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Assessment of Community-Based Activities to Reduce Human-Elephant Conflict in Nepal

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Abstract

Human-elephant conflict (HEC) is a growing problem in Nepal. The Asian elephant (*Elephas maximus*) is the one of the most dangerous wildlife species in Nepal, causing more than 40% of wildlife conflicts with humans and 70% of human casualties. We developed an approach to assess the implementation of community-based HEC activities, and tested it in the buffer zone of the Chitwan National Park in southern Nepal. We conducted focus group sessions in 17 villages, rated 15 attributes in each community, and tested for significant correlations between the attributes. The communities implemented a wide range of community-based HEC activities with varying success. We found that communities with experience managing community forests tended to be more successful in implementing community based HEC activities. We recommend that the national park seek ways to speed up the lengthy process of registering community forests in the buffer zone villages, and provide additional technical and financial support to community-based HEC programs.

Introduction

Human-elephant conflict (HEC) is a growing problem in Nepal [1, 2]. The Asian elephant (*Elephas maximus)* is the most dangerous wildlife species in Nepal, causing more than 40% of the conflicts with humans and 70% of human casualties [3]. More than 290 incidents of elephant damage were reported in the buffer zones of Chitwan National Park and Parsa Wildlife Reserve between 2008 and 2012, including 21 deaths [4]. Most of the incidents occurred in the winter months [2]. The major cause for the increasing human elephant conflict (HEC) is the increasing fragmentation of remaining forests coupled with increasing elephant populations due to their migration from India [5].

Community based approaches have been recommended to address HEC in Nepal [6] and India [7]. Several studies have assessed elephant damage in Nepal in terms of human casualties, crop damage and economic loss, and recommended mitigation measures to reduce human wildlife conflict in Nepal [4, 8, 9]. However, no study to date has examined why some communities in Nepal are better able to implement community based HEC programs than others. Our study assessed the implementation of community-based HEC activities in the buffer zone of Chitwan National Park. We focused on the construction of solar electric fencing, the major community-based HEC approach in our study sites, but also assessed a number of other community based HEC activities. Solar electric fencing is considered to be the most cost effective approach to reducing damage from wild elephants [1].

We were particularly interested to learn if communities involved in the management of community forests (CF) were better able to collaborate in community-based HEC activities than communities that were not managing a CF. Governments around the world are increasingly devolving authority for forest management to the local level through community forestry programs [10-12]. This approach has been particularly widespread in Nepal, where more than 13,000 CF user groups in Nepal are managing 25% of the total area of national forests [13]. CFs are recognized as providing a range of economic and social benefits to the participating communities [10-12, 14]. An analysis of CFs in Nepal found evidence of improved governance, and concluded that CFs, “have much pertinent experience to offer in village level planning and decision making” p. 43 [15]. Another study reported that CF User Groups had effectively negotiated with external agencies for development projects in their villages such as rural electrification [16]. Therefore, we expected that communities managing CFs would possess the organizational skills to implement more effective community-based HEC programs.

Our study addressed three research questions:

1. Are communities with active CFs more successful at implementing HEC activities than communities without CFs?
2. What other factors make some communities more successful than others in implementing community-based HEC programs?
3. What can the government do to strengthen the capability of communities to implement community-based HEC activities?

Methods

Site Selection

We implemented the study in the buffer zone of Chitwan National Park in southern Nepal near the border with India. The area of the national park is 932 km^2 with an elevation range of 150 m to 950 m above sea level [17]. The climate of the area is classified as sub-tropical. We selected 17 villages in the buffer zone of the national park based on the findings of a previous study that assessed the number and types of HEC incidents in the buffer zone between 2008 and 2012 [4]. We selected 15 villages with the highest number of HEC incidents in five Village Development Committees (VDC), and included two villages in Kumjoj VDC that had fewer HEC incidents but were located in the same general area (Table 1).

