Received: 14 July 2023 | Revised: 4 September 2024 | Accepted: 10 September 2024

DOI: 10.1111/csp2.13238

CONTRIBUTED PAPER

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access

WILEY

Attitudes towards causes of and solutions to conflict between humans and Asian elephants

Surendranie J. Cabral de Mel[1,2] | **Saman Seneweera**[2,3,4] | **Ashoka Dangolla**[5] | **Devaka K. Weerakoon**[6] | **Rachel King**[7] | **Tek Maraseni**[1,8] | **Benjamin L. Allen**[1,9]

[1]Institute for Life Sciences and the Environment, University of Southern Queensland, Toowoomba, Queensland, Australia

[2]National Institute of Fundamental Studies, Kandy, Sri Lanka

[3]School of Agriculture, Food and Ecosystem Sciences, Faculty of Sciences, The University of Melbourne, Parkville, Victoria, Australia

[4]Department of Agricultural Engineering and Environmental Technology, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Sri Lanka

[5]Department of Veterinary Clinical Sciences, University of Peradeniya, Peradeniya, Sri Lanka

[6]Department of Zoology and Environmental Sciences, University of Colombo, Colombo, Sri Lanka

[7]School of Mathematics, Physics and Computing, University of Southern Queensland, Toowoomba, Queensland, Australia

[8]Northwest Institute of Eco-Environment and Resources, Chinese Academy of Sciences, Lanzhou, China

[9]Centre for African Conservation Ecology, Nelson Mandela University, Port Elizabeth, South Africa

Correspondence
Surendranie J. Cabral de Mel, Institute for Life Sciences and the Environment, University of Southern Queensland, Toowoomba, QLD 4350, Australia.
Email: surendranie.cabral@gmail.com

Funding information
National Institute of Fundamental Studies (in-kind support); National Research Council Sri Lanka, Grant/Award Number: 19-046; University of Southern Queensland (International Fees Research Scholarship)

Abstract

Many Asian elephant populations inhabit fragmented human-dominated landscapes. Human–elephant conflict (HEC) has intensified in such regions, resulting in the deaths of hundreds of people and elephants each year. Controversy between stakeholders then arises as people debate the merits of HEC mitigation approaches, stifling progress. We conducted a survey to evaluate the opinions of experts, farmers and others who have and have not experienced HEC ($n = 611$), on the causes of HEC, the importance of, conservation of and co-existence with elephants, and on the acceptability and effectiveness of potential HEC mitigation methods. Analysis of variance and the Potential for Conflict Index showed that all groups agreed with nine of the 10 causes of HEC assessed, on average. All respondent groups had mostly positive attitudes towards the importance and conservation of elephants. However, farmers exposed to HEC disagreed that people should co-exist with elephants and supported the view that elephants should be removed from human habitats. All groups agreed on the acceptability and effectiveness of electric fencing, early warning systems with infrasonic call detectors, Global Positioning System collars and geophones. However, there was disparity in views between the experts and other stakeholder groups on the acceptability and effectiveness of restricting elephants to protected areas, and translocation of problem elephants to protected areas away from their capture site or to wild elephant holding grounds. While similar views between stakeholders on many subjects are encouraging for elephant conservation, the disparities identified should be given greater attention when planning HEC management programs to minimize conflict between stakeholders.

KEYWORDS

Co-existence, conservation, *Elephas maximus*, expert opinion, human–wildlife conflict, public opinion, wildlife management

1 | INTRODUCTION

Mitigating human–wildlife conflict is one of the biggest challenges for wildlife conservation, and the increased focus on this issue is evident from the exponential rise in related research in recent years (König et al., 2020; Marchini et al., 2019; Su et al., 2022). Human–wildlife conflict is generally described as negative interactions between humans and wild animals (Madden, 2004), but is fundamentally a conflict between humans with different interests and ideas about managing wildlife (Bobier & Allen, 2022; Peterson et al., 2010; Redpath et al., 2015). The term 'human–wildlife conflict' also emphasizes wild animals as an opponent or enemy, so the term 'human–wildlife co-existence' should be encouraged as a better way of addressing the problem (Frank & Glikman, 2019; Peterson et al., 2010; Pooley et al., 2017). Following the definition of human–carnivore co-existence by Carter and Linnell (2016), human–wildlife co-existence can be defined as "a sustainable though dynamic state, where humans and wildlife coadapt to sharing landscapes and human interactions with wildlife are effectively governed to ensure wildlife populations persist in socially legitimate ways that ensure tolerable risk levels" (Pooley et al., 2021, p. 785). Therefore, rather than considering conflict and co-existence as two opposite poles of a continuum, conflict (Hill, 2021), risk (Carter & Linnell, 2016) and tolerance (Bhatia et al., 2020) are each important components of co-existence. Allen et al. (2023) further explains that, in ecological terms, "co-existence *requires* killing and death; co-existence *is not* the absence of animal killing or death" (p. 9).

Human–wildlife co-existence has both negative and positive dimensions (Bhatia, 2021). Negative co-existence is where there is latent intolerance (people have negative attitudes but do not engage in negative behaviors to harm or kill wildlife) or where both attitudes and behaviors are neutral towards wildlife, and positive co-existence is where there is appreciation (people have positive attitudes but no positive behavior towards wildlife) or stewardship (both people's behavior and attitudes towards wildlife are positive; Bhatia, 2021; Bhatia et al., 2020). To conserve wildlife in shared landscapes with manifested intolerance, that is, people showing negative attitudes and violent behaviors towards wildlife (Bhatia et al., 2020), the ultimate goal would be to achieve positive co-existence where risks of living with wildlife remains at tolerable levels. Accomplishing this can be challenging because of the multiple complexities involved. For example, it may be more challenging depending on the size, charismatic nature or the conservation importance of the species concerned (Drijfhout et al., 2020; Engel et al., 2017; Johnson & Sciascia, 2013; Kansky et al., 2014), the spatial scale of the issue creating variable economic and political conditions (Akampurira & Marijnen, 2024; Fletcher & Toncheva, 2021; Margulies & Karanth, 2018), or diverse cultural or social values and perspectives (Agnihotri et al., 2021; Bobo et al., 2014; Manfredo et al., 2021; Oommen, 2021; Pooley, 2016). Furthermore, lack of agreement between different stakeholders on acceptable wildlife management strategies especially between experts and affected parties can result in controversy and exacerbate the complexity (Kendal & Ford, 2018; Redpath et al., 2013).

Mitigating conflicts between humans and Asian elephants *Elephas maximus* is one such example that has become extremely challenging due to multiple complexities. The Asian elephant (hereafter elephant) is listed as Endangered in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Williams et al., 2020). Elephants are found in 13 Asian countries (Fernando & Pastorini, 2011) where they are revered or regarded as sacred in the major cultures and religions within the region (Köpke et al., 2021; Oommen, 2021; Pimmanrojnagool & Wanghongsa, 2002; Thekaekara et al., 2021). High human population densities (The World Bank, 2022) and the focus of these countries on large scale economic development projects results in habitat loss, forcing large numbers of elephants to inhabit fragmented and heterogenous human-dominated landscapes (Chen et al., 2022; Fernando et al., 2021; Liu et al., 2017; Madhusudan et al., 2015; Othman et al., 2019; Padalia et al., 2019). Negative interactions between humans and elephants have become inevitable in these places. Human–elephant conflict (HEC) results in the deaths of hundreds of humans and elephants each year across their range (Acharya et al., 2016; Ganesh, 2019; Prakash et al., 2020; Qomariah et al., 2018). People also experience large scale crop loss and property damage caused by elephants (Nair & Jayson, 2021; Saif et al., 2020), and further suffer from hidden costs such as impacts on psychological and social wellbeing due to fear of safety, additional workload, lack of sleep, and loss of a family member or their livelihood (Barua et al., 2013; de Silva et al., 2023; Guru & Das, 2021; Sampson et al., 2021). Despite this, public perception towards elephants remains generally positive (Sampson et al., 2019; Tripathy et al., 2022; van de Water & Matteson, 2018), though views on co-existence with elephants may not be the same among stakeholders.

People's desire for conservation and co-existence with elephants may vary depending on their exposure to wild elephants, concern for elephants and their habitat, awareness and involvement in environmental activities, urbanization, age, gender, education, occupation, income and many other factors (Abdullah et al., 2019; Barua et al., 2010; Ogra, 2008; Su et al., 2020; Tan et al., 2020; van de Water & Matteson, 2018). But tangible costs (e.g., crop and property damage, death or injury) and benefits (e.g., economic gain through ecotourism, compensation and insuarance), and intangible costs (trauma from the death of a family member or fear) and benefits (e.g., cultural values) are the most important drivers of people's tolerance towards elephants (de Silva et al., 2023; Kansky et al., 2016; Kansky & Knight, 2014; Saif et al., 2020). The severity of HEC may also vary with factors such as availability of forest habitats, type of crops cultivated, harvesting period, human density, and people's dependency on forest resources (Chartier et al., 2011; Neupane et al., 2017; Sampson et al., 2019; Thant et al., 2021; Thant et al., 2022; Tripathy et al., 2022). The majority of HEC mitigation approaches attempt to exclude problem elephants by physically removing or deterring them, though these approaches have many drawbacks and have not been very successful (Cabral de Mel et al., 2022; Shaffer et al., 2019). It is important to identify and address the root causes of the problem (Shaffer et al., 2019) and implement reliable HEC mitigation tools so that costs of living with elephants are decreased and understanding and tolerance is increased (Ardiantiono et al., 2021; Neupane et al., 2017; Tan et al., 2020; van de Water & Matteson, 2018). A greater understanding of stakeholder views will help plan effective HEC mitigation strategies (Dickman et al., 2013) and promote co-existence with elephants.

Participation of various stakeholders in planning and decision making is critical for the success of wildlife management programmes (Reed, 2008). However, it is often only the experts who are consulted in the formulation and implementation of HEC management strategies (Chen et al., 2021; Gross et al., 2022; Wong et al., 2021) and represented in the media (Barua, 2010). Integrating the opinion of other stakeholders in the planning and decision-making process may lead to better outcomes (Kendal & Ford, 2018). These stakeholders include those experiencing HEC; particularly farmers whose livelihoods are directly affected (Neupane et al., 2017; Sampson et al., 2019; van de Water & Matteson, 2018) and also those who do not experience HEC but have a general awareness of it and may have the capacity to contribute towards conservation of elephants in their country (Bandara & Tisdell, 2003; Bandara & Tisdell, 2004; Sampson et al., 2022; Tan et al., 2020). Evaluation of expert opinions (Can et al., 2014; Heeren et al., 2017; Lute et al., 2018; Lute et al., 2020) and comparing them with that of the public (Drijfhout et al., 2022; Heneghan & Morse, 2019; van Eeden et al., 2019) may be helpful in identifying similarities as well as conflicting views that could hinder implementing elephant conservation and HEC mitigating strategies.

Several studies on public attitudes towards elephant conservation and HEC mitigation have compared or supplemented research findings with the opinions of experts or key informants (see Köpke et al., 2023; Nayak & Swain, 2020; Pant et al., 2016; Su et al., 2020; Thekaekara et al., 2021; Tripathy et al., 2022). Some of these studies have shown differences in views between the experts and the local communities experiencing HEC in how they perceived elephants (Thekaekara et al., 2021) and their views on the effectiveness of HEC mitigation tools (Köpke et al., 2023; Nayak & Swain, 2020). However, these studies have been conducted only at community level with relatively small numbers of experts and/or using qualitative methods. Although these studies are useful, a broader study to understand similarities and differences in expert and public opinion would help to identify aspects that are already agreed upon, along with those that need greater attention when planning and implementing elephant conservation programmes. In this study we assess the perceptions of different stakeholder groups towards the causes of HEC, the importance and conservation of elephants and co-existence with them, and views on the acceptability and effectiveness of a variety of potential HEC mitigation tools. Our aim was to compare and contrast stakeholder perceptions and identify any areas of agreement or disagreement, with the intent to describe an acceptable pathway forward to improve the conservation and management of elephants.

2 | METHODOLOGY

2.1 | Ethics statement

The protocol and conduct of our data collection was approved by the Human Research Ethics Committee of the University of Southern Queensland, Australia (H21REA209) and the Institute of Biology, Sri Lanka (ERC IOBSL 258 012022). Our research was conducted in accordance with these approvals.

2.2 | Data collection

2.2.1 | Survey administration

Our survey targeted citizens/residents of the Asian elephant range countries (Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Thailand and Vietnam) and experts who are conducting research or work related to Asian elephants from around the world. We conducted an online and paper-based survey using convenience and snowball sampling (Atkinson & Flint, 2001; Dragan & Isaic-Maniu, 2013). The online survey was developed using the University of Southern Queensland online survey tool. Both the online and paper-based surveys were similar except for minor changes to comply with the format, and were designed in a manner that would require approximately 20 min for a respondent to complete them. Data were collected during May to October 2022.

Participants from the public were recruited by sharing the online survey link on social media platforms and was particularly shared among groups with a keen interest in wildlife, conservation, and animal welfare. The self-administered paper-based survey was conducted to recruit participants from rural farming areas and areas experiencing HEC with difficulty accessing online surveys. The paper-based survey was conducted within Sri Lanka—the country with the highest density of Asian elephants, the highest number of elephant deaths, and second-highest number of human deaths resulting from HEC (Prakash et al., 2020). The paper-based survey forms were distributed among participants with the support of volunteer field assistants.

Experts were recruited by emailing the online survey link directly to over 500 experts working on Asian elephants, including those working in non-governmental organizations (NGOs), zoos and government authorities, researchers and welfare activists. Email addresses of elephant experts were obtained from research articles published in the last 20 years, and webpages of relevant organizations. Organizations who had received the link to the survey were asked to share the survey link among their expert staff members.

Both online and paper-based surveys were made available in English, as well as Sinhala and Tamil, the two main languages spoken in Sri Lanka. Informed consent was obtained from respondents by using an information sheet at the beginning of the survey, informing that participation was entirely voluntary, and that they would provide consent to participate by voluntarily completing and submitting their online or paper-based survey form. The number of respondents who completed and submitted the online survey and the paper-based survey were 513 (response rate = 46.4%) and 130 (response rate = 60.5%), respectively, resulting in a total of 643 completed surveys. The data collected were non-identifiable to the researcher (i.e., names or any contact details were not collected).

2.2.2 | Survey questions

The survey comprised of two main sections with close-ended multiple choice and five-point Likert-type questions. Section One requested information on the demography of participants such as age, gender, highest level of formal education, citizenship, religion and involvement in agriculture and in work related to Asian elephants (Table S1). Section Two of the survey collected information on respondents' experience with HEC, and perception of elephants and HEC under four main categories, with responses on a bipolar scale (−2 to +2), as follows.

Category 1: Possibility of 10 factors being causes of HEC ("definitely not", "probably not", "neutral", "probably" and "definitely").

Category 2: Agreement on 11 statements concerning the importance and conservation of elephants and coexistence with them ("strongly disagree", "disagree", "neutral", "agree" and "strongly agree").

Category 3: Acceptability of 25 potential HEC mitigation tools ("unacceptable", "somewhat unacceptable", "neutral", "somewhat acceptable" and "acceptable").

Category 4: Perceived effectiveness of 25 potential HEC mitigation tools ("ineffective", "somewhat ineffective", "neutral", "somewhat effective" and "effective").

For Category 4, an additional option of "I do not know" was provided to avoid receiving responses from those totally unfamiliar with HEC mitigation tools; these responses were removed from the analysis. A short explanation was also provided for some of the HEC mitigation tools to help respondents in cases where the terminology may have been unfamiliar to them. Survey questions analyzed in this study are provided in Table S2. These questions were developed by the research team with some adaptations from other literature (Sampson et al., 2019, 2022). Additional questions were asked in this survey that are not considered here but were published elsewhere (Cabral de Mel, Seneweera, Dangolla, et al., 2023).

2.3 | Data analysis

Perceptions of respondents were analyzed based on their social groups (experts, farmers and others) and their personal experience in HEC (HEC or no HEC). Respondents were identified as an "expert" if they had selected at least one answer to the question on current or previous involvement in work related to Asian elephants (Table S1). Respondents were identified as a "farmer" if they selected either farmer-annual crops, farmer-perennial crops or farmer-livestock to the question on involvement in fields related to agriculture (Table S1). Those who were neither experts nor farmers were categorized as "other". Respondents who selected a level of severity of HEC they have personally experienced and/or mentioned one or more HEC related problems they had experienced were classified as "HEC" (Table S3) and the others as "no HEC". Of the 643 completed surveys, 32 were omitted for technical reasons (e.g., respondents were neither a citizen/resident of a range country or worked on Asian elephants, or because responses were spurious) resulting in a total of 611 responses in the final analysis.

