestock predation by carnivores: human-wildlife conflict in northwest Yunnan, China. Environmental Management 52(6):1334–1340. https://doi.org/10.1007/s00267-013-0192-8. [PubMed] [CrossRef] [Google Scholar]

106. Zabel A, Holm-Muller K (2008) Conservation performance payments for carnivore conservation in Sweden. Conserv Biol 22:247–251
References

107. Karanth KK, Naughton-Treves L, DeFries R, Gopalaswamy AM (2013b) Living with wildlife and mitigating conflicts around three Indian protected areas. Environmental Management 52:1320–1332

108. Chen S, Yi ZF, Campos-Arceiz A, Chen MY, Webb EL (2013) Developing a spatially-explicit, sustainable and risk-based insurance scheme to mitigate human-wildlife conflict. Biological Conservation 168:31–39. https://doi.org/10.1016/j.biocon.2013.09.017. [CrossRef] [Google Scholar]

109. Chen Y, Marino J, Chen Y, Tao Q, Sullivan CD, Shi K, Macdonald DW (2016b) Predicting hotspots of human-elephant conflict to inform mitigation strategies in Xishuangbanna, Southwest China. PLoS One 11(9):e0162035. https://doi.org/10.1371/journal.pone.0162035. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

110. Barua M, Bhagwat SA, Jadhav S (2013) The hidden dimensions of human–wildlife conflict: health impacts, opportunity and transaction costs. Biological Conservation 157:309–316

111. Steele JR, Rashford BS, Foulke TK, Tanaka JA, Taylor DT (2013) Wolf (Canis lupus) predation impacts on livestock production: direct effects, indirect effects, and implications for compensation ratios. Rangeland Ecol Manag 66:539–544

112. Linnell JDC, Odden J, Mertens A (2012) Mitigation methods for conflict associated with carnivore depredation on livestock. In: Carnivore ecology and conservation: a handbook of techniques

113. Chen S, Yi ZF, Campos-Arceiz A, Chen MY, Webb EL (2013) Developing a spatially-explicit, sustainable and risk-based insurance scheme to mitigate human-wildlife conflict. Biological Conservation 168:31–39. https://doi.org/10.1016/j.biocon.2013.09.017. [CrossRef] [Google Scholar] See also, https://www.willis.com/Documents/Publications/Services/Environmental/5328_Environmental_Insurance_Product_Fact_Sheet.pdf

114. Harihar A (2014) Understanding local perceptions to tigers as relates to conflict. WWF Human Tiger Conflict Workshop, 28th–31st October 2014. Sauraha, Chitwan National Park, HTC

115. Zabel A, Roe B (2009) Optimal design of pro-conservation incentives. Ecol Econ 69:126–134

116. MoEA (2008) Bhutan sustainable hydropower development policy. Ministry of Economic Affairs, Royal Government of Bhutan

117. RGOB (2011) Water act of Bhutan, NECS, RGOB

118. GNHCS (2017) An approach to integrating ecosystem services into development planning, Tashichodzong, Thimphu, August 2017

119. Sears RR, Choden K, Dorji T, Dukpa D, Phuntsho S, Rai PB, Wangchuk J, Baral H (2018) Bhutan’s forests through the framework of ecosystem services: rapid assessment in three forest types. Forests 9:675. https://doi.org/10.3390/f9110675. www.mdpi.com/journal/forests

120. Namibian Association of Community Based Natural Resource Management (2008) Namibia’s communal conservancies: a review of progress in 2007 (NACS0, Windhoek, Namibia).Google Scholar

121. Archabald K, Naughton-Treves L (2001) Tourism revenue-sharing around National Parks in western Uganda: Early efforts to identify and reward local communities. Environ Conserv 28:135–149. CrossRefGoogle Scholar

122. Ecotourism (2017) https://ebscosustainability.files.wordpress.com › 2010/07 › ecotourism

123. Dr Tobias and Ms. Morrison, personal communication on community education around the world. See their book, Sanctuary: Global Oases of innocence, with a foreword by her Majesty the Queen, Ashi Dorji Wangmo Wangchuck, A dancing star foundation book, Los Angeles, CA 2008