We visited each village during January and February 2015 and conducted focus group sessions with the local residents to discuss how they are addressing conflict with elephants. Each focus group session lasted 2-4 hours and involved an average of nine participants. After each session, the villagers took us on a tour of their HEC sites, which provided another opportunity for us to ask questions. We also collected secondary data from office records and libraries of the Chitwan National Park and the Department of National Parks and Wildlife Conservation.

Prior to the visiting the first village, we developed a list of 15 attributes to quantify in each village. The first attribute was the total number of HEC incidents between 2008 and 2012 according to Pant and Hockings (2013). The other 14 attributes included socio-economic status, land tenure security, experience in implementing community-based HEC activities, experience with community forestry, and several attributes related to the impact and status of the HEC activities. We developed criteria to rank each of our new attributes on either a 1-3 or a 1-5 scale, and compiled an open-ended questionnaire to elicit the information we required to rate each attribute. This type of attribute ranking has been used in other studies of community based activities [18, 19]. We field-tested the rating system in the first three villages and made some adjustments before visiting the remaining villages (Table 2).

Statistical Analysis

We analyzed the data using IBM SPSS Statistics (v.25, Armonk, NYL IBM Corp). We classified the number of HEC incidents as interval data, and the ranking data for all other attributes as ordinal data. We tested for significant correlations using Kendal's Tau, which is considered the most appropriate nonparametric test when the sample size is small and there are many tied ranks [20]. We used one-tailed tests when we had predicted positive correlations and two-tailed tests when we did not have a specific prediction.

Results

Major problems in the villages

Eleven of the 17 focus groups considered wild elephants to be the most serious problems in their village, and all of the focus groups reported that the number of HEC incidents had increased during the previous two years. The most frequent damage was eating and trampling agricultural crops, which occurred in all of the 17 villages studied. The crops most often damaged by elephants were rice, wheat, and maize. Elephants also damaged houses or grain storage structures in all 17 villages. The elephants generally came into the villages between July and December. Humans had been injured or killed in four of the study villages during the previous two years. Single elephants did the most damage, although sometimes herds of elephants entered the villages.

The villagers offered different explanations for the increasing problems with elephants. Many believed that the national park was not large enough to support the increasing population of elephants and that a limited food supply in the national park was causing the elephants to search for food in the neighboring villages. Others attributed the problem to the release of older domesticated elephants that were previously used for tourism purposes in the national park. These elephants were unafraid of humans and accustomed to being fed by them. Furthermore, they tended to be larger than wild elephants.

Four of the 17 villages reported that flooding from the Riyo River was an even greater problem than elephant conflict. Flooding had repeatedly damaged their agricultural land and homes, and made it harder for them to implement activities to prevent elephants from entering their villages. Two villages reported that their most serious problem was landlessness or lack of drinking water supply (Table 3). Other wildlife species reported as serious problems in some villages included Bengal tiger (*Panthera tigris tigris*), Indian rhinoceros (*Rhinoceros unicornis*), chital (*Axis axis*), and Indian boar (*Sus scrofa cristatus*), all of which live in the national park but frequently enter the villages (Table 3).

Community Forestry

The community forestry program of Nepal allows villages to request the Forest Department to give them legal rights to manage a block of national forest near the village. The village must establish a CF management group that will coordinate the management of the CF and ensure that the forest is managed sustainability. The CF Management Group must also maintain accurate financial records and ensure that CF products are distributed equitably. We found that ten of the 17 study villages were participating in the community forestry program, and one was managing a community grassland (CG). Most of the CFs were not yet formally registered, which limited their management options. Nevertheless, most of the CFs and the CG appeared to be functioning well and providing valuable services to the communities.