We calculated the overall mean ($\overline{X}$) and group means ($\overline{x}$) of six groups; expert-HEC, expert-no HEC, farmer-HEC, farmer-no HEC, other-HEC and other-no HEC for the responses given for each item on the five-point scale (-2 to $+2$). We used analysis of variance (ANOVA) to compare group mean scores (Engel et al., 2017; Sponarski et al., 2015; Stinchcomb et al., 2024). Where the ANOVAs were significant, post hoc *t*-tests; Bonferroni post hoc test (when variances were homogenous) or Tamhane post hoc test (when variances were unequal) were used to determine the differences between groups. For all ANOVA results effect sizes (Eta values) are given in Tables 1–4 with values 0.100, 0.243, and 0.371 depicting a minimum, typical and substantial relationship, respectively (Vaske, 2008). These analyses were conducted in R statistical software (R Core Team, 2022). Then we assessed the level of consensus within groups using the Potential for Conflict Index$_2$ (PCI_2) and compared the differences in consensus levels for each item using the PCI_2 difference test (Vaske et al., 2010). PCI_2 is a useful way to visualize mean responses between groups and the level of consensus within groups using bubble graphs. PCI_2 values correspond to dispersion within the sample and ranges between 0 and 1, with 0 indicating complete consensus between respondents and 1 indicating no consensus or highest potential for conflict (responses are equally divided between the extreme responses) within a group. PCI_2 values were calculated and illustrated using the programs provided by Vaske et al. (2010). The size of each bubble in the graphs depicts the PCI_2 value, with larger bubbles indicating high potential for conflict in the group, and the center of the bubble indicating the mean score on the scale of the Y axis for each group. Items analyzed are italicized whenever mentioned in the results section. Phrases from the survey are shortened for some items here for the convenience of display. Full details can be found in Table S2. If a group had a positive mean score for an item, it was considered that on average the group agreed or had a positive view on that item; and if a group had a negative mean score for an item, it was considered that on average the group disagreed or had a negative view on it.

3 | RESULTS

From the 611 survey responses we analyzed, respondents were predominantly between 18 and 35 years of age (52.9%, $n = 323$), while 32.2% ($n = 197$) and 14.9% ($n = 91$) were between 35–56 years and >56 years, respectively (Table S1). Over half of the respondents were male (52.9%, $n = 323$) and 1.0%, 11.3% and 87.7%, of respondents had received education up to primary, secondary and tertiary level as the highest level of education, respectively. Respondents were mainly Sri Lankans (81.7%, $n = 499$), followed by citizens of other Asian elephant range countries (13.8%, $n = 84$) and citizens from non-range countries (4.6%, $n = 28$). There was a total of 158 individual experts in this study, corresponding to 25.9% of the study sample. This included 70 Sri Lankans, 60 from other range countries and the 28 respondents from non-range countries, who belonged to one or more of the following Asian elephant expert categories: Researchers and educators ($n = 102$), NGOs working on Asian elephants ($n = 65$), current or previous members of the IUCN Asian elephant specialist group ($n = 31$), zoo based organizations housing Asian elephants ($n = 19$), and government organizations working on Asian elephants ($n = 27$; Table S4). These experts included, 65 (10.6%) who had experienced HEC and 93 (15.2%) who had not. Farmers in this study comprised

TABLE 1 The overall mean ($\overline{X}$), group mean ($\overline{x}$) and analysis of variance comparisons between experts, farmers and others, who have and have not experienced human–elephant conflict (HEC) for causes of HEC.

Item	All respondents $\overline{X}$	Group means positive/negative/mixed	Expert-HEC $\overline{x}$	Expert-no HEC $\overline{x}$	Farmer-HEC $\overline{x}$	Farmer-no HEC $\overline{x}$	Other-HEC $\overline{x}$	Other-no HEC $\overline{x}$	$F_{(5,605)}$	p	Eta
1. Loss of elephant habitats due to natural causes	0.61	√	0.52	0.53	0.66	0.63	0.69	0.61	0.22	.955	0.04
2. Humans have encroached elephant habitats[T]	1.65	√	1.65[a]	1.84[a]	1.15[b]	1.70[a]	1.63[a]	1.74[a]	10.62	<.001	0.28
3. Elephant population is increasing[T]	−0.09	O	0.11[ab]	−0.19[a]	0.54[b]	−0.15[ab]	−0.02[a]	−0.33[a]	7.76	<.001	0.25
4. Human population is increasing[T]	1.45	√	1.72[a]	1.72[a]	0.87[b]	1.48[a]	1.46[a]	1.47[a]	13.07	<.001	0.31
5. Unplanned development[T]	1.61	√	1.51[ab]	1.77[a]	1.24[b]	1.63[ab]	1.54[a]	1.72[a]	8.25	<.001	0.25
6. Poor land-use planning [T]	1.53	√	1.54[ac]	1.76[a]	0.94[b]	1.74[ac]	1.34[c]	1.69[a]	18.38	<.001	0.36
7. Agricultural expansion[T]	1.35	√	1.57[ac]	1.66[a]	1.07[bc]	1.52[abc]	1.31[c]	1.26[c]	6.72	<.001	0.23
8. Elephants do not have enough food in the forest	1.05	√	0.89	0.87	1.06	1.41	1.14	1.09	1.87	.098	0.12
9. Blocking of elephant migratory paths[T]	1.51	√	1.48[ab]	1.56[a]	1.13[b]	1.56[ab]	1.51[a]	1.63[a]	6.00	<.001	0.22
10. Elephants are attracted to crops[T]	1.28	√	1.52[a]	1.52[a]	1.21[ab]	1.41[ab]	1.24[ab]	1.16[b]	4.39	.001	0.19

Note: Means with different superscripts (a–c) differ statistically at $p < .05$ based on Tamhane post hoc test (T). '√' and 'O' under group means indicate all positive mean scores and mixed (positive and negative) scores by stakeholder groups, respectively. Eta (effect size) values 0.100, 0.243, and 0.371 depict a minimum, typical and substantial relationship, respectively.

Conservation Science and Practice
A Journal of the Society for Conservation Biology
Open Access

TABLE 2 Overall mean ($\overline{X}$), group means ($\overline{x}$) and analysis of variance comparisons between experts, farmers and others, who have and have not experienced human–elephant conflict (HEC) for perception of the importance and conservation of elephants and co-existence with them.

Item	All respondents $\overline{X}$	Group means positive/ negative/ mixed	Expert-HEC $\overline{x}$	Expert-no HEC $\overline{x}$	Farmer-HEC $\overline{x}$	Farmer-no HEC $\overline{x}$	Other-HEC $\overline{x}$	Other-no HEC $\overline{x}$	$F_{(5,605)}$	p	Eta
1. Elephants should be protected[T]	1.72	√	1.83^{ac}	1.80^{ac}	1.36^{bc}	1.67^{abc}	1.58^{c}	1.84^{a}	8.99	<.001	0.26
2. Elephants are an important part of the ecosystem[T]	1.72	√	1.91^{a}	1.83^{a}	1.33^{b}	1.63^{ab}	1.53^{b}	1.83^{a}	12.29	<.001	0.30
3. Elephants are important for tourism and country's economy	1.44	√	1.28	1.42	1.28	1.52	1.42	1.53	1.60	.159	0.11
4. Elephant conservation benefits rural economy[B]	1.34	√	1.26^{ab}	1.56^{a}	1.00^{b}	1.30^{ab}	1.20^{ab}	1.45^{a}	4.70	<.001	0.19
5. Elephants play an important role in the country's culture and religion	1.31	√	1.48	1.44	1.24	1.26	1.25	1.28	1.06	.380	0.09
6. Elephants are an endangered species[B]	1.34	√	1.45^{a}	1.63^{a}	0.94^{b}	1.15^{ab}	1.27^{ab}	1.39^{a}	6.34	<.001	0.22
7. Humans have taken over elephant habitats[T]	1.40	√	1.55^{acd}	1.69^{ac}	0.86^{b}	1.41^{acd}	1.33^{ad}	1.45^{acd}	11.08	<.001	0.29
8. Elephants have taken over human habitats[B]	−0.87	X	-1.09^{ac}	-1.18^{a}	-0.28^{bc}	-1.00^{ac}	-0.71^{c}	-0.93^{ac}	8.98	<.001	0.26
9. Humans should try to co-exist with elephants[B]	0.71	O	1.00^{ac}	1.20^{a}	-0.11^{b}	0.74^{ac}	0.49^{c}	0.80^{c}	16.26	<.001	0.34
10. Humans should be removed from elephant habitats[B]	0.50	√	0.38^{ab}	0.47^{ab}	0.02^{a}	0.78^{b}	0.51^{b}	0.67^{b}	5.25	<.001	0.20
11. Elephants should be removed from human habitats[B]	−0.21	O	-0.31^{acd}	-0.78^{a}	0.44^{bc}	-0.07^{abcd}	0.01^{c}	-0.28^{cd}	11.43	<.001	0.29

Note: Means with different superscripts (a–d) differ statistically at $p < .05$ based on Bonferroni post hoc test (B) or Tamhane post hoc test (T). '√', 'X' and 'O' under group means indicate all positive mean scores, all negative mean scores and mixed (positive and negative) scores by stakeholder groups, respectively. Eta (effect size) values 0.100, 0.243, and 0.371 depict a minimum, typical and substantial relationship, respectively.

TABLE 3 Overall mean ($\overline{X}$), group means ($\bar{x}$) and analysis of variance comparisons between experts, farmers and others, who have and have not experienced human–elephant conflict (HEC) for the acceptability of HEC mitigation tools (sorted in the descending order of overall mean score for acceptability).

Item	All respondents $\overline{X}$	Group means positive/ negative/mixed	Expert-HEC $\bar{x}$	Expert-no HEC $\bar{x}$	Farmer-HEC $\bar{x}$	Farmer-no HEC $\bar{x}$	Other-HEC $\bar{x}$	Other-no HEC $\bar{x}$	$F_{(5,605)}$	p	Eta
1. Infrasonic call detectors[T]	1.30	√	1.48^{ac}	1.52^{a}	0.81^{bc}	1.48^{ac}	1.05^{c}	1.39^{a}	8.22*	<.001	0.25
2. GPS collars[T]	1.25	√	1.40^{a}	1.20^{ab}	0.77^{b}	1.52^{a}	1.06^{ab}	1.41^{a}	6.58*	<.001	0.23
3. Geophones[T]	1.20	√	1.43^{a}	1.58^{a}	0.38^{b}	1.3^{ac}	0.99^{c}	1.34^{a}	18.69*	<.001	0.37
4. Compensation or insurance schemes[T]	0.89	√	1.35^{a}	1.29^{a}	0.24^{bd}	1.07^{acd}	0.71^{d}	0.87^{cd}	9.92*	<.001	0.28
5. Planting thorny plants[B]	0.83	√	1.06^{ac}	1.25^{a}	0.44^{bc}	0.89^{abc}	0.72^{abc}	0.79^{c}	4.26	.001	0.18
6. Planting unpalatable crops[B]	0.82	√	0.94^{a}	1.19^{a}	0.19^{b}	1.07^{a}	0.84^{a}	0.84^{a}	5.98	<.001	0.22
7. Bee fences[B]	0.60	√	0.45^{a}	0.86^{a}	0.29^{a}	0.93^{a}	0.78^{a}	0.55^{a}	2.66	.022	0.15
8. Electric fencing[B]	0.51	√	0.83^{a}	0.83^{a}	0.92^{a}	0.56^{ab}	0.47^{ab}	0.20^{b}	7.40	<.001	0.24
9. Flashlights	0.46	√	0.58	0.71	0.19	0.48	0.48	0.43	1.47	.198	0.11
10. Restricting elephants to protected areas[B]	0.33	O	-0.18^{a}	-0.22^{a}	0.76^{b}	0.59^{ab}	0.52^{b}	0.42^{b}	7.19	<.001	0.24
11. Lighting bonfires	0.24	O	0.51	0.27	−0.04	0.67	0.39	0.17	2.05	.070	0.13
12. Shouting	0.18	O	0.40	0.38	−0.13	0.07	0.20	0.17	1.56	.171	0.11
13. Smoke	0.11	O	0.2	0.33	−0.26	−0.04	0.18	0.12	2.12	.061	0.13
14. Translocation to protected areas[B]	0.07	O	-0.55^{a}	-0.67^{a}	0.49^{b}	0.19^{ab}	0.40^{b}	0.24^{b}	11.43	<.001	0.29
15. Translocation to wild elephant holding grounds[B]	0.01	O	-0.34^{ab}	-0.77^{a}	0.33^{b}	0.00^{ab}	0.30^{b}	0.18^{b}	9.06	<.001	0.26
16. Trenches and ditches[B]	−0.14	O	0.34^{a}	0.00^{ab}	0.25^{a}	-0.15^{ab}	-0.28^{ab}	-0.39^{b}	4.80	<.001	0.20
17. Elephant drives[B]	−0.19	O	-0.29^{ab}	-0.65^{a}	0.09^{b}	0.04^{ab}	-0.04^{ab}	-0.18^{ab}	3.23	.007	0.16
18. Thunder flashes[B]	−0.20	O	0.03^{ab}	-0.23^{a}	0.4^{b}	-0.04^{b}	0.14^{ab}	-0.57^{ac}	8.59	<.001	0.26
19. Firecrackers[B]	−0.40	O	0.00^{a}	-0.37^{ab}	0.08^{a}	0.07^{a}	-0.28^{ab}	-0.75^{b}	7.26	<.001	0.24
20. Capture and taming problem elephants[B]	−0.62	X	-0.71^{ab}	-1.15^{a}	-0.21^{b}	-0.48^{ab}	-0.28^{b}	-0.66^{b}	5.63	<.001	0.21
21. Sterilizing elephants[B]	−1.24	X	-1.05^{ab}	-1.24^{ab}	-0.91^{a}	-1.30^{ab}	-1.31^{ab}	-1.37^{b}	2.54	.027	0.14
22. Official culling of problem elephants	−1.34	X	−1.25	−1.51	−1.36	−1.59	−1.29	−1.28	1.00	.420	0.09
23. Nail boards[T]	−1.69	X	-1.51^{a}	-1.83^{a}	-1.51^{a}	-1.70^{a}	-1.69^{a}	-1.74^{a}	2.66	.022	0.15

TABLE 3 (Continued)

Item	All respondents $\overline{X}$	Group means positive/negative/mixed	Expert-HEC $\bar{x}$	Expert-no HEC $\bar{x}$	Farmer-HEC $\bar{x}$	Farmer-no HEC $\bar{x}$	Other-HEC $\bar{x}$	Other-no HEC $\bar{x}$	$F_{(5,605)}$	p	Eta
24. Shot guns[T]	−1.71	X	-1.58^{a}	-1.92^{a}	-1.04^{b}	-1.85^{a}	-1.80^{a}	-1.84^{a}	15.65	<.001	0.34
25. Jaw bombs[T]	−1.71	X	-1.60^{ab}	-1.89^{a}	-1.52^{b}	-1.81^{ab}	-1.58^{ab}	-1.78^{ab}	3.18	.008	0.16

Note: Means with different superscripts (a–d) differ statistically at $p < .05$ based on Bonferroni post hoc test (B) or Tamhane post hoc test (T). '√', 'X' and 'O' under group means indicate all positive mean scores, all negative mean scores and mixed (positive and negative) scores by stakeholder groups, respectively. Eta (effect size) values 0.100, 0.243, and 0.371 depict a minimum, typical and substantial relationship, respectively.

*$F_{(5,604)}$. GPS, Global Positioning System.

18.3% ($n = 112$) of our sample, of which the majority were involved in cultivation of annual crops ($n = 85$), followed by perennial crops ($n = 21$), and farming livestock (n = 6; Table S1). These famers included, 85 (13.9%) who had experienced HEC and 27 (4.4%) who had not. There were 341 (55.8%) respondents who were classified as others. Of these, 83 (13.6%) had experienced HEC and 258 (42.2%) had not. The total number of respondents who have experienced HEC comprised 38.1% ($n = 233$) of the study sample (Table S3).

3.1 | Respondents' perception of the causes of HEC

Of the 10 survey items assessed, all respondent groups on average agreed on nine of them as probable causes of HEC (Table 1) of which the top two causes were *humans have encroached elephant habitats* ($\overline{X} = 1.65$, $\bar{x}_{min} = 1.15$, $\bar{x}_{max} = 1.84$) and *unplanned development* ($\overline{X} = 1.61$, $\bar{x}_{min} = 1.24$, $\bar{x}_{max} = 1.77$). Of the nine causes agreed upon, the farmer-HEC group had the lowest agreement (Tamhane post hoc test, $p < .05$) on *humans have encroached elephant habitats* ($F_{(5,605)} = 10.62$, $p < .001$), *poor land-use planning* ($F_{(5,605)} = 18.38$, $p < .001$), *human population is increasing* ($F_{(5,605)} = 13.07$, $p < .001$) as probable causes of HEC compared to all groups (Table 1). Expert-HEC and farmer-HEC on average agreed on *elephant population is increasing* as a probable cause of HEC ($\bar{x}$ values 0.11 and 0.54, respectively), with farmer-HEC's agreement on this being very different (Tamhane post hoc test, $p < .05$) to the views of expert-no HEC, other-HEC and other-no HEC who had negative or neutral views on it ($F_{(5,605)} = 7.76$, $p < .001$, Table 1). There was high potential for conflict on *habitat loss due to natural causes* as a probable cause of HEC within all groups ($PCI_{2min} = 0.27$, $PCI_{2max} = 0.48$, Figure 1). Expert HEC and Expert-no HEC also had the highest conflict in views on *elephant population is increasing* (PCI_2 values 0.38 and 0.42, respectively) and *elephants do not have enough food in the forest* (PCI_2 values 0.33 and 0.24, respectively) being a probable cause of HEC (Figure 1).