124. Karanth KK, Gopalaswamy AM, Prasad PK, Dasgupta S (2013a) Patterns of human–wildlife conflicts and compensation: insights from Western Ghats protected areas. Biological Conservation 166:175–185. https://doi.org/10.1016/j.biocon.2013.06.027. [CrossRef] [Google Scholar]
125. Miller JRB (2015, August) Mapping attack hotspots to mitigate human–carnivore conflict: approaches and applications of spatial predation risk modeling. Biodiversity and Conservation 24(12). https://doi.org/10.1007/s10531-015-0993-6

126. Barlow A, Greenwood C, Ahmad IU, Smith JLD (2010) Use of an action-selection framework for Human-Carnivore conflict in the Bangladesh Sundarbans. Conservation Biology 24(5):1338–1347

127. Inskip C, Ridout M, Fahad Z, Tully R, Barlow A, Barlow CG, Islam MA, Roberts T, MacMillan D (2013) Human– tiger conflict in context: risks to lives and livelihoods in the Bangladesh Sundarbans. Human Ecology 41(2):169–186

128. Karanth KK, Gopalaswamy AM, DeFries R, Ballal N (2012) Assessing patterns of human-wildlife conflicts and compensation around a Central Indian protected area. PLoS ONE 7(12). https://doi.org/10.1371/journal.pone.0050433

129. Nugraha RT, Sugardjito J (2009) Assessment and management options of human-tiger conflicts in Kerinci Seblat National Park, Sumatra, Indonesia. Mammal Study 34:141–154

130. WWF-TAI et al (2014) Human wildlife conflict

131. MOAF (2017) Bhutan RNR statistics, renewable natural resources statistics division-Directorate Services, Ministry of Agriculture & Forest, Royal Government of Bhutan

132. DOFPS (2016) Deforestation report, DOFPS, MOAF, RGOB

133. Maetz M, Dukpa D and Dorji Y (2012) Private investment in agriculture in Bhutan, MOAF, RGOB.

134. DOA (2014) Agriculture statistics, 2014, Department of Agriculture, Ministry of Agriculture and Forests, RGOB, Thimphu Bhutan

135. State of the Nation Report (2017) Second Parliament of the RGOB, Thimphu

136. Dawa Gyelmo (2016) Wangdue; Human-wildlife conflict leads to abandonment of Amochu village, October 24, 2016 News Leave a comment 2,347 Views

137. Dechen Tshomo (2018) Human-wildlife conflict irks farmers in Punakha: October 23, 2018 News Leave a comment 585 Views http://www.kuenselonline.com/human-wildlife-conflict-irks-farmers-in-punakha/

138. Tshering Palden (2016) Human-wildlife conflict resolution critical to LG elections September 18, 2016 News Leave a comment 1,885 Viewshttp://www.kuenselonline.com/human-wildlife-conflict-resolution-critical-to-lg-elections/

139. Nima Wangdi (2016) Human-wildlife conflict rampant in Chumey July 5, 2016 News Leave a comment 1,915 Views http://www.kuenselonline.com/human-wildlife-conflict-rampant-in-chumey/

140. Tshering Wangdi, Trashigang Human wildlife conflict worsens in Khatpoe:http://www.kuenselonline.com/human-wildlife-conflict-worsens-in-khatpoe/ December 21, 2015 News Leave a comment 1,225 Views

141. Rajesh Rai (2016) Sipsu; Human-wildlife conflict takes a toll http://www.kuenselonline.com/human-wildlife-conflict-takes-a-toll/ June 16, 2016 News Leave a comment 2,550 Views

142. JWS (2019) Human wildlife conflict report, Jomotshangkha Wild Life Sanctuary, DOFPS, MOAF.

143. Sangay T, Vernes K (2008) Human–wildlife conflict in the Kingdom of Bhutan: patterns of livestock predation by large mammalian carnivores. Biological Conservation (5):141, 1272–1282. https://doi.org/10.1016/j.biocon.2008.02.027