The CF members were generally able to purchase timber or thatch grass once per year after making a nominal payment to the CF. The payments were deposited in the CF fund, which was managed by the CF management committee and used to hire forest guards to patrol the forest. CF funds were also used to support village development activities, including building gabion structures for flood control, supporting local schools, building community irrigation systems, improving access roads to the community, and providing loans to individual CF members for activities such as creating fish ponds or installing biogas systems. Some CFs produced bamboo for flood prevention activities, or provided free fuelwood to community members for events such as funerals and marriages. In four of the study sites, CFs provided valuable support to community-based HEC programs, including repair of the solar electric fences by the CF guards, and provision of CF timber to replace fence posts that were damaged by elephants.

Individual activities to reduce human- elephant conflict

Individuals in the villages implemented a number of activities to reduce elephant damage. The most common individual activity was shouting or making noise by striking tins to drive the elephants away. A few individuals constructed private watchtowers near their agriculture fields, or planted timber trees in their fields, which was less profitable than producing food crops but less likely to be damaged by elephants. However, these individual approaches had much less impact than community-based activities that are implemented on a much larger scale.

Community-based activities to reduce human- elephant conflict

The communities implemented nine types of community-based activities to reduce human elephant conflict. We classified these as Primary Activities, which involve construction and require significant inputs from the community, and Secondary Activities, which involve fewer community inputs (Table 4).

Solar Electric Fencing: The major HEC activity was construction of solar electric fences between the national park and the villages. Because electricity was generally not available in the area, this activity required the installation of batteries charged by solar panels. Most of the villages could not afford to implement this activity on their own, but fortunately, the national park provided technical and financial assistance. Each participating village established a "Functional Group" (FG) to manage the activity composed of 8-10 members. The national park provided wires, solar batteries, solar panels, other necessary items, and in some cases, timber from the national park for fence posts. The villagers provided labor to construct the solar fencing, which included carrying the poles to the site, placing and fixing poles, and attaching the fencing wire. The FGs assigned one or more guards to monitor elephant damage to the fence. The guards were also responsible for turning on the electric current each evening and turning it off in the morning. If any major damage to the fence took place, the guard informed the FG, which organized the villagers to repair it. Most communities paid the guards in cash or with food grains. In some communities, the households took turns as guards on a volunteer basis.

The solar electric fencing was highly effective at deterring elephants during the first year. However, the elephants quickly learned that they could avoid electric shocks by throwing trees at the fence and breaking the wires. The elephants also learned that they could knock down the fences by pushing against the posts. Therefore, the elephants started coming back into many of the villages during the 2^{nd} year, despite the efforts of the community to maintain the fence. The fencing was much more effective at controlling rhinos, which generally avoided the fences after getting shocked once. Flooding of the Riyo River has been an even greater problem for many communities. Flooding repeatedly swept many poles and wires of fenced areas, so the communities found it hard to cope with these two independent problems (elephant and flooding damage) simultaneously. In some villages, major repair work on the fences was required three times per year.

Dams: Several communities constructed earthen dams and built their solar fences on top of them. These earthen dams reduced the risk of flood damage to the fences, and made it harder for elephants to damage the electric fencing. In some cases, the villagers constructed the dams by hand. In other cases, the national park provided an excavator for the dam construction. In both cases, the community established a FG coordinate the construction. One person from every household was required to provide free labor. In some cases, villagers owning land near the dam constructed fishponds in the excavated areas, which provided an additional source of food and income.

The combination of dams and electric fencing was much more effective at reducing elephant damage. However, in some cases the elephants started damaging the fences by throwing trees on the wires from the bottom of the dams. They also damaged the dams by digging into the soil. However, the dams were still considered to be very effective, despite the significant amount of labor required to construct and maintain them.

Community Watchtower: The third activity we categorized as a "primary activity" was constructing community watchtowers. The participating villages established FGs to coordinate the construction of the towers. The national park provided the timber, which was harvested inside the park and transported to the village by tractor. One member of each household participated in harvesting the timber and constructing the watchtower. Some villages hired contractors to construct the towers. During June-December, when elephants were likely to enter the village, groups of villagers took turns sleeping in the towers. When an elephant entered the village, they villagers tried to deter them by making loud noise, lighting fires, or shining torchlights at the elephants. In some cases, they phoned the army and asked them to come drive the elephants away. This approach was successful at some sites, but elephants attacked and damaged some of the towers.