3.2 | Respondents' perception of the importance and conservation of elephants and co-existence with them

All respondent groups on average agreed on eight of the statements assessed (Table 2) with highest agreement ($\overline{X} = 1.72$, Table 2) on *elephants should be protected* ($\bar{x}_{min} = 1.36$, $\bar{x}_{max} = 1.84$) and *elephants are an important part of the ecosystem* ($\bar{x}_{min} = 1.33$, $\bar{x}_{max} = 1.91$). Of these

TABLE 4 Overall mean ($\overline{X}$), group means ($\overline{x}$) and analysis of variance comparisons between experts, farmers and others, who have and have not experienced human–elephant conflict (HEC) for the perceived effectiveness of HEC mitigation tools (sorted in the descending order of overall mean score for acceptability).

Item	All respondents $\overline{X}$	Group means positive/negative/mixed	Expert-HEC $\overline{x}$	Expert-no HEC $\overline{x}$	Farmer-HEC $\overline{x}$	Farmer-no HEC $\overline{x}$	Other-HEC $\overline{x}$	Other-no HEC $\overline{x}$	$F_{(5, m)}$*	*p*	Eta
1. Infrasonic call detectors	0.99	√	1.17	0.98	0.72	0.92	0.72	1.11	1.81	.109	0.16
2. GPS collars	1.03	√	1.18	0.85	0.85	0.88	0.79	1.21	2.15	.059	0.17
3. Geophones	1.00	√	1.07	0.94	0.70	1.00	0.76	1.16	1.87	.100	0.17
4. Compensation or insurance schemes[B]	0.20	O	0.60^{a}	0.48^{ab}	-0.18^{b}	0.13^{ab}	-0.06^{ab}	0.22^{ab}	3.52	.004	0.19
5. Planting thorny plants	0.26	O	0.15	0.22	0.06	−0.09	0.51	0.36	1.60	.159	0.14
6. Planting unpalatable crops[B]	0.21	O	0.26^{ab}	0.51^{a}	-0.3^{b}	-0.04^{ab}	0.28^{ab}	0.29^{a}	4.05	.001	0.21
7. Bee fences[T]	0.29	O	-0.08^{a}	0.10^{a}	0.05^{a}	0.78^{a}	0.54^{a}	0.47^{a}	3.05	.010	0.20
8. Electric fencing	0.38	√	0.64	0.40	0.51	0.42	0.30	0.28	1.17	.323	0.10
9. Flashlights	−0.01	O	0.00	0.05	−0.11	−0.36	0.05	0.03	0.62	.684	0.08
10. Restricting elephants to protected areas[B]	0.04	O	-0.34^{ab}	-0.57^{a}	0.32^{b}	0.17^{ab}	0.26^{b}	0.17^{b}	5.49	.001	0.22
11. Lighting bonfires	0.05	O	0.10	0.10	−0.17	0.05	0.10	0.09	0.67	.645	0.08
12. Shouting[B]	−0.19	O	0.11^{a}	0.09^{a}	-0.48^{a}	-0.46^{a}	-0.25^{a}	-0.21^{a}	2.71	.020	0.16
13. Smoke[B]	−0.19	O	-0.24^{ab}	-0.17^{ab}	-0.55^{a}	-0.30^{ab}	-0.42^{ab}	0.07^{b}	2.82	.016	0.18
14. Translocation to protected areas[B]	−0.09	O	-0.46^{ac}	-0.98^{a}	0.34^{bc}	0.25^{c}	0.10^{c}	0.12^{c}	10.23	<.001	0.31
15. Translocation to wild elephant holding grounds[B]	−0.04	O	-0.38^{ac}	-0.86^{a}	0.61^{b}	-0.09^{abc}	0.16^{c}	0.08^{c}	10.45	<.001	0.31
16. Trenches and ditches	−0.14	O	0.03	−0.27	−0.08	−0.10	0.05	−0.25	0.91	.477	0.10
17. Elephant drives	−0.21	O	−0.15	−0.54	−0.33	0.15	0.02	−0.18	1.59	.162	0.13
18. Thunder flashes	0.34	√	0.24	0.05	0.54	0.28	0.58	0.29	2.14	.059	0.14
19. Firecrackers	0.08	√	0.13	0.11	0.11	0.12	0.01	0.06	0.09	.993	0.03
20. Capture and taming problem elephants[B]	−0.42	O	-0.58^{ab}	-0.94^{a}	-0.29^{ab}	-0.11^{ab}	0.08^{b}	-0.42^{ab}	3.79	.002	0.21
21. Sterilizing elephants	−0.94	X	−1.06	−1.16	−0.73	−0.67	−0.70	−1.01	1.00	.420	0.12
22. Official culling of problem elephants	−1.03	X	−0.67	−1.11	−1.16	−1.17	−0.84	−1.10	0.93	.459	0.12
23. Nail boards	−1.42	X	−1.53	−1.39	−1.44	−1.48	−1.42	−1.40	0.11	.990	0.04

TABLE 4 (Continued)

Item	All respondents $\overline{X}$	Group means positive/ negative/mixed	Expert-HEC $\bar{x}$	Expert-no HEC $\bar{x}$	Farmer-HEC $\bar{x}$	Farmer-no HEC $\bar{x}$	Other-HEC $\bar{x}$	Other-no HEC $\bar{x}$	$F_{(5, m)}$*	*p*	Eta
24. Shot guns[T]	−1.19	X	-1.11^{ab}	-1.21^{ab}	-0.69^{a}	-1.32^{ab}	-1.14^{ab}	-1.36^{b}	2.76	.018	0.17
25. Jaw bombs	−1.36	X	−1.40	−1.39	−1.34	−1.28	−1.18	−1.42	0.50	.780	0.07

Note: Means with different superscripts (a–d) differ statistically at $p < .05$ based on Bonferroni post hoc test (B) or Tamhane post hoc test (T). '√', 'X' and 'O' under group means indicate all positive mean scores, all negative mean scores and mixed (positive and negative) scores by stakeholder groups, respectively. Eta (effect size) values 0.100, 0.243, and 0.371 depict a minimum, typical, and substantial relationship, respectively.
*$F_{(5,m)}$ degrees of freedom (m) for items 1 to 25 are 337, 365, 324, 473, 428, 443, 350, 562, 523, 529, 526, 545, 406, 497, 488, 472, 436, 517, 533, 417, 324, 348, 380, 445, 445. GPS, Global Positioning System.

eight, the lowest agreement was on *humans should be removed from elephant habitats* ($\overline{X} = 0.50$, Table 2) with farmer-HEC having a neutral view ($\bar{x} = 0.02$) and all other groups having a low agreement ($\bar{x}_{max} = 0.78$) compared to their agreement on the other agreed statements. Farmer-HEC's agreement ($\bar{x} = 0.86$) on *humans have taken over elephant habitats* was the lowest (Tamhane post hoc test, $p < .05$) compared to all groups ($F_{(5,605)} = 11.08$, $p < .001$, Table 2) and had high potential for conflict ($PCI_2 = 0.14$) within the group compared to that of the two expert groups ($PCI_2 = 0.00$, Figure 2). There was also high potential for conflict in views on *elephant conservation benefits rural economy* within the farmer-HEC ($PCI_2 = 0.15$) and other-HEC ($PCI_2 = 0.17$) groups compared to that of expert-HEC ($PCI_2 = 0.03$, Figure 2).

All groups disagreed on *elephants have taken over human habitats* ($\bar{x}_{min} = -1.18$, $\bar{x}_{max} = -0.28$); but farmer-HEC's disagreement ($\bar{x} = -0.28$) was much lower (Bonferroni post hoc test, $p < .05$) than that of all groups except other-HEC group ($F_{(5,605)} = 8.98$, $p < .001$, Table 2). Farmer-HEC disagreed ($\bar{x} = -0.11$) on *humans should try to co-exist with elephants* (Bonferroni post hoc test, $p < .05$) while all other groups agreed on this ($F_{(5,605)} = 16.26$, $p < .001$, Table 2). There were also mixed views ($\bar{x}_{min} = -0.78$, $\bar{x}_{max} = 0.44$) on *elephants should be removed from human habitats* ($F_{(5,605)} = 11.43$, $p < .001$, Table 2), with the farmer-HEC group agreeing on it ($\bar{x} = 0.44$), other-HEC group having a neutral view ($\bar{x} = 0.01$), and all other groups disagreeing on the statement. The agreement of farmer-HEC on this was particularly different to the disagreement shown by other-no HEC and the two expert groups and the neutral view of other-HEC was also different to the disagreement shown by the expert-no HEC group (Bonferroni post hoc test, $p < .05$).

3.3 | Respondents' perception of the acceptability and effectiveness of *HEC* mitigation tools

All groups on average agreed on the acceptability of nine mitigation tools (Table 3 and Figure 3). They were early warning with *infrasonic call detectors* ($\bar{x}_{min} = 0.81$, $\bar{x}_{max} = 1.52$), Global Positioning System or *GPS collars* ($\bar{x}_{min} = 0.77$, $\bar{x}_{max} = 1.52$) and *geophones* ($\bar{x}_{min} = 0.38$, $\bar{x}_{max} = 1.58$), *compensation or insurance schemes* ($\bar{x}_{min} = 0.24$, $\bar{x}_{max} = 1.35$), *planting thorny plants* ($\bar{x}_{min} = 0.44$, $\bar{x}_{max} = 1.25$), *planting unpalatable crops* ($\bar{x}_{min} = 0.19$, $\bar{x}_{max} = 1.19$), *bee fences* ($\bar{x}_{min} = 0.29$, $\bar{x}_{max} = 0.86$), *electric fencing* ($\bar{x}_{min} = 0.20$, $\bar{x}_{max} = 0.92$) and *flashlights* ($\bar{x}_{min} = 0.19$, $\bar{x}_{max} = 0.71$). Out of them,

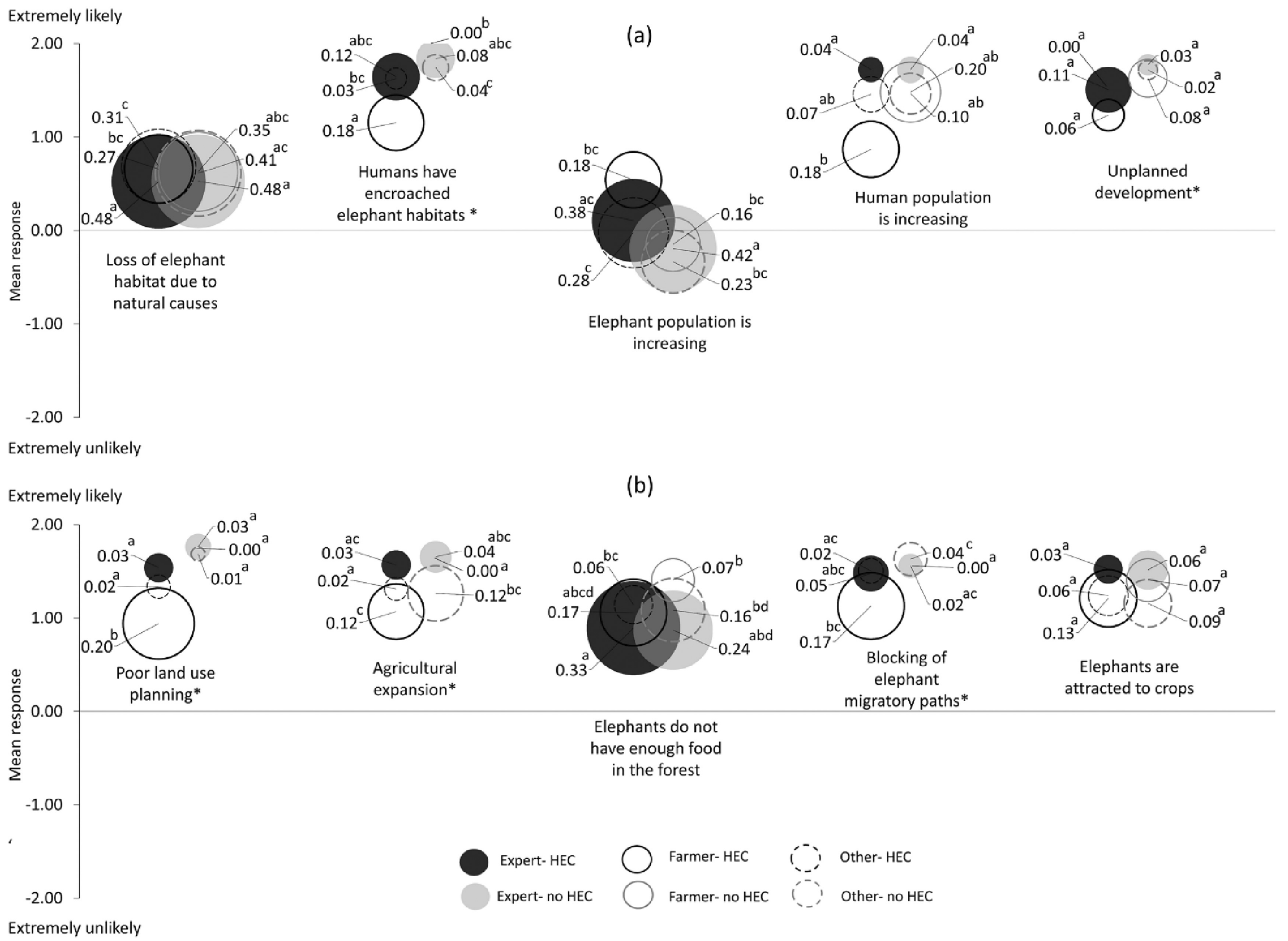

FIGURE 1 Bubble graphs (a and b) depicting the mean and Potential for Conflict Index$_2$ (PCI_2) for the perception towards causes of human–elephant conflict (HEC) among experts, farmers and others with and without experience in HEC. Centre of the bubble indicates the mean score (on the scale of the y axis), and bubble size illustrates the magnitude of PCI_2 with larger bubbles indicating high potential for conflict among respondents within groups. PCI_2 values with different superscripts (a–d) represent significant difference in PCI_2 values ($p < .05$). * denotes items having one or more groups not represented in the graph due to PCI_2 being 0.00.

only four tools; *GPS collars* ($\bar{x}_{min} = 0.79$, $\bar{x}_{max} = 1.21$), *geophones* ($\bar{x}_{min} = 0.70$, $\bar{x}_{max} = 1.16$), *infrasonic call detectors* ($\bar{x}_{min} = 0.72$, $\bar{x}_{max} = 1.17$) and *electric fencing* ($\bar{x}_{min} = 0.28$, $\bar{x}_{max} = 0.64$) were agreed, on average, as effective by all groups (Table 4 and Figure 3). There were mixed views on the acceptability of 10 HEC mitigation tools (Table 3 and Figure 4) of which there were neutral to positive views on the effectiveness of *thunder flashes* ($\bar{x}_{min} = 0.05$, $\bar{x}_{max} = 0.58$) and *firecrackers* ($\bar{x}_{min} = 0.01$, $\bar{x}_{max} = 0.13$) by all groups (Table 4 and Figure 4). Expert-HEC and expert-no HEC disagreed ($\bar{x}$ values ranging between −0.18 and −0.77) on the acceptability of *restricting elephants to protected areas* ($F_{(5,605)} = 7.19$, $p < .001$), *translocation to protected areas* ($F_{(5,605)} = 11.43$, $p < .001$) and *translocation to wild elephant holding grounds* ($F_{(5,605)} = 9.06$, $p < .001$) which were different (Bonferroni post hoc test, $p < .05$) to the view of farmer-HEC, other-HEC and other-no HEC who agreed on their acceptability (Table 3). Similarly the two expert groups disagreed ($\bar{x}$ values ranging between −0.34 and −0.98) on the effectiveness of these tools (Table 4) with the view of expert-no HEC group being different (Bonferroni post hoc test, $p < .05$) to the agreement shown by the rest of the groups on their effectiveness; *restricting elephants to protected areas* ($F_{(5,529)} = 5.49$, $p < .001$), *translocation to protected areas* ($F_{(5,497)} = 10.23$, $p < .001$) and *translocation to wild elephant holding grounds* ($F_{(5,488)} = 10.45$, $p < .001$).

