The Rufford Foundation
Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Ashok Kumar Ram
Project title	Geospatial Habitat Suitability, Migratory Pattern of Asian Elephant (Elephus maximus) and its Coexistence in Central Nepal.
RSG reference	20338-2
Reporting period	Dec 2017- Dec 2018
Amount of grant	£ 4990
Your email address	ashokrink11@gmail.com
Date of this report	June 12, 2018

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Assess habitat suitability, migratory pattern of Asian elephants in Central Nepal				15 x15 km grids were prepared and plotted over the study area map for screening presence absence sign of elephants. Available forest roads, trails, rivers were used as transect/ segments to collect the presence absence data. Using presence only data habitats.
Aware students, teachers and local communities through conservation education, rally and radio program.				>2500 students from 20 secondary schools, and >5000 local residents were educated through conservation classes, conservation rally and conservation Radio programme.
Assess and map out human elephant conflict (HEC) status of central Nepal.				All the HEC prone areas were identified and surveyed for getting HEC status in terms of fatality, injury, crop and property damage from five districts.
Preliminary field visit.				Major HEC areas were identified and five higher conflict areas were selected for human elephant interface study.
Identification of CBOs.				Five CBAPOs, five BZUCs and10 CFUGs were identified. Two people of each CBOs were selected, trained and mobilised for conducting conservation education program in five identified conflict zones.
Transect & plot lay out for habitat suitability analysis				15 x15 km grids were plotted over the study area. Forest roads, trails, rivers were used as transect/ segments for screening presence absence of elephants.
Land use Land cover change (LULC).				
Habitat suitability analysis using MaxEnt method				Distance to forest, distance to road, distance to water holes, ecology. Ecoregion, distance to settlements, Aspects, slopes were used as variables for assessing habitat suitability through MaxEnt.

Conservation awareness Program:				BZUCS, BZFUGs, ECO clubs were used to carry out conservation education. 15 people were involved in conducting conservation education.
School education				Conservation education lectures were delivered in 20 different secondary schools by eco-clubs.
Conservation Radio program (Save the elephant: Hatti mero Sathi)				Twelve episodes of conservation radio programme on Hati mero Sathi (Save the elephants as a main theme) were broadcast from local FM radio (Radio Samarpan Simara).
Conservation rally.				Conservation rally was organised on the occasion of World Environment Day. Local CBOs, CFUGs, BZMCs, students, Nepal police and Armed Police Force, national park staff and ZSL staffs participated in a conservation rally. It was organised in Pathalaiya Bara.
Report preparation and submission				

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

Human-elephant conflict HEC) is a most serious problem in Nepal. There are 15-20 people killed each year during human elephant conflict and this number is increasing. In the meantime three to five elephants were also killed in retaliation. This year one elephant was killed by poaching. Their tusks were also stolen. Elephant poaching incident for ivory was experienced for the first time in Nepal.

Majority of HEC incidents occurred outside the protected areas on the migratory routes of elephants. Saptari, Siraha, Sindhuli, Mahotari, Dhanusa, Sarlahi, rautahat and Bara districts are some areas which experienced the most severe human-elephant conflicts outside the protected area.

Our study aim was also to assess HEC from five different highest conflict zones. We have selected hamlets and went for questionnaire survey. Some people reacted very positively and some people reacted very offensively. Some victims threatened us for not coming to their territory. This was a great unforeseen difficulties for us during our research.

We have tried to find out the reason for victims' aggression. Ultimately we came to know that some researcher went for interview and they assured them that they will come with monetary incentives and programmes but they never returned.

They also told that they hadn't gotten additional incentives form government and none of government staff visited after the incidents (death of their cousin). There is a gap in our policy because one time relief is only provisioned for death, injury, crop and property damage cases. Victims of death cases had lost their principal breadwinner and their responsibilities were shifted to their widow or kids. Ultimately the lifestyle of victim's families were changed, kids left schools and we also found victim's spouse were mentally ill in some cases. These victims were demanding widow allowances, employment, kids' education and health insurance.

Side by side, there were lots of researchers visiting the victim's house and asking the same questions repeatedly regarding conflict. These incidents made victim's spouse irritated because they have talked about their family death many times which opened their forgotten injury again. This is another unforeseen difficulties for me to accomplish my study. To address this problem we need to document all the HEC death and injury cases in a single book, which help future researcher to know conflict status from a single place.