The villagers also experimented with a number of minor activities that we classified as "secondary activities."

Siren: One village tried using a siren that had been provided by the national park. The siren was stored in a household at the center of the village. When an elephant approached, the siren was used to frighten the elephant and to let the other villagers know that the elephant is present. This approach was effective in some cases, but did not always deter the elephant.

Elephant Guard: the national park helped three villages to experiment with a domesticated elephant guard. The national park provided two domesticated elephants to each village for 45 days. The communities were responsible for providing food to the elephant and an elephant driver. The presence of these large domesticated elephants deterred wild elephants from entering the village. This activity was effective, but the domesticated elephants were only available for one season.

Torchlight: The national park provided large torchlights to two villages. A team of three younger people in each community was selected to operate the torchlights. The community alerted the team if an elephant was seen in the village. Then the team focused the torchlights on the elephant from three directions and other villagers shouted or burned firewood. In one village, this activity was effective. However, after one year, the battery died and the village could not afford to replace it. In the other village, the elephants became aggressive when the torchlights were focused on it, and the community abandoned this approach.

Chili Powder: In two villages, the national park donated 500 sacks of chili powder, which the villagers mixed with cow dung. They placed the sacks along the electric fence and in different locations in the village. They burned the mixture at night when an elephant entered the ward. However, the villagers developed eye problems from the smoke when winds shifted, and the fumes made some elephants become more aggressive. After trying this method five times with limited success, the communities abandoned it.

Tractor Patrol: In one village, the national park provided a tractor and a torch light for patrolling during the crop-harvesting season. A group of six young people was involved in tractor patrolling on a rotational basis. When an elephant entered the village, they blew the horn of the tractor and focused the torchlight on the elephant. However, this method was not effective.

Community Burning: In two villages where residents had been killed by elephants during the previous year, the community collected firewood and stored it in multiple locations in their agricultural fields. The national park also provided some wood, which the villagers transported to their villages on bullock carts. When elephants entered the villages, groups of villagers lit fires in different locations. This activity was moderately successful, but some elephants continued to enter the villages.

Attribute Ratings in the Study Villages

Based on the focus group sessions and our discussions with community members during the field visits, we rated the 15 community attributes for the 17 villages (Tables 5A and 5B).

Correlations between Attributes

We predicted that many of the 15 attributes would be positively correlated. Our statistical tests of these predictions (one-tailed tests) found a number of significant correlations (Tables 6A and 6B). We also tested for correlations (two-tailed) between attributes for which we did not predict positive correlations. None of these test results was significant except for community capability with problem rating (Kendal's Tau = .543, $p < 0.016$, N=17) and community ability with flood resistance (Kendal's Tau = 0.612, $p < 0.006$, N=16).

Discussion

Were communities with active CFs more successful at implementing HEC activities than communities without CFs?

We assessed three attributes related to community forestry: the legal status of the CF, the range of activities implemented by the CF, and the amount of support that the CF contributed to HEC programs. As expected, these three attributes were positively correlated. We also detected a number of positive correlations between the CF attributes and the effectiveness of the HEC programs. CF experience was positively correlated with the scale of the HEC program, the impact of the HEC programs during the first year, and the current impact on rhino damage. CF contributions to HEC programs were positively correlated with the current impact of HEC programs on elephant damage, and with the current status of the electric fences.

We expected that villages with successful CFs would have greater motivation to implement additional HEC activities, but we did not detect any correlations between these attributes. We believe that this was largely due to the extensive flooding in the area, which repeatedly damaged the electric fencing in many of the villages and was significantly correlated to the current status of the fencing. We learned that HEC programs in some villages had initially very successful, but had failed by the time of our study. We originally assumed that the success of the HEC activities would be linked to the effort and capability of the communities, but the flooding turned out to be a confounding factor. Our findings agreed with research conducted one year after our study, which reported that only 26% of the electric fences in the buffer zone of the Chitwan National Park were operating effectively due to severe flood damage [21].