All respondent groups agreed on the unacceptability of six tools (Table 3 and Figure 5), which included capture and *taming problem elephants* ($\bar{x}_{min} = -1.15$, $\bar{x}_{max} = -0.21$), *sterilizing elephants* ($\bar{x}_{min} = -1.37$, $\bar{x}_{max} = -0.91$), *official culling of problem elephants* ($\bar{x}_{min} = -1.51$, $\bar{x}_{max} = -1.25$), *nail boards* ($\bar{x}_{min} = -1.83$, $\bar{x}_{max} = -1.51$), *shot guns* ($\bar{x}_{min} = -1.92$, $\bar{x}_{max} = -1.04$)

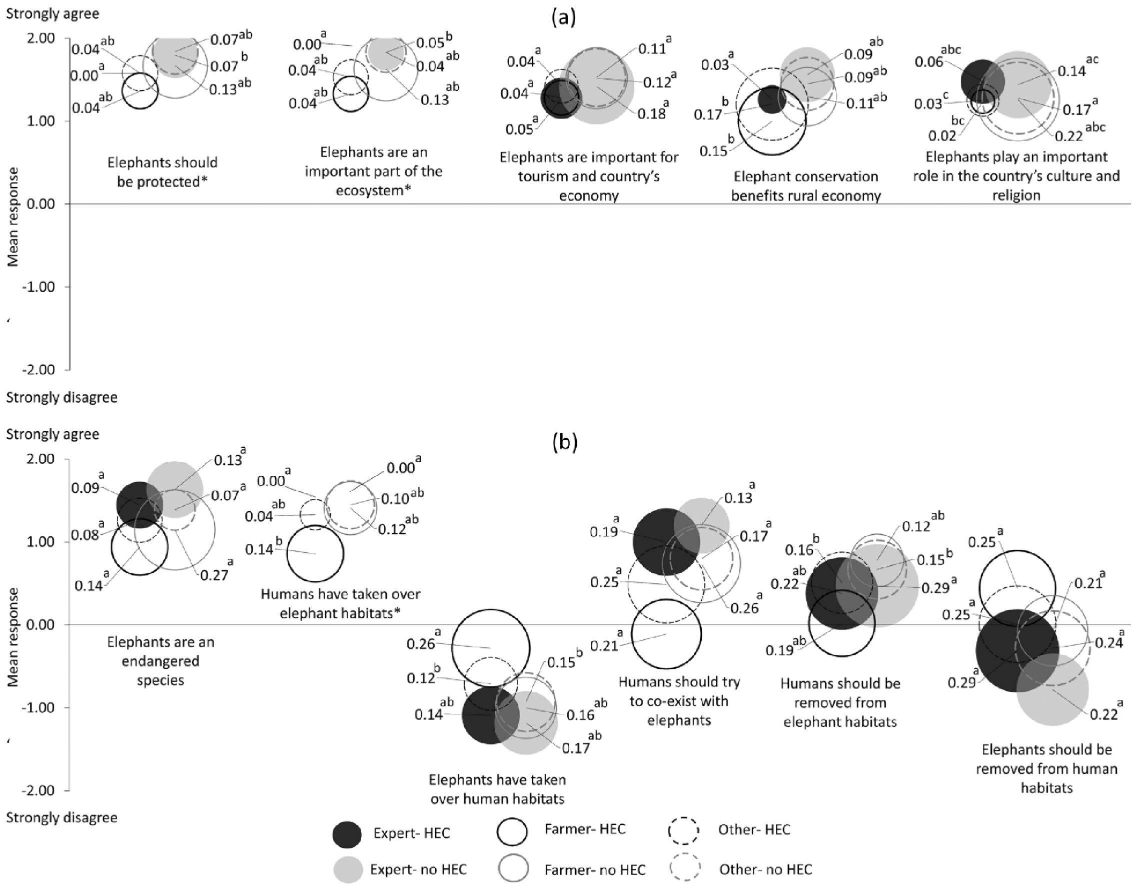

FIGURE 2 Bubble graphs (a and b) depicting mean and Potential for Conflict Index$_2$ (PCI_2) for agreement of different statements related to importance, conservation and co-existence with elephants among experts, farmers and others with and without experience in human-elephant conflict (HEC). Centre of the bubble indicate the mean score (on the scale of the y axis) and bubble size illustrates the magnitude of PCI_2 with larger bubbles indicating high potential for conflict among respondents within groups. PCI_2 values with different superscripts (a–c) represent significant difference in PCI_2 values ($p < .05$). * denotes items having one or more groups not represented in the graph due to PCI_2 being 0.00.

and *jaw bombs* ($\bar{x}_{min} = -1.89$, $\bar{x}_{max} = -1.52$). Farmer-HEC group had the highest acceptability of *shot guns* ($\bar{x} = -1.04$, Tamhane post hoc test, $p < .05$) compared to all other groups ($F_{(5,605)} = 15.65$, $p < .001$, Table 3) but also a high potential for conflict on it within the group ($PCI_2 = 0.43$, Figure 5). All groups agreed on the ineffectiveness of *sterilizing elephants* ($\bar{x}_{min} = -1.16$, $\bar{x}_{max} = -0.67$), *official culling of problem elephants* ($\bar{x}_{min} = -1.17$, $\bar{x}_{max} = -0.67$), *nail boards* ($\bar{x}_{min} = -1.53$, $\bar{x}_{max} = -1.39$), *shot guns* ($\bar{x}_{min} = -1.36$, $\bar{x}_{max} = -0.69$) and *jaw bombs* ($\bar{x}_{min} = -1.42$, $\bar{x}_{max} = -1.18$; Table 4 and Figure 5). The other-HEC group had a slightly positive view ($\bar{x} = 0.08$) on the effectiveness of *capture and taming problem elephants* which was particularly different (Bonferroni post hoc test, $p < .05$) from the negative view of the expert-no HEC group ($\bar{x} = -0.94$) while all the other groups also perceived it to be an ineffective tool ($F_{(5,417)} = 3.79$, $p < .001$, Table 4).

4 | DISCUSSION

We assessed views on Asian elephant conservation and HEC mitigation by experts, farmers, and others with or without personal experience in HEC. We identified many similarities in views towards the causes of HEC (Table 1 and Figure 1), and each group had positive views towards the importance and conservation of elephants (Table 2 and Figure 2). We identified disparities in views on increasing elephant population is a cause of HEC and the possibility of co-existing with elephants and removing elephants from human habitats. Respondent groups also expressed different views towards the acceptability and effectiveness of some HEC mitigation tools (Tables 3 and 4 and Figures 3–5), particularly around restricting elephants to protected areas, and translocating problem elephants into protected areas away from capture sites and into wild elephant holding grounds. Understanding

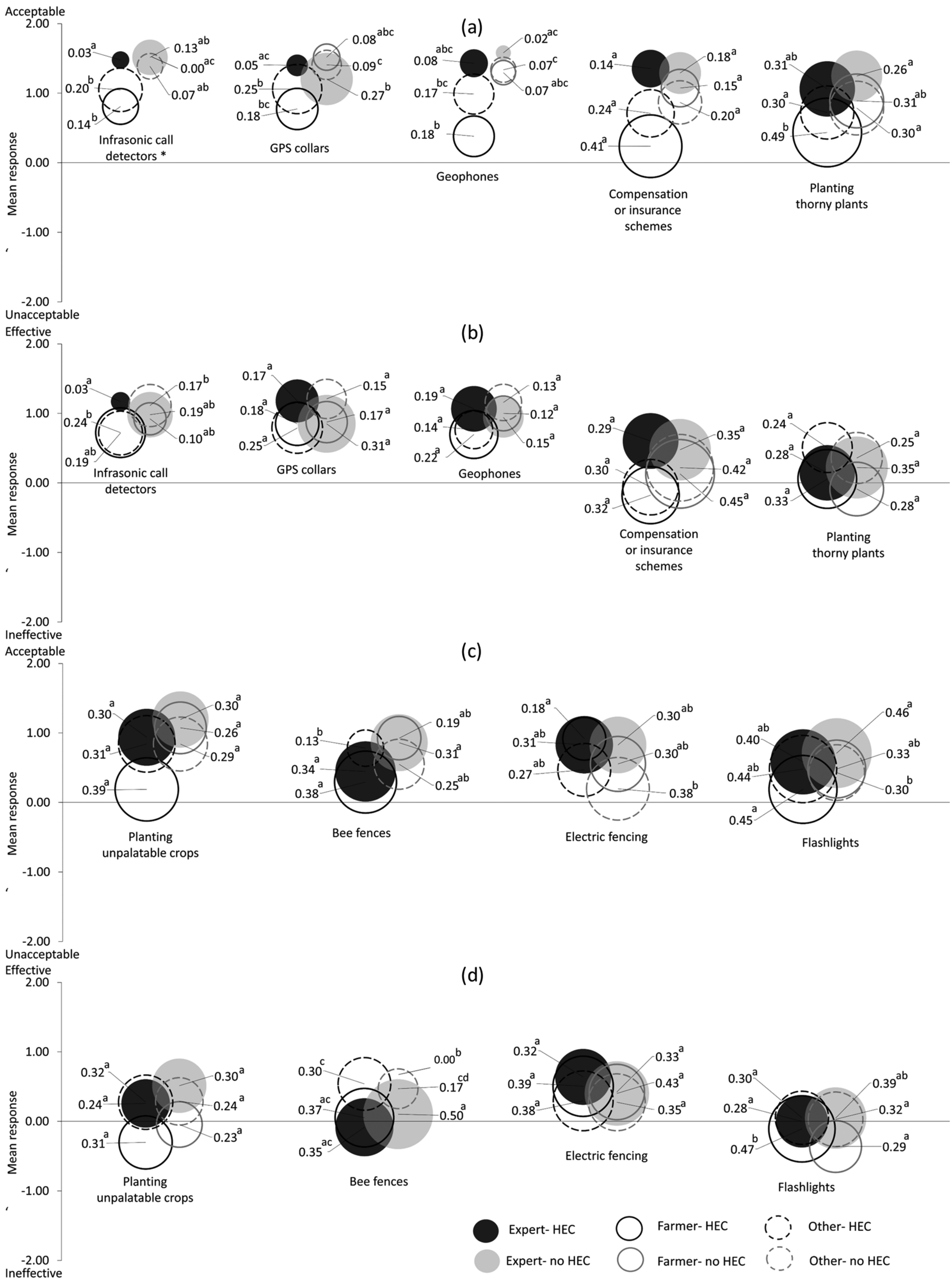

FIGURE 3 Legend on next page.

these similarities and differences in opinions can assist with the development of acceptable and effective HEC mitigation strategies to successfully achieve conservation goals (Dhungana et al., 2022; Drijfhout et al., 2022; Engel et al., 2017; Heneghan & Morse, 2019; Stinchcomb et al., 2024; van Eeden et al., 2019). Our findings provide an insight into views that may be positive for elephant conservation and management and draws attention towards those views that may lead to unnecessary entanglements or controversies among important stakeholder groups related to HEC.

4.1 | Causes of HEC

The high agreement among all groups on many of the anthropogenic causes of HEC shows that there is an overall awareness among all groups that HEC is a man-made problem. Despite this general agreement, experts and farmers who have experienced HEC perceived that an increasing elephant population is also a probable cause of HEC, as opposed to others (Table 1). There was also high potential for conflict on this point within the two expert groups (Figure 1). There are reports of range expansions and increases in several regional elephant populations (Baskaran et al., 2011; Fernando et al., 2011; Jigme & Williams, 2011; Singh et al., 2023; Sukumar, 2006) even though overall elephant numbers are declining or are very small in many range countries (Fernando & Pastorini, 2011; Menon & Tiwari, 2019). Previous studies have also shown that people experiencing HEC in different regions perceived that elephant populations are increasing (see de Silva et al. (2023) for an example from Sri Lanka) or declining (see Sampson et al. (2022) for an example from Myanmar). Therefore, variable population trajectories at local scales may be contributing to the disagreement between groups, and conflicting views within the expert groups, on increasing elephant numbers being a probable cause of HEC at broader scales.

There was also high potential for conflict within expert groups on loss of elephant habitat due to natural causes and not having enough food in forests being causes of HEC when compared to their consensus on others (Figure 1). A deficit in available information or lack of wider discussions on these aspects may lead to different views within expert groups or lack of strong opinions about them. For example, there is some evidence that natural processes like climate change may cause changes in elephant distribution and could therefore create more HEC (Guarnieri et al., 2024; Kanagaraj et al., 2019; Yang et al., 2022), but this may not be a topic widely discussed as a cause of HEC. Furthermore, although not having enough food in forests is perceived as a cause of HEC, HEC incidents are known to peak during the harvesting season but not particularly during the dry season when there could be low availability of food in forests (Gubbi, 2012; Neupane et al., 2017; Webber et al., 2011). Elephants in Sri Lanka are also known to move out of protected areas during the dry season (due to low availability of food) to feed in fallow land without causing conflict with people (Fernando et al., 2005). However, the increasing use of longer cultivation periods or irrigated dry season cultivation may lead to increased conflict as elephants compete with humans for food during dry seasons (Anuradha et al., 2019; Pastorini et al., 2013). These variable situations may lead to low consensus among experts. Where there are differences in views between stakeholders it will be beneficial to further investigate them under each local HEC situation and communicate with relevant stakeholders to build consensus on them, because addressing root causes is essential to successfully mitigate HEC.

4.2 | Importance and conservation of elephants and co-existence with them

We found mostly positive attitudes towards the importance and conservation of elephants, even among those affected by HEC (Table 2), similar to observations described in other studies (Sampson et al., 2019; Su et al., 2020; Tripathy et al., 2022; van de Water & Matteson, 2018). This may be linked to the majority of respondents identifying themselves as followers of Buddhism (59.7%) and Hinduism (10.8%; Table S1) who each consider elephants as sacred beings (Gogoi, 2018; Köpke et al., 2021; Oommen, 2021; Sukumar, 2003; Thekaekara et al., 2021). However, rather than reverence specifically towards elephants, it may be due to compassion and respect for all living things (de Silva et al., 2023), as is preached in

FIGURE 3 Bubble graphs depicting mean and Potential for Conflict Index$_2$ (PCI_2) for acceptability (a and c) and perceived effectiveness (b and d) for nine human–elephant conflict (HEC) mitigation tools agreed on average as acceptable by experts, farmers and others with and without experience in HEC. Centre of the bubble indicate the mean score (on the scale of the y axis) and bubble size illustrates the magnitude of PCI_2 with larger bubbles indicating high potential for conflict among respondents within groups. PCI_2 values with different superscripts (a–d) represent significant difference in PCI_2 ($p < .05$). * denotes items having one or more groups not represented in the graph due to PCI_2 being 0.00. GPS, Global Positioning System.

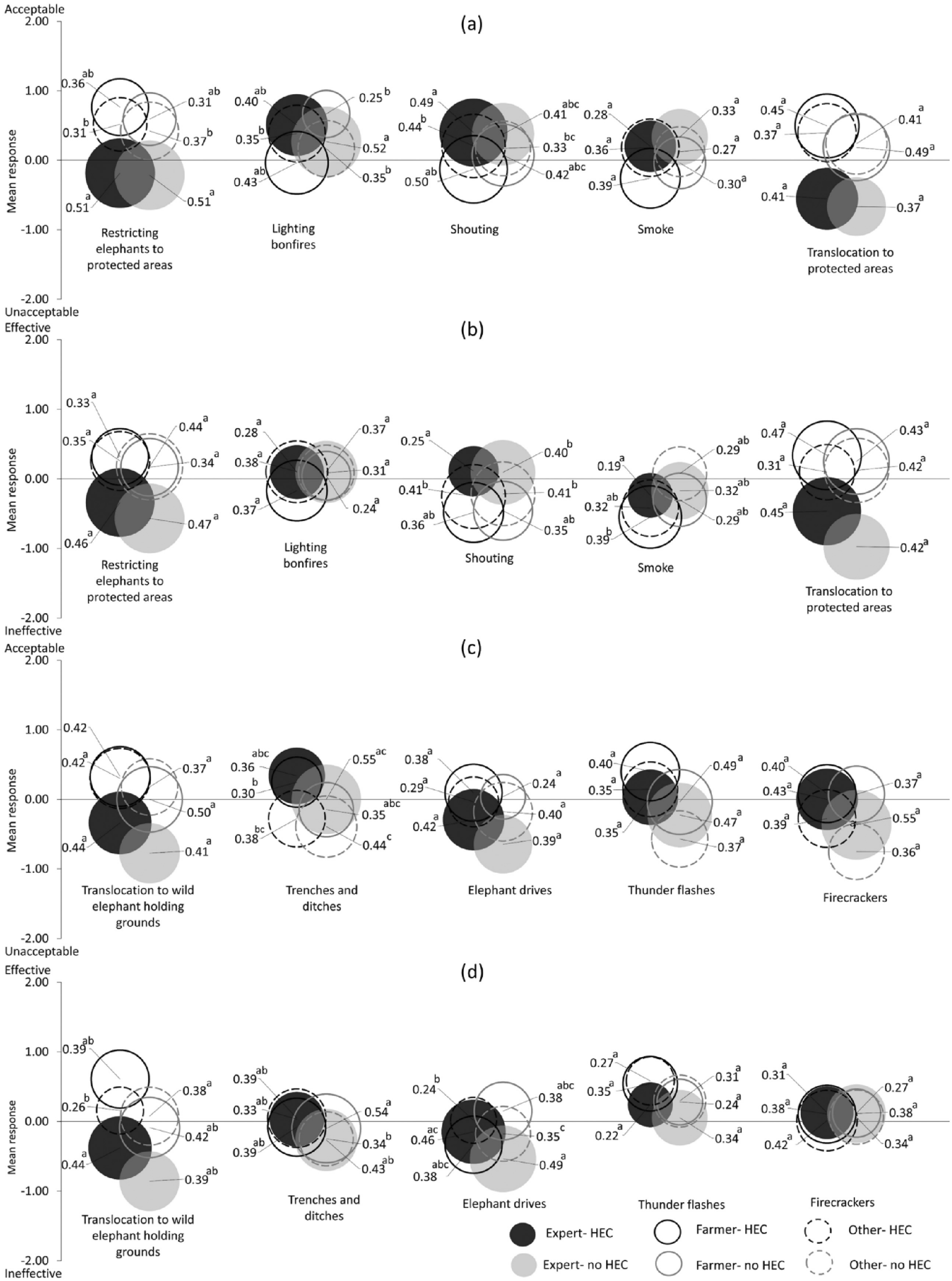

FIGURE 4 Legend on next page.