These demands were not incorporated in the policy guidelines for mitigating human elephant conflict. There a strong policy and elephant conservation plan is required to address these problem.

3. Briefly describe the three most important outcomes of your project.

Asian Elephant (Elephus maximus) is an endangered species (IUCN 2011), Nepal's protected (NPWCA 1973) and Appendix I species (CITEC, 1973) of Nepal. There are 38-52000 elephants remaining in 13 Asian elephant range countries of the world (Sukumar 2006) and 15,000 are in captivity. India alone covers a 60% of global population of elephants(Sukumar 2006). Nepal is located as a small buffer land in between China and India. Nepal has a small population of elephants (109-142) distributed in four isolated populations (Pradhan, Williams, and Dhakal 2011).

As a mega herbivore and habitat generalist, it travels along migration routes and requires a large home range (14-10000 km^2) (Williams 2016). Asian elephant is a large bodied animal and required large amount of food (140-180 kg) and same amount of water per day.

Nepal bears very bears a small population which is distributed in four isolated populations (i.e. eastern, central, mid-western and far-western) (Dnpwc 2010). Bardiya alone has greater than 57 elephants (Flagstad et al. 2012) and the rest are distributed in eastern, central and far western Nepal. Eastern population migrated from West Bengal via Jhapa to Koshi Tappu Wildlife reserve (KTWR) sunsari and reached up to Jogidah Udaypur and western elephants from Corbett National Park (India) enter in to Nepal via Dudhuwa National Park to Suklaphanta National Park (ShuNP) and also entered through Katarniaghat Wildlife sanctuary to Bardiya National Park (BNP).

Nepalese Elephants migrated from Suklaphanta NP to Bardiya NP. (P.Velde 2011) in the west. 45-65 elephants (PNP 2018) (PNP 2017) are concentrated in central Nepal

from Chitwan National Park (CNP) to Parsa National Park (PNP). These elephants are also migrated towards Bagmati and Sarlahi. Elephants were migrating for searching of food, mates, salt leeks along the foot hills of Siwalik hills (P.Velde 2011). During their east west migration, they have interacted with local people, and as a result 5-10 people killed and 3-5 elephants were killed in retaliation each year (Ram 2014). Not only human fatality but also crop and property damages were also happened severely. These human elephant conflicts (HEC) were happened due to forest fragmentation, poaching, HEC & less education of elephant behaviour to local people. (Pant G et al., 2016).

To overcome human elephant conflict (HEC), poaching, retaliation and reduce forest fragmentation along with habitat improvement; Nepal Government (GON) has established a protected areas network having five National park and one Wildlife reserve along with four protected forest and six forest corridors.

Along with these interventions; GON has also initiated for providing relief to victims, raising solar fence (Electric fence) as well as concreted fence and highly galvanized iron metal pipe fence for reducing human elephant conflict. Side by side GON has also initiated human wildlife conflict mitigation program through community participation via buffer zone development program.

Though GON has intervened a lot of program including providing relief for compensating human wildlife conflict, but HEC is not reduced as per the innovation and becoming gaining momentum. There are >100 people killed in elephant attack and 50 people were having injured. (DNPWC 2014, 2015, 2017) and MOFE 2017. Besides this elephant's retaliation, electrocution and poaching is also happened. These incidents were happened due to less awareness, severe habitat fragmentation, forest degradation, invasive species extension, poaching and illegal trade of ivory in Nepal. Very less studies regarding nature and extent of HEC, its population, habitat suitability and migration pattern were carried out in Nepal.

Therefore this study was completed by raising conservation awareness among school kids, teachers, villagers, CBOs members, BZMCs, BZUCs, BZCFUgs, CFUGs through conducting conservation classes, stakeholder sensitization, school eco-clubs mobilizations, awareness raising material distribution and forecasting conservation Radio program "Save the Elephants" through local FM Radio Samarpan Simara, Bara. Besides conservation awareness, habitat suitability analysis and migration pattern of elephant were also assessed.

3.1. Objectives:

Assess habitat suitability, migratory pattern of Asian elephants in Central Nepal

Aware students, teachers and local communities through conservation education, rally and radio program.

Assess and map out human elephant conflict (HEC) status of central Nepal.