144. Tshering Palden, Review human-wildlife conflict strategy, say foresters http://www.kuenselonline.com/review-human-wildlife-conflict-strategy-say-foresters/ October 27, 2015 Lead Story, News Leave a comment 2,028 Views

145. Jamtsho Y, Katel O (2019) Livestock depredation by snow leopard and Tibetan wolf: implications for herders’ livelihoods in Wangchuck Centennial National Park, Bhutan. Pastoralism: Research, Policy and Practice 9:1. https://doi.org/10.1186/s13570-018-0136-2

146. Rostro-García S, Kamler JF, Ash E, Clements GR, Gibson L, Lynam AJ, McEwing R, Naing H, Paglia S (2016) Endangered leopards: range collapse of the Indochinese leopard (Panthera pardus delacouri) in Southeast Asia. Biological Conservation 201:293–300
References

147. MOAF (2018) Statistics on electric fencing as of February 2018 Posted on June 1, 2018, http://www.moaf.gov.bt/statistics-on-electric-fencing-as-of-february-2018/#more-9350; Personal communication with Mr Ganesh Chettri, Sr. specialist, DOA

148. Nirmala Pokhrel (2017, August 11) Elephants damage crops and properties in Sarpang; https://kuenselonline.com/elephants-damage-crops-and-properties-in-sarpang/

149. DOFPS (2018) Human-elephant conflict report, DFO – Sarpang, DOFPS, MOAF, RGOB

150. Virtual Fencing, https://onpasture.com/2018/02/26/virtual-fence-keep-livestock-in-pasture-without-installing-posts-or-wires/

151. Rajesh Rai, Sipsu; Human-wildlife conflict takes a toll http://www.kuenselonline.com/human-wildlife-conflict-takes-a-toll/; June 16, 2016 News Leave a comment 2,550 Views

152. MOAF (2014) Institutionalization of human-wildlife conflict management endowment fund; http://www.moaf.gov.bt/institutionalisation-of-human-wildlife-conflict-management-endowment-fund/

153. Tshering Palden (2019, May) HWC endowment fund targets USD 35M; https://kuenselonline.com/hwc-endowment-fund-targets-usd-35m/

154. Rinchen Zangmo, Human-wildlife conflict still a major problem: http://www.kuenselonline.com/human-wildlife-conflict-still-a-major-problem/ November 9, 2017 News Leave a comment 1,946 Views

155. Brooks A (2015) The SAFE approach to HWC, WWF Tigers Alive Initiative, WWF International

156. Barney, GO, Global 2000 – the report to the President, entering the 21st century

157. Miller JRB, Jena J (2016) Livestock losses and hotspots of attack from tigers and leopards in Kanha Tiger Reserve. Central India Reg Environ Change 16(Suppl 1):S17. https://doi.org/10.1007/s10113-015-0871-5

158. Tshering U, Katel O, Nidup T (2017) Determining ungulate distribution and habitat utilization in Royal Manas National Park, Bhutan. International Journal of Fauna and Biological Studies 4(2):91–96. ISSN 2347-2677 IJFBS 2017; 4(2): 91-96 Received: 13-01-2017 Accepted: 14-02-2017

159. Quy RJ, Massei G, Lambert MS, Coats J, Miller LA, Cowan DP (2014) Effects of a GnRH vaccine on the movement and activity of free-living wild boar (Sus scrofa). Wildlife Research 41(3):185–193. https://doi.org/10.1071/WR14035

160. Oral contraceptive baits for Canada geese and feral pigeons: https://www.aphis.usda.gov/publications/wildlife_damage/content/printable_version/fs_ovocontrol.pdf

161. O’rand MG, Widgren EE, Sivashanmugam P, Richardson RT, Hall SH, French FS, VandeVoort CA, Ramachandra SG, Ramesh V, Jagamadha Rao A (2004, November 12) Reversible immunocontraception in male monkeys immunized with eppin. Science 306(5699):1189–1190

162. ACC&D (Alliance for Contraception in Cats & Dogs): GonaCon™ (GnRH plus hemocyanin conjugate) formulations Contraceptive for Mammalian Species: www.acc-d.org