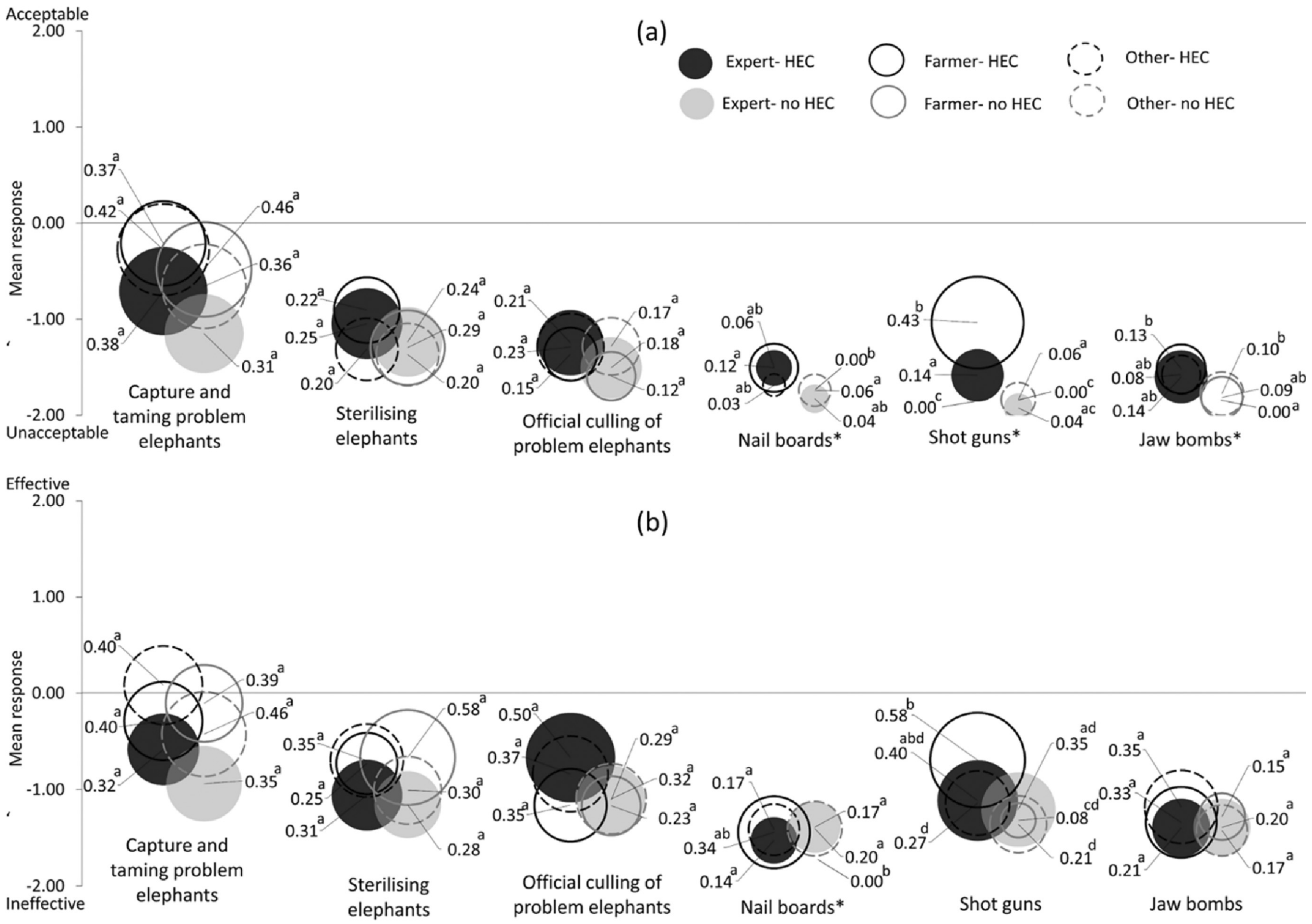

FIGURE 5 Bubble graphs depicting mean and Potential for Conflict Index$_2$ (PCI$_2$) for acceptability (a) and perceived effectiveness (b) for six human–elephant conflict (HEC) mitigation tools agreed on average as unacceptable by experts, farmers and others with and without experience in HEC. Centre of the bubble indicate the mean score (on the scale of the y axis) and bubble size illustrates the magnitude of PCI$_2$ with larger bubbles indicating high potential for conflict among respondents within groups. PCI$_2$ values with different superscripts (a–d) represent significant difference in PCI$_2$ ($p < .05$). * denotes items having one or more groups not represented in the graph due to PCI$_2$ being 0.00.

Buddhism. All respondent groups also agreed that humans have taken over elephant habitats and not vice versa (Abdullah et al., 2019; Sampson et al., 2019). But, our results show that expression of mostly positive attitudes towards elephants and their conservation does not necessarily make people experiencing HEC willing to co-exist with elephants; especially the farmers (Ardiantiono et al., 2021; de Silva et al., 2023; Sampson et al., 2022; van de Water & Matteson, 2018). The farmer-HEC group perceived that elephants should be removed from human habitats rather than removing humans (Table 2, Figure 2). Despite most respondent groups agreeing that humans should be relocated away from elephant habitats, this might be difficult to implement given the many social issues that arise from such a process (Su et al., 2020).

The inequality in sharing costs and benefits of living with elephants could be influencing this unwillingness to co-exist with elephants among our farmer-HEC group (Jordan et al., 2020). Agricultural communities are the

FIGURE 4 Bubble graphs depicting mean and potential for conflict index$_2$ (PCI$_2$) for acceptability (a and c) and perceived effectiveness (b and d) for 10 human–elephant conflict (HEC) mitigation tools with mixed views on acceptability among experts, farmers and others with and without experience in HEC. Centre of the bubble indicate the mean score (on the scale of the y axis) and bubble size illustrates the magnitude of PCI$_2$ with larger bubbles indicating high potential for conflict among respondents within groups. PCI$_2$ values with different superscripts (a–d) represent significant difference in PCI$_2$ ($p < .05$). * denotes items having one or more groups not represented in the graph due to PCI$_2$ being 0.00.

most severely impacted by living alongside elephants given they experience significant tangible costs (Gulati et al., 2021; van de Water & Matteson, 2018). However, studies have shown that intangible costs of living with elephants such as fear and concern about future crop losses caused by elephants are the main factors driving intolerance rather than tangible economic loss (de Silva et al., 2023; Saif et al., 2020). Although tangible economic benefits may be a less important driver of tolerance, its contribution to support and empower people and influence their attitudes cannot be ignored (Ardiantiono et al., 2021; van de Water & Matteson, 2018). In our study we observed that all respondent groups agreed on elephant conservation benefiting the rural economy, but farmer-HEC and other-HEC had conflicting views on this compared to the expert-HEC group (Figure 2). Recent studies in an area near the Udawalawe National Park in Sri Lanka has shown that the people experiencing HEC actually do not receive tangible economic benefits from the revenue generated by protected areas or the ecotourism industry in their region (de Silva et al., 2023; Kariyawasam et al., 2020). This suggests that while elephant ecotourism has the potential to boost the rural economy generally, it may not boost the household economies of people actually experiencing HEC. Experts need to recognize these disparities in views, the importance of balancing costs and benefits of HEC, and provide farmers with sufficient assurance about their lives and livelihoods if co-existence with elephants is to be promoted among people affected by HEC (Ardiantiono et al., 2021; van de Water & Matteson, 2018).

4.3 | Acceptability and effectiveness of HEC mitigation tools

All groups on average agreed on the unacceptability and ineffectiveness of many potentially lethal or harmful HEC mitigation tools (Tables 3 and 4 and Figure 5). The majority of our respondents (particularly the farmers and others) are from Sri Lanka where illegal killing of elephants occur at a considerable level (LaDue, Eranda, et al., 2021; Prakash et al., 2020). Although positive, compassionate attitudes may be borne and predominate as a result of religious and cultural influences (de Silva et al., 2023; Köpke et al., 2023), it is also possible that our respondents may not respond truthfully about their perceptions on killing or harming elephants given its illegality, even if they perceive it as an acceptable form of self-defense (de Silva et al., 2023). Although shot guns are considered unacceptable by all groups, there was high potential for conflict within the farmer-HEC group on this. Such conflict in views could be because some respondents perceive it acceptable as a tool of self-defense or as an acoustic deterrent by firing to the air (Nath et al., 2009), although they are often shot at elephants which cause fatal injuries (de Silva et al., 2013; LaDue, Eranda, et al., 2021; LaDue, Vandercone, et al., 2021; Santiapillai et al., 2010). However, disapproval of killing or harming elephants, suggests reduced support for such methods in managing HEC, which is a positive aspect for the conservation of elephants.

There was disagreement between experts and all other groups on the acceptability and effectiveness of restricting elephants to protected areas and translocation of problem causing elephants to protected areas away from their capture sites and into wild elephant holding grounds (Figure 4). The public have expressed the view that authorities are responsible for mitigating HEC and that removing problem causing elephants from their lands and/or confining elephants into protected areas would be a lasting solution (de Silva et al., 2023; He et al., 2011; Sampson et al., 2019; Talukdar & Choudhury, 2020; van de Water & Matteson, 2018). Although experts have shown that these methods are ineffective in reducing HEC and negatively impact the wellbeing of elephants (Anthony, 2021; Fernando, 2011; Fernando, 2015; Fernando et al., 2012; Fernando et al., 2015; Pinter-Wollman, 2009; Stüwe et al., 1998), this awareness is lacking among the general public. Therefore, experts need to pay attention to these opposing perceptions and better explain to local communities experiencing HEC why such methods are not viable options. However, this positive view on restricting elephants to protected areas and translocation by people experiencing HEC could also be due to their negative experiences and/or their view that most other methods available to them are ineffective in mitigating HEC (Figures 3 and 4).

There was lack of agreement on the acceptability and/or effectiveness of many of the traditional deterrents (e.g., flashlights, lighting bonfires, shouting to chase elephants and smoke), except on the effectiveness of thunder flashes and firecrackers (Table 4 and Figure 4). Community-based crop guarding using loud noises, explosives, fire and lights have shown to be effective in keeping elephants away (Gunaryadi et al., 2017; Hedges & Gunaryadi, 2010; Nyhus et al., 2000; van de Water & Matteson, 2018), but they may be effective only in the short term given elephants quickly habituate to them (Aziz et al., 2016; Davies et al., 2011; Fernando et al., 2011). Therefore, experts should encourage use of these methods with other interventions during shorter periods to ensure their effectiveness in the long term.

There were several other tools that were deemed acceptable by all groups too, albeit with mixed views on their effectiveness (Figure 3). For example, farmers in our study perceived that planting unpalatable crops is ineffective despite evidence that they may be effective and support the livelihoods of local communities (Dharmarathne et al., 2020; Gross et al., 2017; Ly et al., 2020). One reason for this may be the increased time and money required to change to alternative cropping or farming practices (Neupane et al., 2017). Experts and farmers who have experienced HEC also had relatively neutral or negative opinions on the effectiveness of bee fences, perhaps because their success against elephants in Africa (King et al., 2009; King et al., 2010) is not well reflected in studies on elephants in Asia (Fernando & Corea, 2019; Sugiyo et al., 2016; van de Water et al., 2020). Compensation schemes could be effective in providing relief to those affected and thereby improve people's tolerance levels towards co-existing with elephants (Chen et al., 2021; Jasmine et al., 2015). But similar to many other studies, respondents who have experienced HEC seem to feel that it is ineffective because reporting and claiming compensation is difficult, time-consuming, and the available funds are insufficient to cover the real losses (Bandara & Tisdell, 2002; Borah et al., 2022; Karanth et al., 2013; Ogra & Badola, 2008; Tisdell & Zhu, 1998). Such schemes are also prone to fraud (Ogra & Badola, 2008) and do not actually prevent the loss, but merely shift the cost of the losses from farmers to the general public via government or other management agencies. Regardless, we suggest that the tools that are considered acceptable but sometimes ineffective represent those tools that are most likely to become more important in the future following sufficient research and development to improve them. Research effort to improve the efficacy of these tools is warranted.

Interestingly, only four HEC mitigation tools were perceived by all groups as both acceptable and effective (Tables 3 and 4 and Figure 3). These were electric fencing and early warning systems with infrasonic call detectors, GPS collars and geophones, although only electric fencing could be considered a widely used tool. Previous studies have shown that people generally perceive electric fencing to be an effective HEC mitigation tool (Nayak & Swain, 2020; Neupane et al., 2018; Ponnusamy et al., 2016; van de Water & Matteson, 2018), but, its effectiveness strongly depends on proper maintenance (Jasmine et al., 2015; Liefting et al., 2018; Pekor et al., 2019). Electric fences are costly to build and maintain (Gunaryadi et al., 2017), are often broken by elephants (Desai & Riddle, 2015; Jasmine et al., 2015), limit elephant movement and gene flow (Estes et al., 2012; Hayward & Kerley, 2009; Puyravaud et al., 2022), and might only shift the problem from one area to another (Osipova et al., 2018). However, community based electric fences can be quite effective in managing HEC where the responsibility of fence maintenance is adopted by community members (Fernando, 2020; Fernando et al., 2011; Samaranayake et al., 2023). The other three tools considered both acceptable and effective are not widely used at present, have relatively limited information on their success, or are still under development (Dabare et al., 2015; Sugumar & Jayaparvathy, 2013; Venkataraman et al., 2005; Zeppelzauer et al., 2015). Despite this, the importance of early warning systems in preventing HEC incidents is being increasingly recognized as a good approach. For example, China has invested large amounts of funds on remotely triggered alarms, mobile warning messages, infrared triggered cameras and drones, which have been reported to be effective at detecting problems with elephants (Chen et al., 2021); but alone, most tools do not actually mitigate those problems, which still require people to use traditional methods to prevent elephants from entering their properties (Cabral de Mel et al., 2022; Gross et al., 2022). Nevertheless, the generally positive attitudes among people towards uncommon and sophisticated early warning systems may indicate a willingness in people to test and explore modern technologies to mitigate HEC. Technologies that both warn about and mitigate potential HEC incidents before they occur are most promising, and should be further investigated (Cabral de Mel, Seneweera, de Mel, Dangolla, et al., 2023; Cabral de Mel, Seneweera, de Mel, Medawala, et al., 2023).

Our survey responses are based on HEC placed in a general context to get a broader understanding of perceptions of various aspects of HEC. However, stakeholder views on causes of HEC and its mitigation approaches may differ based on local contexts and the severity of HEC experienced (Tan et al., 2020). Therefore, opinions could be further evaluated by asking respondents how much they would agree or disagree under different HEC scenarios, especially where disagreements were identified (Engel et al., 2017; Heneghan & Morse, 2019). For example, how much respondents would agree with co-existence, translocation of a problem elephant, restricting elephants to protected areas, or elephant holding grounds when there is low frequency of crop raiding, high frequency of crop raiding or frequent lethal encounters with elephants. Such assessment may provide a better understanding of people's perception to develop and implement HEC mitigation approaches specific for each HEC situation. Conflicting views between experts and people experiencing HEC is of particular concern because successful adoption of HEC management approaches will depend on the local people perceiving them as favorable and effective (Denninger Snyder & Rentsch, 2020; Noga et al., 2015). We recommend that experts pay attention to those views of people experiencing HEC, particularly to those who express different views to their own. Doing so will help develop better ways to communicate, understand and engage with local people to reach consensus on mutually important topics.

Conflicting views among the experts are also problematic given they could lead to highly variable recommendations or measures for HEC mitigation. Further to the reasons discussed above, the differences in views among experts can be due to their professional or social biases, moral obligations and personal wildlife value orientations; experts are not always objective towards their decisions and opinions about wildlife (Bruskotter et al., 2019; Donfrancesco et al., 2023; Lute et al., 2018; Treves & Santiago-Ávila, 2020) especially under uncertainty (Heeren et al., 2017; Karns et al., 2021). For example, conservationists and animal rights activists who prioritize 'saving elephants' are most likely to have a strong view that human activities are the root cause of HEC, and that factors that may be related to elephants are not (Thekaekara et al., 2021). Further classification of experts by asking them to identify whether they are strong animal rights activists, conservationists, etc. (van Eeden et al., 2019) may also help to better understand their perceptions. The differences in opinions within expert-HEC may be driven by local context, but disparity between expert-HEC and expert-no HEC can also be due to their distance from the problem, their experiences or relevance of HEC in their personal lives, or proximity to elephants. In some instances, we observed that the view of those experiencing HEC to differ from that of expert-no HEC but with no significant disparity with expert-HEC. This could largely be due to the limited engagement of expert-no HEC with local people experiencing HEC, unlike expert-HEC who deal with HEC and engage with local communities on a daily basis. Irrespective of their social identity and experiences affecting their personal views, experts should work together to develop consensus if we are to succeed in HEC mitigation.

There are a few important limitations to our study. For example, although we have tried to formulate our survey questions carefully, some questions may have similar meanings to different people, and hence their results may be correlated (e.g., the causes of HEC associated with unplanned development, poor land-use planning, and agricultural expansion may be similar). Had the questions been formulated differently we may have obtained slightly different results. Our survey asked what respondents thought about different aspects of HEC, and their responses may be based on their individual perceptions, which may not be driven by a comprehensive ecological understanding. Furthermore, there are inherent limitations of online surveys resulting in selective participation of respondents (e.g., participation may be limited to those who have access to a smart phone or internet or are literate) and self-selection of respondents (e.g., who has a special interest in the topic surveyed; Andrade, 2020; Heiervang & Goodman, 2011). This is reflected by the majority of our participants being below the age of 35 and with high literacy. By combining our online survey with a paper-based survey targeting rural farming populations, we have been able to somewhat overcome the sampling bias to represent a broad sample of people experiencing HEC. Although we opened our online survey to all elephant range countries, most of our respondents were from Sri Lanka, so our results may better reflect the situation in Sri Lanka than in other range countries (even though the experts in this study were represented by many different countries and are of a diverse background). Future studies may benefit from collaborative research with other range countries to compare and understand the perceptions of different stakeholders. It would also be beneficial to further explore 'why' respondents perceived some mitigation tools to be effective or ineffective over the others that would provide a better understanding for their improvement and refinement.