3.2. Methods:

Study area:

Nepal is a federal country having 7 provinces. There are 200-225 elephants distributed in four sub populations. My study area connects Province No. 1 in Udaypur, Province no 3 in Sindhuli, Makwanpur and Chitwan. The majority of my study area is distributed in Provinve No 2. This province has less forest, but bears highest human population having 27.95% poor people. (http://admin.myrepublica.com/economy/story/26637/poverty-severe-in-province-6-and-2.html). Majority forest areas were either encroached or deforested for infrastructure development work for highway, Airport, Public schools and Electric transmission line. Habitat fragmentation, habitat loss, forest destructions, encroachment leads elephant population decline and push elephants to migrate east west by using Siwalik (chure) foothills of Nepal.

This study covers 8 districts of central Nepal including Sindhuli, Mahotari, Sarlahi, Rautahat, Bara, Parsa, Makwanpur and Chitwan including two protected area i.e. Parsa National Park and Chitwan National Park. Previously we have also included Dhanusa district in this study and leaving Chitwan and Makwanpur district. Since Chitwan and Makwanpur district is covered by Chitwan National Park and have a good presence of elephant and it is also a hot spot of HEC, we have included both Makwanpur and Chitwan district by omitting Dhanusa district. This study area covers an area of broader Siwalik, Terai landscape and covers an area of 14332 square kilometre along with 8300 square kilometres of forest area including 2500 square kilometre protected areas of CNP and PNP.

Study area is bordered north by Mahabharat mountain range, south by Indian territory along with Valmiki Tiger Reserve (VTR), east by Dhanusa & Udaypur and bordered west by Nawalparasi district. Study area is rich in floral as well as faunal diversity. It has 120 tigers, 600 one horned rhinoceros, 405 Indian bison, 45-65 elephants and abundant number of dhole, prey species, bears and more than 500 birds species as well as more than 530 species of plants(CNP 2017, PNP 2017 & DNPWC 2017).

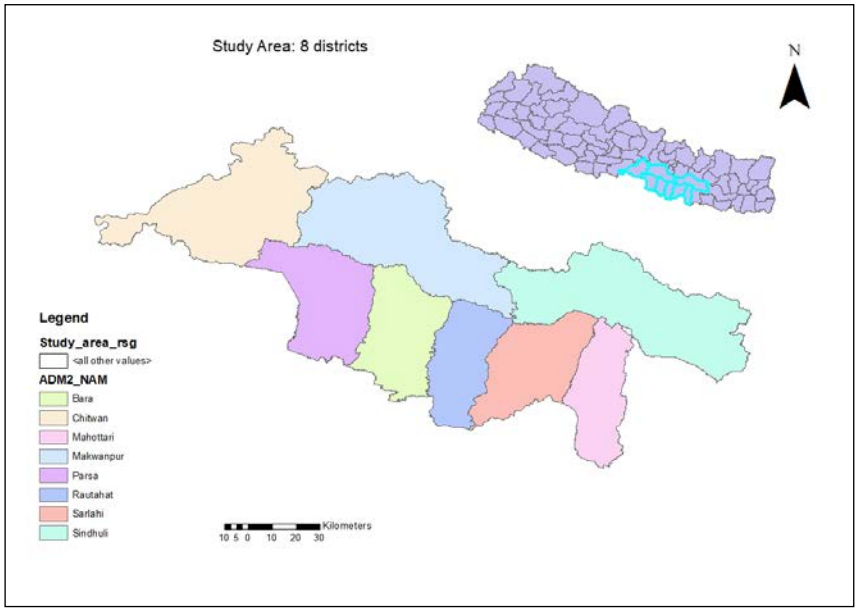


Figure1: Study area; 8 districts of central Nepal.

Among these elephant population 25-30 individuals have shared VTR, CNP and PNP area through Syauli- Brahamanagar-Valmiki corridor. Both Indian and Nepalese people in this area have impacted by human elephant conflict. To assess study objectives, we have used the following methods to accomplish the proposed study.

Grids allocation for transect survey.