Another factor was the small sample size of our study. If we had been able to assess a greater number of villages, we may have detected a greater number of significant correlations between our CF attributes and the impact of the HEC programs. Nevertheless, we did not detect any significant negative correlations between these attributes. Therefore, despite the limitations of our study, we believe that our results support the hypothesis that experience with community forestry supports the implementation of more effective community-based HEC programs. Our findings agree with other studies that concluded that CFs helped communities develop improved governance and village-level planning, including negotiating with external agencies for development projects in their villages [15, 16].

Our findings on community capability also support our belief that strong community institutions have an important impact on a village's ability to manage community-based programs. We did not expect correlations between our community capability attribute and our CF attributes, because we knew that some very capable and motivated communities did not have any suitable land for establishing a CF, even though they would have liked to create one. However, our community capability attribute was positively correlated with impact on rhino damage, status of electric fencing, and community motivation to implement additional activities.

What other factors made some communities more successful than others in implementing community-based HEC programs?

We expected that communities with lower socio-economic status and less land tenure security would be less able to implement HEC programs than wealthier communities. However, we did not detect any significant correlations between these two attributes and any other attributes. We were encouraged by this finding, and believe that the financial support provided by the national park has made it possible for both rich and poor communities to participate in community-based HEC activities.

We assessed the current impact of the HEC programs with two attributes: impact on elephant damage, and impact on rhino damage. As expected, these two attributes were closely correlated, even though many communities reported that their HEC programs had been much more successful in reducing damage by rhinos. In addition, both attributes were correlated with the impact of the program during the first year, and with the current status of the fence, as we expected. We also expected that these two attributes would be correlated with community capability, but this was only the case for the impact on rhino damage.

We expected that the motivation of communities to implement additional HEC activities would be correlated with community capability, the scale of the HEC program, the impact during the first year, the status of the electric fence, and the impact on elephant and rhino damage. We detected significant correlations for all of these attributes, except for impact on elephant damage. We believe these correlations would have been even stronger without the confounding factor of the flooding.

How can the national park further strengthen the capability of communities to implement community-based HEC activities?

Based on our findings, we offer the following recommendations to the national park: (a) seek ways to speed up the process of CF registration, which would help communities develop the institutional capability to implement community-based HEC programs and also provide an additional source of local support for the HEC programs; (b) encourage communities in flood-prone areas to build solar fences on top of dams, and provide financial support to the communities for dam construction; and (c) provide more intensive training to the community functional groups on repair and maintenance of the solar batteries and associated wiring; and encourage the functional groups to maintain a supply of wire, iron nails and poles, so immediate repairs can be done after elephant damage.

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Table 1: Information about study villages, including the number of participants in the focus groups, and the number of HEC incidents between 2008 and 2012

Village Development Committee	Ward No	Total Households	Number of Focus Group Participants*	Number of HEC Incidents**			
				Property	Crop	Human casualty	All types
Ayodhapuri	1	200	10	7	2	0	9
Ayodhapuri	4	50	9	3	0	0	3
Ayodhapuri	5	100	12	6	5	0	11
Ayodhapuri	6	428	8	10	3	0	13
Ayodhapuri	7	650	7	5	4	0	9
Ayodhapuri	8	250	10	10	28	1	39
Ayodhapuri	9	1,000	11	8	5	4	17
Bagauda	5	100	8	5	11	0	16
Bagauda	6	200	9	6	3	0	9
Gardi	1	800	16	2	7	1	10
Gardi	4	700	8	6	2	1	9
Kalyanpur	6	190	9	5	11	0	16
Kalyanpur	9	300	6	2	4	0	6
Kumroj	2	250	8	2	0	0	2
Kumroj	3	2,000	8	3	0	0	3
Thori	3	90	6	2	1	1	4
Thori	5	250	7	3	3	0	6

* In the current study. **Based on Pant and Hockings (2013).