5 | CONCLUSIONS

In conclusion, we found that all stakeholder groups generally agreed on most causes of HEC, had positive opinions towards elephant conservation, and perceived that lethal and harmful HEC mitigation methods are both ineffective and unacceptable. However, those affected by HEC largely disagreed with the idea of co-existing with elephants and instead supported the removal of elephants from human habitats. Despite the apparent impasse, we identified several mutually acceptable tools that offer the best opportunities to mitigate HEC if or when issues affecting their inconsistent reliability can be overcome. We recommend that researchers should focus their efforts on refining the effectiveness of these tools and approaches, and on reducing both tangible and intangible costs of living with elephants to tolerable levels. Experts should understand and be aware that differences in stakeholder views exist and give special attention to views of those who experience HEC when formulating appropriate management strategies. Experts should also consider their own biases and work together to develop consensus among them on HEC mitigation measures. Such understanding will help in developing more effective HEC mitigation measures to reduce the frequency and severity of HEC in the future, leading to better outcomes for both humans and elephants living in shared landscapes.

AUTHOR CONTRIBUTIONS

Surendranie J. Cabral de Mel: conceptualisation, methodology, investigation, data curation, formal analysis, visualization, project administration, writing—original draft, writing—review and editing. Saman Seneweera: funding acquisition, writing—review and editing, project administration, supervision. Ashoka Dangolla: methodology, writing—review and editing, project administration, supervision. Devaka K. Weerakoon: methodology, writing—review and editing, project administration, supervision. Rachel King: formal analysis, writing—review and editing. Tek Maraseni: methodology, writing—review and editing, project administration, supervision. Benjamin L. Allen: conceptualisation, methodology, writing—review and editing, project administration, supervision.

ACKNOWLEDGEMENTS

Authors sincerely thank Ruvinda K. de Mel, Umair Khaleelullah, Ashkar Thasleem, Sanjaya N. Weerakkody, Rukmal Ratnayake, Kulangana Theivendrarajah, Jael Nirubha Kanagaratnam, Mahesh Senarathna, Gajavathany Kandasamy and Dishane K. Hewavithana, for their inputs and support in translating and proofreading the survey. We greatly appreciate the support of the many volunteer assistants in distributing and collecting the paper-based survey and all the respondents for their active participation in the survey. The National Institute of Fundamental Studies, Sri Lanka provided in-kind support. Surendranie J. Cabral de Mel was supported by an International Fees Research Scholarship from the University of Southern Queensland, Australia, and this study was funded by a grant awarded to Saman Seneweera from the National Research Council, Sri Lanka (NRC 19-046, 2019). Authors also thank the anonymous reviewers for their constructive comments. Open access publishing facilitated by University of Southern Queensland, as part of the Wiley - University of Southern Queensland agreement via the Council of Australian University Librarians.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The authors confirm that the supporting data of these findings are available within the article and its supplementary materials. The summarized data generated during the current study are available from the corresponding author on reasonable request.

ORCID

Surendranie J. Cabral de Mel https://orcid.org/0000-0001-5045-2716
Saman Seneweera https://orcid.org/0000-0001-5147-9988
Devaka K. Weerakoon https://orcid.org/0000-0002-3473-4972
Rachel King https://orcid.org/0000-0002-3302-0919
Tek Maraseni https://orcid.org/0000-0001-9361-1983
Benjamin L. Allen https://orcid.org/0000-0002-1533-0163

REFERENCES

Abdullah, A., Sayuti, A., Hasanuddin, H., Affan, M., & Wilson, G. (2019). People's perceptions of elephant conservation and the human-elephant conflict in Aceh Jaya, Sumatra, Indonesia. *European Journal of Wildlife Research*, *65*, 69. https://doi.org/10.1007/s10344-019-1307-1

Acharya, K. P., Paudel, P. K., Neupane, P. R., & Köhl, M. (2016). Human-wildlife conflicts in Nepal: Patterns of human fatalities and injuries caused by large mammals. *PLoS One*, *11*, e0161717. https://doi.org/10.1371/journal.pone.0161717

Agnihotri, S., Madegowda, C., & Si, A. (2021). Tiger becomes termite hill: Soliga/Solega perceptions of wildlife interactions and ecological change 2. https://doi.org/10.3389/fcosc.2021.691900

Akampurira, E., & Marijnen, E. (2024). The politics of mourning in conservation conflicts: The (un)grievability of life and less-than-human geographies. *Political Geography*, *108*, 103031. https://doi.org/10.1016/j.polgeo.2023.103031

Allen, B. L., Bobier, C., Dawson, S., Fleming, P. J. S., Hampton, J., Jachowski, D., Kerley, G. I. H., Linnell, J. D. C., Marnewick, K., Minnie, L., Muthersbaugh, M., O'Riain, M. J., Parker, D., Proulx, G., Somers, M. J., & Titus, K. (2023). Why humans kill animals and why we cannot avoid it. *Science of the Total Environment*, *896*, 165283. https://doi.org/10.1016/j.scitotenv.2023.165283

Andrade, C. (2020). The limitations of online surveys 42, pp. 575–576. https://doi.org/10.1177/0253717620957496

Anthony, V. (2021). Horowpathana elephant holding ground (WWW Document) the morning. https://www.themorning.lk/horowpathana-elephant-holding-ground/

Anuradha, J. M. P. N., Fujimura, M., Inaoka, T., & Sakai, N. (2019). The role of agricultural land use pattern dynamics on elephant habitat depletion and human-elephant conflict in Sri Lanka. *Sustainability*, *11*, 2818. https://doi.org/10.3390/su11102818

Ardiantiono, Sugiyo, Johnson, P. J., Lubis, M. I., Amama, F., Sukatmoko, Marthy, W., & Zimmermann, A. (2021). Towards coexistence: Can people's attitudes explain their willingness to live with Sumatran elephants in Indonesia? *Conservation Science and Practice*, *3*, e520. https://doi.org/10.1111/csp2.520

Atkinson, R., & Flint, J. (2001). Accessing hidden and hard-to-reach populations: Snowball research strategies. *Social Research Update*, *33*, 1–4.

Aziz, M. A., Shamsuddoha, M., Maniruddin, M., Morshed, H. M., Sarker, R., & Islam, M. A. (2016). Elephants, border fence and human-elephant conflict in northern Bangladesh: Implications for bilateral collaboration towards elephant conservation. *Gajah*, *45*, 12–19.

Bandara, R., & Tisdell, C. (2002). Asian elephants as agricultural pests: Economics of control and compensation in Sri Lanka. *Natural Resources Journal*, *42*, 491–520.

Bandara, R., & Tisdell, C. (2003). Comparison of rural and urban attitudes to the conservation of Asian elephants in Sri Lanka: Empirical evidence. *Biological Conservation*, *110*, 327–342. https://doi.org/10.1016/S0006-3207(02)00241-0

Bandara, R., & Tisdell, C. (2004). The net benefit of saving the Asian elephant: A policy and contingent valuation study. *Ecological Economics*, *48*, 93–107. https://doi.org/10.1016/j.ecolecon.2003.01.001

Barua, M. (2010). Whose issue? Representations of human-elephant conflict in Indian and international media. *Science Communication*, *32*, 55–75. https://doi.org/10.1177/1075547009353177

Barua, M., Bhagwat, S. A., & Jadhav, S. (2013). The hidden dimensions of human-wildlife conflict: Health impacts, opportunity and transaction costs. *Biological Conservation*, *157*, 309–316. https://doi.org/10.1016/j.biocon.2012.07.014

Barua, M., Tamuly, J., & Ahmed, R. A. (2010). Mutiny or clear sailing? Examining the role of the Asian elephant as a flagship species. *Human Dimensions of Wildlife*, *15*, 145–160. https://doi.org/10.1080/10871200903536176

Baskaran, N., Varma, S., Sar, C. K., & Sukumar, R. (2011). Current status of Asian elephants in India. *Gajah*, *35*, 47–54.

Bhatia, S. (2021). More than just No conflict: Examining the two sides of the coexistence coin. *Frontiers in Conservation Science*, *2*, 688307. https://doi.org/10.3389/fcosc.2021.688307

Bhatia, S., Redpath, S. M., Suryawanshi, K., & Mishra, C. (2020). Beyond conflict: Exploring the spectrum of human-wildlife interactions and their underlying mechanisms. *Oryx*, *54*, 621–628. https://doi.org/10.1017/S003060531800159X

Bobier, C. A., & Allen, B. L. (2022). Compassionate conservation is indistinguishable from traditional forms of conservation in practice. *Frontiers in Psychology*, *13*, 750313. https://doi.org/10.3389/fpsyg.2022.750313

Bobo, K. S., Florence, F., Aghomo, M., & Ntumwel, B. C. (2014). Wildlife use and the role of taboos in the conservation of wildlife around the Nkwende Hills Forest Reserve; South-west Cameroon.

Borah, B. C., Bhattacharya, A., Sarkar, P., & Choudhury, P. (2022). People's perception on human-elephant conflict in Rani-Garbhanga reserve forest of Assam, India. *GeoJournal*, *87*, 4127–4141. https://doi.org/10.1007/s10708-021-10491-6

Bruskotter, J. T., Vucetich, J. A., Dietsch, A., Slagle, K. M., Brooks, J. S., & Nelson, M. P. (2019). Conservationists' moral obligations toward wildlife: Values and identity promote conservation conflict. *Biological Conservation*, *240*, 108296. https://doi.org/10.1016/j.biocon.2019.108296

Cabral de Mel, S. J., Seneweera, S., Dangolla, A., Weerakoon, D. K., Maraseni, T., & Allen, B. L. (2023). Attitudes towards the Potential Use of Aversive Geofencing Devices to Manage Wild Elephant Movement. *Animals*, *13*(16), 2657. https://doi.org/10.3390/ani13162657

Cabral de Mel, S. J., Seneweera, S., de Mel, R. K., Dangolla, A., Weerakoon, D. K., Maraseni, T., & Allen, B. L. (2022). Current and future approaches to mitigate conflict between humans and Asian elephants: The potential use of aversive geofencing devices. *Animals*, *12*, 2965. https://doi.org/10.3390/ani12212965

Cabral de Mel, S. J., Seneweera, S., de Mel, R. K., Dangolla, A., Weerakoon, D. K., Maraseni, T., & Allen, B. L. (2023). Welfare impacts associated with using aversive geofencing devices on captive Asian elephants. *Applied Animal Behaviour Science*, *265*, 105991. https://doi.org/10.1016/j.applanim.2023.105991

Cabral de Mel, S. J., Seneweera, S., de Mel, R. K., Medawala, M., Abeysinghe, N., Dangolla, A., Weerakoon, D. K., Maraseni, T., & Allen, B. L. (2023). Virtual fencing of captive Asian elephants fitted with an aversive geofencing device to manage their movement. *Applied Animal Behaviour Science*, *258*, 105822. https://doi.org/10.1016/j.applanim.2022.105822

Can, Ö. E., D'Cruze, N., Garshelis, D. L., Beecham, J., & Macdonald, D. W. (2014). Resolving human-bear conflict: A global survey of countries, experts, and key factors. *Conservation Letters*, *7*, 501–513. https://doi.org/10.1111/conl.12117

Carter, N. H., & Linnell, J. D. C. (2016). Co-adaptation is key to coexisting with large carnivores. *Trends in Ecology & Evolution*, *31*, 575–578. https://doi.org/10.1016/j.tree.2016.05.006

Chartier, L., Zimmermann, A., & Ladle, R. J. (2011). Habitat loss and human-elephant conflict in Assam, India: Does a critical threshold exist? *Oryx*, *45*, 528–533. https://doi.org/10.1017/S0030605311000044

Chen, S., Sun, G.-Z., Wang, Y., Huang, C., Chen, Y., Liu, P., Deng, Y., Cao, D.-F., Zhang, M.-X., Ong, S., Zhang, Z.-Y., Yang, H.-P., Wang, Q.-Y., Wang, B., Zheng, X., Lei, Y., Li, C., Sun, J., Bao, M.-W., … Campos-Arceiz, A. (2021). A multistakeholder exercise to identify research and conservation priorities for Asian elephants in China. *Global Ecology and Conservation*, *27*, e01561. https://doi.org/10.1016/j.gecco.2021.e01561

Chen, Y., Atzeni, L., Gibson, L., Sun, Y., Yang, Z., Shi, K., & Dudgeon, D. (2022). Urban expansion and infrastructure development reduce habitat suitability for Asian elephants in southwestern China. *Journal of Wildlife Management*, *86*, e22204. https://doi.org/10.1002/jwmg.22204

Dabare, P., Suduwella, C., Sayakkara, A., Sandaruwan, D., Keppitiyagama, C., De Zoysa, K., Hewage, K., & Voigt, T. (2015). Listening to the giants: Using elephant infra-sound to solve the human-elephant conflict. In: Proceedings of the 6th ACM workshop on real world wireless sensor networks. *Seoul*, 23–26. https://doi.org/10.1145/2820990.2821000

Davies, T. E., Wilson, S., Hazarika, N., Chakrabarty, J., Das, D., Hodgson, D. J., & Zimmermann, A. (2011). Effectiveness of intervention methods against crop-raiding elephants. *Conservation Letters*, *4*, 346–354. https://doi.org/10.1111/j.1755-263X.2011.00182.x

de Silva, S., Ruppert, K., Knox, J., Davis, E. O., Weerathunga, U. S., & Glikman, J. A. (2023). Experiences and emotional responses of farming communities living with Asian elephants in southern Sri Lanka. Trees, For. *People*, *14*, 100441. https://doi.org/10.1016/j.tfp.2023.100441

de Silva, S., Webber, C. E., Weerathunga, U. S., Pushpakumara, T. V., Weerakoon, D. K., & Wittemyer, G. (2013). Demographic variables for wild Asian elephants using longitudinal observations. *PLoS One*, *8*, e82788. https://doi.org/10.1371/journal.pone.0082788

Denninger Snyder, K., & Rentsch, D. (2020). Rethinking assessment of success of mitigation strategies for elephant-induced crop damage. *Conservation Biology*, *34*, 829–842. https://doi.org/10.1111/cobi.13433

Desai, A. A., & Riddle, H. S. (2015). Human-elephant conflict in Asia. Washington, DC, USA.

Dharmarathne, C., Fernando, C., Weerasinghe, C., & Corea, R. (2020). Project orange elephant is a conflict specific holistic approach to mitigating human-elephant conflict in Sri Lanka. *Communications Biology*, *3*, 43. https://doi.org/10.1038/s42003-020-0760-4

Dhungana, R., Maraseni, T., Silwal, T., Aryal, K., & Karki, J. B. (2022). What determines attitude of local people towards tiger and leopard in Nepal? *Journal for Nature Conservation*, *68*, 126223. https://doi.org/10.1016/j.jnc.2022.126223

Dickman, A., Marchini, S., & Manfredo, M. (2013). The human dimension in addressing conflict with large carnivores. In D. W. Macdonald & K. J. Willis (Eds.), *Key topics in conservation biology 2* (pp. 110–126). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118520178.ch7

Donfrancesco, V., Allen, B. L., Appleby, R., Behrendorff, L., Conroy, G., Crowther, M. S., Dickman, C. R., Doherty, T., Fancourt, B. A., Gordon, C. E., Jackson, S. M., Johnson, C. N., Kennedy, M. S., Koungoulos, L., Letnic, M., Leung, L.K.-P., Mitchell, K. J., Nesbitt, B., Newsome, T., … Cairns, K. M. (2023). Understanding conflict among experts working on controversial species: A case study on the Australian dingo. *Conservation Science and Practice*, *5*, 1–14. https://doi.org/10.1111/csp2.12900

Dragan, I.-M., & Isaic-Maniu, A. (2013). Snowball sampling completion. *Journal of Social Sciences*, *5*, 160–177.

Drijfhout, M., Kendal, D., & Green, P. (2022). Mind the gap: Comparing expert and public opinions on managing overabundant koalas. *Journal of Environmental Management*, *308*, 114621. https://doi.org/10.1016/j.jenvman.2022.114621

Drijfhout, M., Kendal, D., & Green, P. T. (2020). Understanding the human dimensions of managing overabundant charismatic wildlife in Australia. *Biological Conservation*, *244*, 108506. https://doi.org/10.1016/j.biocon.2020.108506

Engel, M. T., Vaske, J. J., Bath, A. J., & Marchini, S. (2017). Attitudes toward jaguars and pumas and the acceptability of killing big cats in the Brazilian Atlantic Forest: An application of the potential for conflict Index2. *Ambio*, *46*, 604–612. https://doi.org/10.1007/s13280-017-0898-6

Estes, J. G., Othman, N., Ismail, S., Ancrenaz, M., Goossens, B., Ambu, L. N., Estes, A. B., & Palmiotto, P. A. (2012). Quantity and configuration of available elephant habitat and related conservation concerns in the lower Kinabatangan floodplain of Sabah, Malaysia. *PLoS One*, *7*, e44601. https://doi.org/10.1371/journal.pone.0044601

Fernando, C., & Corea, R. (2019). An assessment of beehive fences in deterring crop raiding elephants: A case study from Wasgamuwa, Sri Lanka. In *Association for Tropical Biodiversity and Conservation Asia Pacific Conference 2019* (p. 71). Thulhiriya.