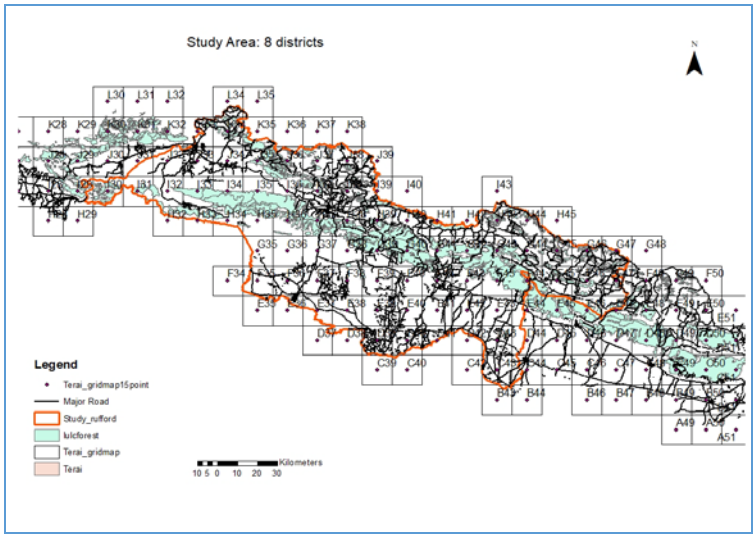


Figure 2: Study area grids used for transect survey.

Major outcomes of this study

A. Remote sensing and GIS used for interpreting results for habitat suitability

i. Satellite images and GIS data

In this study, Landsat series images were used for land use land cover (LULC) classification. The top of atmosphere (TOA) reflectance images were download from www.earthexplorer.com, these images were atmospherically corrected using py6s model. Google earth engine platform were used for LULC mapping. These classified images were download and final map were prepared in ArcMap 10.5.

ASTER 30m DEM were used to prepare slope, aspect and elevation map. Dem were corrected using ArcGIS to remove void.

Forest type layer, road network layer, river layer were purchase from survey department of Nepal. These layers were is Modifies UTM projection. Using ArcGIS tools it was project to geographical coordinate system.

Satellite imageries as shown in figure were used to assess the land use change in the study area. The primary data for this study were Landsat TM and ETM satellite imageries of different dates1990 and 2017 respectively. Criteria to the selection of the multi temporal Landsat data set involved assessment of cloud cover percentage, time of acquisition, and sensor type so that mapping and change detection scope was optimized.

ii. Methods of data analysis

Population data was assessed by guestimate during field survey and distribution map was made in Arc GIS. Vegetation analysis was done using formulas and MS Excel. Focus group discussion data was analysed using MS Excel. Data collected from different sources were entered into different software's. GIS software's ERDAS MAGINE and ArcGIS were used for analysis and interpretation of the satellite imageries and GIS data. GPS Utility of GIMIS was used to download and convert the GPS points and tracts to the ESRI shape file. For the change detection, Spatial Analyst on the ArcGIS was used. Quantitative data were analysed in descriptive manner and qualitative data were analysed by various appreciate tools and presented in charts and graphs. Euclidian Distance tool of ArcGIS was used to create proximity layer for road network and river layer. MaxEnt tool were used for species distribution modelling. 15 replicates were set to run the model 15 times. The final median, standard deviation, min and max of 15 replicates were generated.

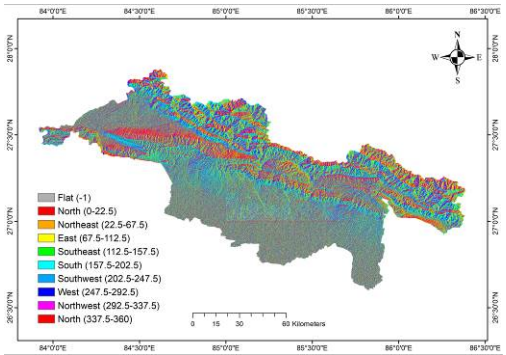
iii. Maximum entropy modelling (MaxEnt)

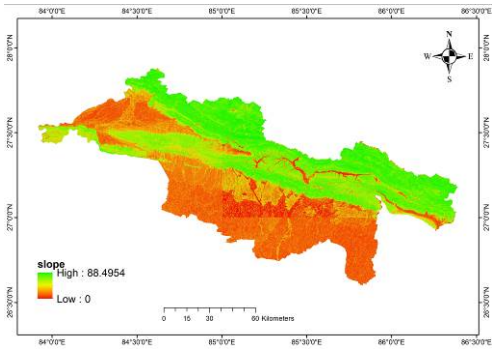
Habitat suitability was assessed through maxtent software by using presence signs of elephants. Elephants presence signs i.e. Elephant tracks, dungs, foot prints, tree bark peeling and breaches signs were detected and recorded along with land use and forest condition during transects survey inside the 15*15 square kilometre grids. Almost all the grids were swept for getting presence absence of elephant along with GPS points and land use.