Table 2. Ranking criteria for village attributes

Rank	Ranking Criteria
HEC Incidents between 2008 and 2012	
	Total number of HEC incidents according to Pant and Hockings (2013)
HEC Problem Rating	
1	Community considers conflict with elephants to be their worst problem
2	Community considers conflict with elephants to be their 2nd worst problem
3	Community considers conflict with elephants to be their 3rd worst problem
Socio-economic status	
1	Almost all residents are subsistence farmers or agricultural laborers, living in traditional houses
2	Most residents are subsistence farmers or agricultural laborers, living in traditional houses
3	Approx. half of residents are commercial farmers living in improved houses with concrete walls or tin roofs
4	Most residents are commercial farmers living in improved houses with concrete walls or tin roofs
5	Almost all residents are commercial farmers living in improved houses with concrete walls or tin roofs
Land tenure security	
1	Almost all residents are landless
2	Most residents are landless
3	Approx. half residents are landless
4	Most residents are not landless
5	Almost no residents are landless
Capability of community intuitions to implement HEC activities	
1	Community lacks organizational capability to implement HEC activities
2	Community has limited organizational capability to implement HEC activities
3	Community has average organizational capability to implement HEC activities
4	Community has good organizational capability to implement HEC activities
5	Community has excellent organizational capability to implement HEC activities
Status of community forest or community grassland	
1	No community forest or community grassland
2	Existing community forest or community grassland that is not yet registered
3	Existing community forest or community grassland that is registered
Experience with community forest or community grassland	
1	No experience with community forest or community grassland
2	Community forest or community grassland not very active and members report poor management
3	Community forest or community grassland is moderately active with average management
4	Community forest or community grassland active with good management, and supports some village development activities
5	Community forest or community grassland is very active, well managed, and supports many village development activities

Rank	Ranking Criteria
Community forest support for HEC activities	
1	No community forest or community grassland
2	Existing community forest or community grassland but no support for HEC activities
3	Existing community forest or community grassland that supports HEC activities
Scale of HEC program	
1	Community has not implemented community-based HEC activities
2	Community implemented one major community-based HEC activity
3	Community implemented two major community-based HEC activities
4	Community implemented three major community-based HEC activities
5	Community implemented three major and two minor community-based HEC activities
Impact of HEC Activities during 1st year	
1	No reduction of damage from wildlife
2	Minor reduction of damage from wildlife
3	Moderate reduction of damage from wildlife
4	High reduction of damage from wildlife
5	Very high reduction of damage from wildlife
Current impact of fencing on rhinos	
1	No reduction of damage from wildlife
2	Minor reduction of damage from wildlife
3	Moderate reduction of damage from wildlife
4	High reduction of damage from wildlife
5	Very high reduction of damage from wildlife
Current impact of fencing on elephants	
1	No reduction of damage from wildlife
2	Minor reduction of damage from wildlife
3	Moderate reduction of damage from wildlife
4	High reduction of damage from wildlife
5	Very high reduction of damage from wildlife
Current status of fencing	
1	Most of the fencing damaged and/or electricity not provided
2	Many areas of fence damaged and/or electricity not available
3	Some portions of the fence functioning, other portions damaged or electricity not available
4	Some openings in fence, electricity generally available
5	Fencing functioning well with electricity
Resistance to flooding of fencing	
1	Flooding has caused extreme damage to fencing
2	Flooding has caused major damage to fencing
3	Flooding has caused moderate but repairable damage to fencing
4	Flooding has caused only minor damage to fencing
5	Flooding has not caused any damage to fencing
Motivation to implement additional HEC activities	
1	Community has lost all motivation to implement HEC activities
2	Community has limited motivation to implement HEC activities
3	Community has average motivation to implement HEC activities