Fernando, P. (2011). Managing 'problem elephants'. *Loris*, *25*, 32–36.

Fernando, P. (2015). Managing elephants in Sri Lanka: Where we are and where we need to be. *Ceylon Journal of Science (Biological Sciences)*, *44*, 1–11. https://doi.org/10.4038/cjsbs.v44i1.7336

Fernando, P. (2020). Guide for implementing community-based electric fences for the effective mitigation of human-elephant conflict. Washington, DC, USA.

Fernando, P., De Silva, M. K. C. R., Jayasinghe, L. K. A., Janaka, H. K., & Pastorini, J. (2021). First country-wide survey of the endangered Asian elephant: Towards better conservation and management in Sri Lanka. *Oryx*, *55*, 46–55. https://doi.org/10.1017/S0030605318001254

Fernando, P., Jayawardene, J., Prasad, T., Hendavitharana, W., & Pastorini, J. (2011). Current status of Asian elephants in Sri Lanka. *Gajah*, *35*, 93–103. https://doi.org/10.5167/uzh-59037

Fernando, P., Leimgruber, P., Prasad, T., & Pastorini, J. (2012). Problem-elephant translocation: Translocating the problem and the elephant? *PLoS One*, *7*, e50917. https://doi.org/10.1371/journal.pone.0050917

Fernando, P., & Pastorini, J. (2011). Range-wide status of Asian elephants. *Gajah*, *35*, 15–20.

Fernando, P., Prasad, T., Janaka, H. K., Ekanayaka, S. K., Nishantha, H. G., & Pastorini, J. (2015). The use of radio-tracking data to guide development and manage elephants. *Wild*, *3*, 12–19.

Fernando, P., Wikramanayake, E., Weerakoon, D., Jayasinghe, L. K. A., Gunawardene, M., & Janaka, H. K. (2005). Perceptions and patterns of human–elephant conflict in old and new settlements in Sri Lanka: Insights for mitigation and management. *Biodiversity and Conservation*, *14*, 2465–2481. https://doi.org/10.1007/s10531-004-0216-z

Fletcher, R., & Toncheva, S. (2021). The political economy of human-wildlife conflict and coexistence. *Biological Conservation*, *260*, 109216. https://doi.org/10.1016/j.biocon.2021.109216

Frank, B., & Glikman, J. A. (2019). Human-wildlife conflicts and the need to include coexistence. In B. Frank, J. A. Glikman, & S. Marchini (Eds.), *Human-wildlife interactions: Turning conflict into coexistence* (pp. 1–19). Cambridge University Press. https://doi.org/10.1017/9781108235730.004

Ganesh, S. (2019). Human elephant conflict kills 1,713 people, 373 pachyderms in 3 years (WWW Document). https://www.thehindu.com/news/national/human-elephant-conflict-kills-1713-people-373-pachyderms-in-3-years/article26225515.ece

Gogoi, M. (2018). Emotional coping among communities affected by wildlife-caused damage in north-east India: Opportunities for building tolerance and improving conservation outcomes. *Oryx*, *52*, 214–219. https://doi.org/10.1017/S0030605317001193

Gross, E. M., Drouet-Hoguet, N., Subedi, N., & Gross, J. (2017). The potential of medicinal and aromatic plants (MAPs) to reduce crop damages by Asian elephants (*Elephas maximus*). *Crop Protection*, *100*, 29–37. https://doi.org/10.1016/j.cropro.2017.06.002

Gross, E. M., Pereira, J. G., Shaba, T., Bilério, S., Kumchedwa, B., & Lienenlüke, S. (2022). Exploring routes to coexistence: Developing and testing a human–elephant conflict-management framework for African elephant-range countries. *Diversity*, *14*, 525. https://doi.org/10.3390/d14070525

Guarnieri, M., Kumaishi, G., Brock, C., Chatterjee, M., Fabiano, E., Katrak-Adefowora, R., Larsen, A., Lockmann, T. M., & Roehrdanz, P. R. (2024). Effects of climate, land use, and human population change on human–elephant conflict risk in Africa and Asia. *Proceedings of the National Academy of Sciences*, *121*, 1–8. https://doi.org/10.1073/pnas.2312569121

Gubbi, S. (2012). Patterns and correlates of human-elephant conflict around a south Indian reserve. *Biological Conservation*, *148*, 88–95. https://doi.org/10.1016/j.biocon.2012.01.046

Gulati, S., Karanth, K. K., Le, N. A., & Noack, F. (2021). Human casualties are the dominant cost of human–wildlife conflict in

India. *Proceedings of the National Academy of Sciences*, *118*, e1921338118. https://doi.org/10.1073/pnas.1921338118

Gunaryadi, D., Sugiyo, & Hedges, S. (2017). Community-based human–elephant conflict mitigation: The value of an evidence-based approach in promoting the uptake of effective methods. *PLoS One*, *12*, e0173742. https://doi.org/10.1371/journal.pone.0173742

Guru, B. K., & Das, A. (2021). Cost of human-elephant conflict and perceptions of compensation: Evidence from Odisha, India. *Journal of Environmental Planning and Management*, *64*, 1770–1794. https://doi.org/10.1080/09640568.2020.1838264

Hayward, M. W., & Kerley, G. I. H. (2009). Fencing for conservation: Restriction of evolutionary potential or a riposte to threatening processes? *Biological Conservation*, *142*, 1–13. https://doi.org/10.1016/j.biocon.2008.09.022

He, Q., Wu, Z., Zhou, W., & Dong, R. (2011). Perception and attitudes of local communities towards wild elephant-related problems and conservation in Xishuangbanna, southwestern China. *Chinese Geographical Science*, *21*, 629–636. https://doi.org/10.1007/s11769-011-0499-4

Hedges, S., & Gunaryadi, D. (2010). Reducing human–elephant conflict: Do chillies help deter elephants from entering crop fields? *Oryx*, *44*, 139. https://doi.org/10.1017/S0030605309990093

Heeren, A., Karns, G., Bruskotter, J., Toman, E., Wilson, R., & Szarek, H. (2017). Expert judgment and uncertainty regarding the protection of imperiled species. *Conservation Biology*, *31*, 657–665. https://doi.org/10.1111/cobi.12838

Heiervang, E., & Goodman, R. (2011). Advantages and limitations of web-based surveys: evidence from a child mental health survey 69–76. https://doi.org/10.1007/s00127-009-0171-9

Heneghan, M. D., & Morse, W. C. (2019). Acceptability of management actions and the potential for conflict following human-black bear encounters. *Society and Natural Resources*, *32*, 434–451. https://doi.org/10.1080/08941920.2018.1556756

Hill, C. M. (2021). Conflict is integral to human-wildlife coexistence. *Frontiers in Conservation Science*, *2*, 734314. https://doi.org/10.3389/fcosc.2021.734314

Jasmine, B., Ghose, D., & Das, S. K. (2015). An attitude assessment of human-elephant conflict in a critical wildlife corridor within the Terai arc landscape, India. *Journal of Threatened Taxa*, *7*, 6843–6852. https://doi.org/10.11609/JoTT.o3914.6843-52

Jigme, K., & Williams, C. (2011). Current status of Asian elephants in Bhutan. *Gajah*, *35*, 25–28.

Johnson, B. B., & Sciascia, J. (2013). Views on black bear management in New Jersey. *Human Dimensions of Wildlife*, *18*, 249–262. https://doi.org/10.1080/10871209.2013.792021

Jordan, N. R., Smith, B. P., Appleby, R. G., Eeden, L. M., & Webster, H. S. (2020). Addressing inequality and intolerance in human–wildlife coexistence. *Conservation Biology*, *34*, 803–810. https://doi.org/10.1111/cobi.13471

Kanagaraj, R., Araujo, M. B., Barman, R., Davidar, P., De, R., Digal, D. K., Gopi, G. V., Johnsingh, A. J. T., Kakati, K., Kramer-Schadt, S., Lamichhane, B. R., Lyngdoh, S., Madhusudan, M. D., Ul Islam Najar, M., Parida, J., Pradhan, N. M. B., Puyravaud, J., Raghunath, R., Rahim, P. P. A., … Goyal, S. P. (2019). Predicting range shifts of Asian elephants under global change. *Diversity and Distributions*, *25*, 822–838. https://doi.org/10.1111/ddi.12898

Kansky, R., Kidd, M., & Knight, A. T. (2014). Meta-analysis of attitudes toward damage-causing mammalian wildlife. *Conservation Biology*, *28*, 924–938. https://doi.org/10.1111/cobi.12275

Kansky, R., Kidd, M., & Knight, A. T. (2016). A wildlife tolerance model and case study for understanding human wildlife conflicts. *Biological Conservation*, *201*, 137–145. https://doi.org/10.1016/j.biocon.2016.07.002

Kansky, R., & Knight, A. T. (2014). Key factors driving attitudes towards large mammals in conflict with humans. *Biological Conservation*, *179*, 93–105. https://doi.org/10.1016/j.biocon.2014.09.008

Karanth, K. K., Gopalaswamy, A. M., Prasad, P. K., & Dasgupta, S. (2013). 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

Kariyawasam, S., Wilson, C., Ishara, L., & Rathnayaka, M. (2020). Conservation versus socio-economic sustainability: A case study of the Udawalawe National Park, Sri Lanka. *Environmental Development*, *35*, 100517. https://doi.org/10.1016/j.envdev.2020.100517

Karns, G. R., Heeren, A., Toman, E. L., Wilson, R. S., Szarek, H. K., & Bruskotter, J. T. (2021). Should Grizzly Bears be Hunted or Protected? Social and Organizational Affiliations Influence Scientific Judgments 7.

Kendal, D., & Ford, R. M. (2018). The role of social license in conservation. *Conservation Biology*, *32*, 493–495. https://doi.org/10.1111/cobi.12994

King, L. E., Lawrence, A., Douglas-Hamilton, I., & Vollrath, F. (2009). Beehive fence deters crop-raiding elephants. *African Journal of Ecology*, *47*, 131–137. https://doi.org/10.1111/j.1365-2028.2009.01114.x

King, L. E., Soltis, J., Douglas-Hamilton, I., Savage, A., & Vollrath, F. (2010). Bee threat elicits alarm call in African elephants. *PLoS One*, *5*, e10346. https://doi.org/10.1371/journal.pone.0010346

König, H. J., Kiffner, C., Kramer-Schadt, S., Fürst, C., Keuling, O., & Ford, A. T. (2020). Human–wildlife coexistence in a changing world. *Conservation Biology*, *34*, 786–794. https://doi.org/10.1111/cobi.13513

Köpke, S., Withanachchi, S. S., Pathiranage, R., Withanachchi, C. R., Gamage, D. U., Nissanka, T. S., Warapitiya, C. C., Nissanka, B. M., Ranasinghe, N. N., Senarathna, C. D., Schleyer, C., & Thiel, A. (2021). Human–elephant conflict in Sri Lanka: A critical review of causal explanations. *Sustainability*, *13*, 8625. https://doi.org/10.3390/su13158625

Köpke, S., Withanachchi, S. S., Pathiranage, R., Withanachchi, C. R., Perera, E. N. C., Schleyer, C., & Thiel, A. (2023). Human–elephant conflict in the Sri Lankan dry zone: Investigating social and geographical drivers through field-based methods. *GeoJournal*, *88*, 5153–5172. https://doi.org/10.1007/s10708-023-10913-7

LaDue, C. A., Eranda, I., Jayasinghe, C., & Vandercone, R. P. G. (2021). Mortality patterns of Asian elephants in a region of human–elephant conflict. *Journal of Wildlife Management*, *85*, 794–802. https://doi.org/10.1002/jwmg.22012

LaDue, C. A., Vandercone, R. P. G., Kiso, W. K., & Freeman, E. W. (2021). Scars of human–elephant conflict: Patterns inferred from field observations of Asian elephants in Sri Lanka. *Wildlife Research*, *48*, 540–553. https://doi.org/10.1071/WR20175

Liefting, Y., de Jong, J. F., & Prins, H. H. T. (2018). A new type of elephant fence: Permeable for people and game but not for elephant. *Gajah*, *49*, 11–19.

Liu, P., Wen, H., Harich, F. K., He, C., Wang, L., Guo, X., Zhao, J., Luo, A., Yang, H., Sun, X., Yu, Y., Zheng, S., Guo, J., Li, L., & Zhang, L. (2017). Conflict between conservation and development: Cash forest encroachment in Asian elephant distributions. *Scientific Reports*, *7*, 6404. https://doi.org/10.1038/s41598-017-06751-6

Lute, M. L., Carter, N. H., López-Bao, J. V., & Linnell, J. D. C. (2018). Conservation professionals agree on challenges to coexisting with large carnivores but not on solutions. *Biological Conservation*, *218*, 223–232. https://doi.org/10.1016/j.biocon.2017.12.035

Lute, M. L., Carter, N. H., López-Bao, J. V., & Linnell, J. D. C. (2020). Conservation professionals' views on governing for coexistence with large carnivores. *Biological Conservation*, *248*, 108668. https://doi.org/10.1016/j.biocon.2020.108668

Ly, C. T., Hung, V., Anh, N. C. T., Bao, H. D., Quoc, P. D. P., Khanh, H. T., van Minh, N., Cam, N. T. H., & Cuong, C. D. (2020). A pilot study of cultivating non-preferred crops to mitigate human-elephant conflict in the buffer zone of yok don National Park, Vietnam. *Gajah*, *51*, 4–9.

Madden, F. (2004). Creating coexistence between humans and wildlife: Global perspectives on local efforts to address human–wildlife conflict. *Human Dimensions of Wildlife*, *9*, 247–257. https://doi.org/10.1080/10871200490505675

Madhusudan, M. D., Sharma, N., Raghunath, R., Baskaran, N., Bipin, C. M., Gubbi, S., Johnsingh, A. J. T., Kulkarni, J., Kumara, H. N., Mehta, P., Pillay, R., & Sukumar, R. (2015). Distribution, relative abundance, and conservation status of Asian elephants in Karnataka, southern India. *Biological Conservation*, *187*, 34–40. https://doi.org/10.1016/j.biocon.2015.04.003

Manfredo, M. J., Berl, R. E. W., Teel, T. L., & Bruskotter, J. T. (2021). Bringing social values to wildlife conservation decisions. *Frontiers in Ecology and the Environment*, *19*, 355–362. https://doi.org/10.1002/fee.2356

Marchini, S., Ferraz, K. M. P. M. B., Zimmermann, A., Guimarães-Luiz, T., Morato, R., Correa, P. L. P., & Macdonald, D. W. (2019). Planning for coexistence in a complex human-dominated world. In B. Frank, J. A. Glikman, & S. Marchini (Eds.), *Human–wildlife interactions: Turning conflict into coexistence* (pp. 414–438). Cambridge University Press. https://doi.org/10.1017/9781108235730.022

Margulies, J. D., & Karanth, K. K. (2018). The production of human-wildlife conflict: A political animal geography of encounter. *Geoforum*, *95*, 153–164. https://doi.org/10.1016/j.geoforum.2018.06.011

Menon, V., & Tiwari, S. K. R. (2019). Population status of Asian elephants *Elephas maximus* and key threats. *International Zoo Yearbook*, *53*, 17–30. https://doi.org/10.1111/izy.12247

Nair, R. P., & Jayson, E. A. (2021). Estimation of economic loss and identifying the factors affecting the crop raiding behaviour of Asian elephant (*Elephas maximus*) in Nilambur part of the southern Western Ghats, Kerala, India. *Current Science*, *121*, 521. https://doi.org/10.18520/cs/v121/i4/521-528

Nath, N. K., Lahkar, B. P., Brahma, N., Dey, S., Das, J. P., Sarma, P. K., & Talukdar, B. K. (2009). An assessment of human-elephant conflict in Manas National Park, Assam, India. *Journal of Threatened Taxa*, *1*, 309–316. https://doi.org/10.11609/JoTT.o1821.309-16

Nayak, M., & Swain, P. K. (2020). From fear to festivity: Multi-stakeholder perspectives on human-elephant conflict and coexistence in India. *Journal of Public Affairs*, *22*, e2496. https://doi.org/10.1002/pa.2496

Neupane, B., Khatiwoda, B., & Budhathoki, S. (2018). Effectiveness of solar-powered fence in reducing human-wild elephant conflict (HEC) in northeast Jhapa district, Nepal. *Journal of Institute of Forestry, Nepal*, *15*, 13–27. https://doi.org/10.3126/forestry.v15i0.24917

Neupane, D., Johnson, R. L., & Risch, T. S. (2017). How do land-use practices affect human: Elephant conflict in Nepal? *Wildlife Biol*, *2017*, wlb.00313. https://doi.org/10.2981/wlb.00313

Noga, S. R., Kolawole, O. D., Thakadu, O., & Masunga, G. (2015). Small farmers' adoption behaviour: Uptake of elephant crop-raiding deterrent innovations in the Okavango Delta, Botswana. *African Journal of Science, Technology, Innovation and Development*, *7*, 408–419. https://doi.org/10.1080/20421338.2015.1096511