Table 3: Three most serious problems in each study site

Ward	Worst Problem	2nd Problem	3rd Problem
Ayodhapuri-1	Elephant	Flooding	Chital
Ayodhapuri-4	Elephant	Flooding	Rhino
Ayodhapuri-5	Elephant	Rhino	Chital
Ayodhapuri-6	Flooding	Elephant	Wild boar
Ayodhapuri-7	Landlessness	Tiger	Elephant
Ayodhapuri-8	Elephant	Spotted deer	Tiger
Ayodhapuri-9	Elephant	Tiger	Rhino
Bagauda-5	Flooding	Elephant	Rhino
Bagauda-6	Flooding	Elephant	Rhino
Gardi-1	Elephant	Flooding	Rhino
Gardi-4	Elephant	Flooding	Rhino
Kalyanpur-6	Elephant	Flooding	Rhino
Kalyanpur-9	Elephant	Flooding	Rhino
Kumroj-2	Elephant	Rhino	Chital
Kumroj-3	Elephant	Rhino	Chital
Thori-3	Flooding	Elephant	Chital
Thori-5	Water supply	Elephant	Flooding

Table 4. Community based activities to human-elephant conflict in the 17 study sites

VDC and Ward	Primary Activities			Secondary Activities					
	Solar electric fence	Dam	Watch-tower	Siren	Elephant guard	Torch-light	Chili powder	Tractor patrol	Commu-nity burning
Ayodhapuri-1	X		X	X		X			
Ayodhapuri-4	X		X						
Ayodhapuri-5	X		X						
Ayodhapuri-6	X								
Ayodhapuri-7	X								
Ayodhapuri-8	X		X			X			
Ayodhapuri-9	X	X	X						
Bagauda-5	X		X						
Bagauda-6	X		X		X				
Gardi-1	X	X	X		X		X	X	X
Gardi-4	X						X		X
Kalyanpur-6	X	X	X		X				
Kalyanpur-9	X		X						
Kumroj-2									
Kumroj-3	X								
Thori-3	X		X						
Thori-5	X								

X = Implemented in village

Table 5A: Rating of village attributes for the study sites

Site	HEC incidents *	HEC problem rating	Socio-economic status	Land tenure	Capa-bility	CF Status	CF experience	CF HEC support
Ayodhapuri-1	9	3	2	4	3	2	3	3
Ayodhapuri-4	3	3	2	4	4	1	1	1
Ayodhapuri-5	11	3	2	4	4	1	1	1
Ayodhapuri-6	13	2	3	4	2	2	3	2
Ayodhapuri-7	9	1	2	3	4	2	3	2
Ayodhapuri-8	39	3	3	4	5	2	3	2
Ayodhapuri-9	17	3	2	4	4	2	2	2
Bagauda-5	16	2	2	4	4	1	1	1
Bagauda-6	9	2	3	3	3	1	1	1
Gardi-1	10	3	2	4	4	1	1	1
Gardi-4	9	3	2	2	4	1	1	1
Kalyanpur-6	16	3	2	4	5	2	3	2
Kalyanpur-9	6	3	2	4	5	2	4	3
Kumroj-2	2	3	3	4	5	3	5	1
Kumroj-3	3	3	4	4	5	3	5	3
Thori-3	4	2	2	4	3	3	4	3
Thori-5	6	2	2	4	2	2	3	1

* Based on Pant and Hockings (2013)

Table 5B: Rating of village attributes for the study sites

Site	Scale of HEC program	Impact after first year	Current impact elephant damage	Current impact rhino damage	Current status of fencing	Flood resistance of fencing	Current motivation
Ayodhapuri-1	3	5	1	3	2	2	3
Ayodhapuri-4	3	3	1	3	2	2	3
Ayodhapuri-5	3	4	1	3	2	2	3
Ayodhapuri-6	2	3	2	3	2	2	2
Ayodhapuri-7	2	5	3	3	3	4	2
Ayodhapuri-8	3	5	2	3	3	4	4
Ayodhapuri-9	4	5	2	4	4	4	4
Bagauda-5	3	5	2	3	3	3	3
Bagauda-6	4	5	3	3	3	2	4
Gardi-1	5	5	1	5	2	4	3
Gardi-4	2	5	1	4	3	4	3
Kalyanpur-6	5	5	2	5	5	2	4
Kalyanpur-9	3	5	3	4	4	5	4
Kumroj-2	1	1	1	1	*	*	3
Kumroj-3	2	2	2	4	4	5	3
Thori-3	3	5	2	2	3	2	3
Thori-5	2	2	1	2	2	2	2

* Kumroj–2 did not construct solar electric fence, so we did not provide a rating for these attributes.

Table 6A: Significant correlations between attributes for which we predicted positive correlations (Kendal's Tau, one-tailed).

	Elephant incidents	Problem rating	Socio-economic	Land tenure	Community capability	CF status	CF experience
Elephant incidents		ns					ns
Problem rating	ns						
Socio-economics							
Land tenure					ns		
Community capability						ns	
CF status							0.920^{**}
CF experience						0.920^{**}	
CF HEC support						0.648^{**}	0.654^{**}
Scale of HEC program	0.393^{*}	ns	ns	ns	ns	ns	ns
1st year impact	0.429^{*}	ns			ns	ns	0.576^{**}
Impact on elephants	ns	ns			ns	ns	ns
Impact on rhinos	ns	0.427^{*}			0.378^{*}	ns	0.453^{*}
Electric fence status	ns	ns			0.580^{**}	ns	ns
Flood resistance of fencing							
Current motivation	ns	0.471^{*}			0.469^{*}	ns	ns

*. Significant at the 0.05 level (1-tailed), **. Significant at the 0.01 level (1-tailed), ns = not significant. N=17 for all tests, except those involving Electric fence status or flood resistance for which N=16.

Table 6B: Significant correlations between attributes for which we predicted positive correlations (Kendal's Tau, one-tailed)

	CF HEC support	Scale of HEC program	1st year impact	Impact on elephants	Impact on rhinos	Electric fence status	Flood resistance of fencing	Current motivation
Elephant incidents	ns	0.393^{*}	0.429^{*}	ns	ns	ns		ns
Problem rating	ns		ns	ns	0.427^{*}	ns		0.471^{*}
Socio-economics		ns						
Land tenure		ns						
Community capability	ns	ns	ns	ns	0.378^{*}	0.580^{**}		0.469^{*}
CF status	0.648^{**}	ns	ns	ns	ns	ns		ns
CF experience	0.654^{**}	ns	ns	ns	ns	ns		ns
CF HEC support		ns	ns	0.426^{*}	ns	0.388^{*}		ns
Scale of HEC program	ns		0.576^{**}	ns	0.453^{*}	ns	ns	0.592^{**}
1st year impact	ns	0.576^{**}		0.377^{*}	0.383^{*}	ns		0.434^{*}
Impact on elephants	0.426^{*}	ns	0.377^{*}		ns	0.560^{**}	ns	ns
Impact on rhinos	ns	0.453^{*}	0.383^{*}	ns		0.468^{**}	0.497^{*}	0.375^{*}
Electric fence status	0.388^{*}	ns	ns	0.560^{**}	0.468^{**}		0.488^{*}	0.555^{**}
Flood resistance of fencing		ns		ns	0.497^{*}	0.488^{*}		ns
Current motivation	ns	0.592^{**}	0.434^{*}	ns	0.375^{*}	0.555^{**}	ns	

*. Significant at the 0.05 level (1-tailed), **. Significant at the 0.01 level (1-tailed), ns = not significant. N=17 for all tests, except those involving Electric fence status or flood resistance for which N=16.