Nyhus, P. J., Tilson, R., & Sumianto. (2000). Crop-raiding elephants and conservation implications at Way Kambas National Park, Sumatra, Indonesia. *Oryx*, *34*, 262–274. https://doi.org/10.1046/j.1365-3008.2000.00132.x

Ogra, M., & Badola, R. (2008). Compensating human–wildlife conflict in protected area communities: Ground-level perspectives from Uttarakhand, India. *Human Ecology*, *36*, 717–729. https://doi.org/10.1007/s10745-008-9189-y

Ogra, M. V. (2008). Human–wildlife conflict and gender in protected area borderlands: A case study of costs, perceptions, and vulnerabilities from Uttarakhand (Uttaranchal), India. *Geoforum*, *39*, 1408–1422. https://doi.org/10.1016/j.geoforum.2007.12.004

Oommen, M. A. (2021). Beasts in the garden: Human–wildlife coexistence in India's past and present. *Frontiers in Conservation Science*, *2*, 1–15. https://doi.org/10.3389/fcosc.2021.703432

Osipova, L., Okello, M. M., Njumbi, S. J., Ngene, S., Western, D., Hayward, M. W., & Balkenhol, N. (2018). Fencing solves human–wildlife conflict locally but shifts problems elsewhere: A case study using functional connectivity modelling of the African elephant. *Journal of Applied Ecology*, *55*, 2673–2684. https://doi.org/10.1111/1365-2664.13246

Othman, N., Goossens, B., Cheah, C. P. I., Nathan, S., Bumpus, R., & Ancrenaz, M. (2019). Shift of paradigm needed towards improving human–elephant coexistence in monoculture landscapes in Sabah. *International Zoo Yearbook*, *53*, 161–173. https://doi.org/10.1111/izy.12226

Padalia, H., Ghosh, S., Reddy, C. S., Nandy, S., Singh, S., & Kumar, A. S. (2019). Assessment of historical forest cover loss and fragmentation in Asian elephant ranges in India. *Environmental Monitoring and Assessment*, *191*, 802. https://doi.org/10.1007/s10661-019-7696-5

Pant, G., Dhakal, M., Pradhan, N. M. B., Leverington, F., & Hockings, M. (2016). Nature and extent of human-elephant *Elephas maximus* conflict in central Nepal. *Oryx*, *50*, 724–731. https://doi.org/10.1017/S0030605315000381

Pastorini, J., Janaka, H. K., Nishantha, H. G., Prasad, T., Leimgruber, P., & Fernando, P. (2013). A preliminary study on the impact of changing shifting cultivation practices on dry season forage for Asian elephants in Sri Lanka. *Tropical Conservation Science*, *6*, 770–780. https://doi.org/10.1177/194008291300600605

Pekor, A., Miller, J. R. B., Flyman, M. V., Kasiki, S., Kesch, M. K., Miller, S. M., Uiseb, K., van der Merve, V., & Lindsey, P. A. (2019). Fencing Africa's protected areas: Costs, benefits, and management issues. *Biological Conservation*, *229*, 67–75. https://doi.org/10.1016/j.biocon.2018.10.030

Peterson, M. N., Birckhead, J. L., Leong, K., Peterson, M. J., & Peterson, T. R. (2010). Rearticulating the myth of human-wildlife conflict. *Conservation Letters*, *3*, 74–82. https://doi.org/10.1111/j.1755-263X.2010.00099.x

Pimmanrojnagool, V., & Wanghongsa, S. (2002). A study of street wandering elephants in Bangkok and the socio-economic life of their mahouts: Viroj Pimmanrojnagool. In I. Baker & M. Kashio (Eds.), *Giants in our hands. Proceedings of the international workshop on the domesticated Asian elephant, 2001 February 5–10* (pp. 35–42). Food and Agriculture Organization Regional Office for Asia and the Pacific.

Pinter-Wollman, N. (2009). Spatial behaviour of translocated African elephants (*Loxodonta africana*) in a novel environment: Using behaviour to inform conservation actions. *Behaviour*, *146*, 1171–1192. https://doi.org/10.1163/156853909X413105

Ponnusamy, V., Chackrapani, P., Lim, T. W., Saaban, S., & Campos-Arceiz, A. (2016). Farmers' perceptions and attitudes towards government-constructed electric fences in peninsular Malaysia. *Gajah*, *45*, 4–11.

Pooley, S. (2016). A cultural herpetology of nile crocodiles in Africa. *Conservation and Society*, *14*, 391–405. https://doi.org/10.4103/0972-4923.197609

Pooley, S., Barua, M., Beinart, W., Dickman, A., Holmes, G., Lorimer, J., Loveridge, A. J., Macdonald, D. W., Marvin, G., Redpath, S., Sillero-Zubiri, C., Zimmermann, A., & Milner-Gulland, E. J. (2017). An interdisciplinary review of current and future approaches to improving human–predator relations. *Conservation Biology*, *31*, 513–523. https://doi.org/10.1111/cobi.12859

Pooley, S., Bhatia, S., & Vasava, A. (2021). Rethinking the study of human–wildlife coexistence. *Conservation Biology*, *35*, 784–793. https://doi.org/10.1111/cobi.13653

Prakash, T. G. S. L., Wijeratne, A. W., & Fernando, P. (2020). Human-elephant conflict in Sri Lanka: Patterns and extent. *Gajah*, *51*, 16–25.

Puyravaud, J., Cushman, S. A., Reddy, P. A., Boominathan, D., Sharma, R., Arumugam, N., Selvan, K. M., Mohanraj, N., Arulmozhi, S., Rahim, A., Kalam, T., De, R., Udayraj, S., Luis, A., Najar, M. U. I., Raman, K., Krishnakumar, B. M., Goyal, S. P., & Davidar, P. (2022). Fencing can alter gene flow of Asian elephant populations within protected areas. *Conservation*, *2*, 709–725. https://doi.org/10.3390/conservation2040046

Qomariah, I. N., Rahmi, T., Said, Z., & Wijaya, A. (2018). Conflict between human and wild Sumatran elephant (*Elephas maximus sumatranus* Temminck, 1847) in Aceh Province, Indonesia. *Biodiversitas Journal of Biological Diversity*, *20*, 77–84. https://doi.org/10.13057/biodiv/d200110

R Core Team. (2022). R: A language and environment for statistical computing.

Redpath, S. M., Bhatia, S., & Young, J. (2015). Tilting at wildlife: Reconsidering human–wildlife conflict. *Oryx*, *49*, 222–225. https://doi.org/10.1017/S0030605314000799

Redpath, S. M., Young, J., Evely, A., Adams, W. M., Sutherland, W. J., Whitehouse, A., Amar, A., Lambert, R. A., Linnell, J. D. C., Watt, A., & Gutiérrez, R. J. (2013). Understanding and managing conservation conflicts. *Trends in Ecology & Evolution*, *28*, 100–109. https://doi.org/10.1016/j.tree.2012.08.021

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation*, *141*, 2417–2431. https://doi.org/10.1016/j.biocon.2008.07.014

Saif, O., Kansky, R., Palash, A., Kidd, M., & Knight, A. T. (2020). Costs of coexistence: Understanding the drivers of tolerance towards Asian elephants *Elephas maximus* in rural Bangladesh. *Oryx*, *54*, 603–611. https://doi.org/10.1017/S0030605318001072

Samaranayake, G. D. K., Herath, H. M. H. I., Piyadasa, T. S. K., & Dangolla, A. (2023). Private electric fences: A novel and effective approach to preventing elephant depredation. *Gajah*, *56*, 36–39. https://doi.org/10.2305/DXXK3113

Sampson, C., Glikman, J. A., Rodriguez, S. L., Tonkyn, D., Soe, P., O'Connor, D., Chit, A. M., & Leimgruber, P. (2022). Rural and urban views on elephants, conservation and poaching. *Oryx*, *56*, 609–616. https://doi.org/10.1017/S0030605321000156

Sampson, C., Leimgruber, P., Rodriguez, S., McEvoy, J., Sotherden, E., & Tonkyn, D. (2019). Perception of human–elephant conflict and conservation attitudes of affected communities in Myanmar. *Tropical Conservation Science*, *12*, 194008291983124. https://doi.org/10.1177/1940082919831242

Sampson, C., Rodriguez, S. L., Leimgruber, P., Huang, Q., & Tonkyn, D. (2021). A quantitative assessment of the indirect impacts of human-elephant conflict. *PLoS One*, *16*, e0253784. https://doi.org/10.1371/journal.pone.0253784

Santiapillai, C., Wijeyamohan, S., Bandara, G., Athurupana, R., Dissanayake, N., & Read, B. (2010). An assessment of the human-elephant conflict in Sri Lanka. *Ceylon Journal of Science (Biological Sciences)*, *39*, 21–33. https://doi.org/10.4038/cjsbs.v39i1.2350

Shaffer, L. J., Khadka, K. K., Van Den Hoek, J., & Naithani, K. J. (2019). Human-elephant conflict: A review of current management strategies and future directions. *Frontiers in Ecology and Evolution*, *6*, 235. https://doi.org/10.3389/fevo.2018.00235

Singh, A., Kumara, H. N., Mahato, S., & Velankar, A. D. (2023). Anthropogenic driven range expansion of Asian elephant *Elephas maximus* in an agricultural landscape and its consequences in South West Bengal, India. *Journal for Nature Conservation*, *73*, 126374. https://doi.org/10.1016/j.jnc.2023.126374

Sponarski, C. C., Vaske, J. J., & Bath, A. J. (2015). Differences in management action acceptability for coyotes in a National Park. *Wildlife Society Bulletin*, *39*, 239–247. https://doi.org/10.1002/wsb.535

Stinchcomb, T. R., Ma, Z., Swihart, R. K., Caudell, J. N., Nyssa, Z., & Sponarski, C. C. (2024). Mapping social conflicts to enhance the integrated management of white-tailed deer (*Odocoileus virginianus*). *Conservation Science and Practice*, *6*, e13086. https://doi.org/10.1111/csp2.13086

Stüwe, M., Abdul, J. B., Nor, B. M., & Wemmer, C. M. (1998). Tracking the movements of translocated elephants in Malaysia using satellite telemetry. *Oryx*, *32*, 68–74. https://doi.org/10.1046/j.1365-3008.1998.00019.x

Su, K., Ren, J., Yang, J., Hou, Y., & Wen, Y. (2020). Human-elephant conflicts and villagers' attitudes and knowledge in the Xishuangbanna nature reserve, China. *International Journal of Environmental Research and Public Health*, *17*, 8910. https://doi.org/10.3390/ijerph17238910

Su, K., Zhang, H., Lin, L., Hou, Y., & Wen, Y. (2022). Bibliometric analysis of human–wildlife conflict: From conflict to coexistence. *Ecological Informatics*, *68*, 101531. https://doi.org/10.1016/j.ecoinf.2021.101531

Sugiyo, Ardiantiono, Santo, A., Marthy, W., & Amama, F. (2016). Evaluating the intervention methods to reduce human-elephant conflict around way Kambas National Park. In *Conserving Sumatran wildlife heritage for sustainable livelihood; proceedings of the 3rd international wildlife symposium* (pp. 30–36). University of Lampung.

Sugumar, S. J., & Jayaparvathy, R. (2013). An early warning system for elephant intrusion along the forest border areas. *Current Science*, *104*, 1515–1526.

Sukumar, R. (2003). *The living elephants: Evolutionary ecology, behavior and conservation*. Oxford University Press.

Sukumar, R. (2006). A brief review of the status, distribution and biology of wild Asian elephants *Elephas maximus*. *International Zoo Yearbook*, *40*, 1–8. https://doi.org/10.1111/j.1748-1090.2006.00001.x

Talukdar, N. R., & Choudhury, P. (2020). Attitudes and perceptions of the local people on human–elephant conflict in the Patharia Hills reserve Forest of Assam, India. *Proceedings of the Zoological Society*, *73*, 380–391. https://doi.org/10.1007/s12595-020-00343-5

Tan, A. S. L., de la Torre, J. A., Wong, E. P., Thuppil, V., & Campos-Arceiz, A. (2020). Factors affecting urban and rural tolerance towards conflict-prone endangered megafauna in peninsular Malaysia. *Global Ecology and Conservation*, *23*, e01179. https://doi.org/10.1016/j.gecco.2020.e01179

Thant, Z. M., May, R., & Røskaft, E. (2021). Pattern and distribution of human-elephant conflicts in three conflict-prone landscapes in Myanmar. *Global Ecology and Conservation*, *25*, e01411. https://doi.org/10.1016/j.gecco.2020.e01411

Thant, Z. M., May, R., & Røskaft, E. (2022). Human–elephant coexistence challenges in Myanmar: An analysis of fatal elephant attacks on humans and elephant mortality. *Journal for Nature Conservation*, *69*, 126260. https://doi.org/10.1016/j.jnc.2022.126260

The World Bank. (2022). Countries and economies (WWW Document). https://data.worldbank.org/country

Thekaekara, T., Bhagwat, S. A., & Thornton, T. F. (2021). Coexistence and culture: Understanding human diversity and tolerance in human-elephant interactions. *Frontiers in Conservation Science*, *2*, 735929. https://doi.org/10.3389/fcosc.2021.735929

Tisdell, C., & Zhu, X. (1998). Protected areas, agricultural pests and economic damage: Conflicts with elephants and pests in Yunnan, China. *Environmentalist*, *18*, 109–118.

Treves, A., & Santiago-Ávila, F. J. (2020). Myths and assumptions about human-wildlife conflict and coexistence. *Conservation Biology*, *34*, 811–818. https://doi.org/10.1111/cobi.13472

Tripathy, B. R., Liu, X., & Ranga, V. (2022). Demographic circumstances and people's sentiments towards elephants in the human–elephant conflict hotspot villages of Keonjhar forest division in eastern India. *Diversity*, *14*, 311. https://doi.org/10.3390/d14050311

van de Water, A., King, L. E., Arkajak, R., Arkajak, J., van Doormaal, N., Ceccarelli, V., Sluiter, L., Doornwaard, S. M., Praet, V., Owen, D., & Matteson, K. (2020). Beehive fences as a sustainable local solution to human-elephant conflict in Thailand. *Conservation Science and Practice*, *2*, e260. https://doi.org/10.1111/csp2.260

van de Water, A., & Matteson, K. (2018). Human-elephant conflict in western Thailand: Socio-economic drivers and potential mitigation strategies. *PLoS One*, *13*, 1–14. https://doi.org/10.1371/journal.pone.0194736

van Eeden, L. M., Newsome, T. M., Crowther, M. S., Dickman, C. R., & Bruskotter, J. (2019). Social identity shapes support for management of wildlife and pests. *Biological Conservation*, *231*, 167–173. https://doi.org/10.1016/j.biocon.2019.01.012

Vaske, J. J. (2008). *Survey research and analysis: Applications in parks, recreation and human dimensions*. Venture Publishing Inc.

Vaske, J. J., Beaman, J., Barreto, H., & Shelby, L. B. (2010). An extension and further validation of the potential for conflict index. *Leisure Sciences*, *32*, 240–254. https://doi.org/10.1080/01490401003712648

Venkataraman, A. B., Saandeep, R., Baskaran, N., Roy, M., Madhivanan, A., & Sukumar, R. (2005). Using satellite telemetry to mitigate elephant-human conflict: An experiment in northern West Bengal, India. *Current Science*, *88*, 1827–1831.

Webber, C. E., Sereivathana, T., Maltby, M. P., & Lee, P. C. (2011). Elephant crop-raiding and human-elephant conflict in Cambodia: Crop selection and seasonal timings of raids. *Oryx*, *45*, 243–251. https://doi.org/10.1017/S0030605310000335

Williams, C., Tiwari, S. K. R., Goswami, V. R., de Silva, S., Kumar, A., Baskaran, N., Yoganand, K., & Menon, V. (2020). *Elephas maximus* (WWW document). IUCN Red List Threat. Species 2020. https://doi.org/10.2305/IUCN.UK.2020-3.RLTS.T7140A45818198.en

Wong, E. P., Campos-Arceiz, A., Zulaikha, N., Chackrapani, P., Quilter, A. G., de la Torre, J. A., Solana-Mena, A., Tan, W. H., Ong, L., Rusli, M. A., Sinha, S., Ponnusamy, V., Lim, T. W., Or, O. C., Aziz, A. F., Hii, N., Tan, A. S. L., Wadey, J., Loke, V. P. W., … Saaban, S. (2021). Living with elephants: Evidence-based planning to conserve wild elephants in a megadiverse south east Asian country. *Frontiers in Conservation Science*, *2*, 1–12. https://doi.org/10.3389/fcosc.2021.682590

Yang, W., Ma, Y., Jing, L., Wang, S., Sun, Z., Tang, Y., & Li, H. (2022). Differential impacts of climatic and land use changes on habitat suitability and protected area adequacy across the Asian elephant's range. *Sustainability*, *14*, 4933. https://doi.org/10.3390/su14094933

Zeppelzauer, M., Hensman, S., & Stoeger, A. S. (2015). Towards an automated acoustic detection system for free-ranging elephants. *Bioacoustics*, *24*, 13–29. https://doi.org/10.1080/09524622.2014.906321

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Cabral de Mel, S. J., Seneweera, S., Dangolla, A., Weerakoon, D. K., King, R., Maraseni, T., & Allen, B. L. (2024). Attitudes towards causes of and solutions to conflict between humans and Asian elephants. *Conservation Science and Practice*, *6*(11), e13238. https://doi.org/10.1111/csp2.13238