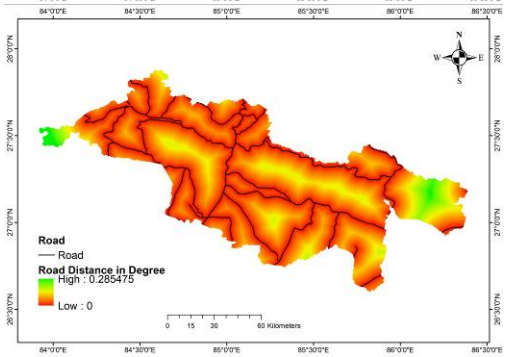
Maximum entropy modelling of species geographic distributions (MaxEnt) was used for predicting probability of occurrence of Elephant (Phillips, S. J., et al., 2006 & Kafle H., *et al.* 2009). Continuous predictor variables as proximity to forest, proximity settlement, proximity to water bodies, proximity to road and proximity to DEM and categorical land use / land cover map were used as independents to evaluate the habitat variables that effectively defines elephant presence.

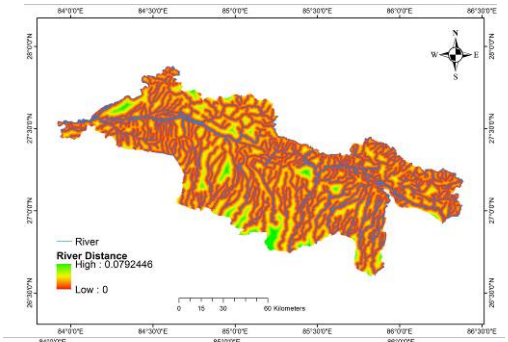
In this study 15 split-sample models for Elephant, created Sat My 12 09:08:07 NPT 2018 using Maxent version 3.4.1. 345 presence records used for training, 115 for testing & 10000 points used to determine the Maxent distribution (background points and presence points). AUC value ranging from 0 and 1. The average test AUC for the replicate runs is 0.898, and the standard deviation is 0.008. (Calculated as in DeLong, DeLong & Clarke-Pearson 1988, and equation 2). The algorithm converged after 1180 iterations (18 seconds).

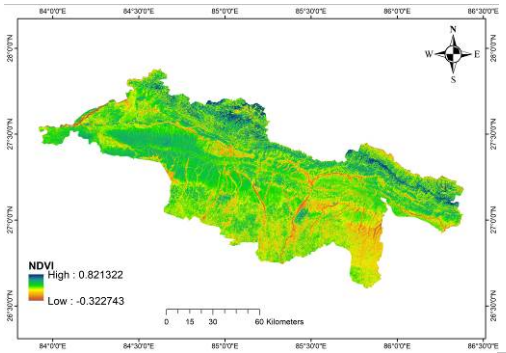
We have used 12 different environment variables for running MaXent (all continuous): Soil types, forest distance, elevation, lulc, NDVI, slope, road distance, ecology, ecoregion, aspect. Settlement distance, river distance) and get the regularization values: linear/quadratic/product: 0.050, categorical: 0.250, threshold: 1.000, hinge: 0.500. Continuous predictor variables as Soil types, forest distance, elevation, lulc, slope, road distance, ecology, ecoregion, aspect. Settlement distance, river distance e used as independents to evaluate the habitat variables that effectively define elephant presence. These are some major variables used for analysing MaxEnt.

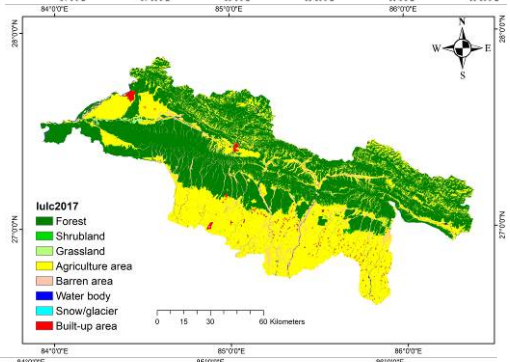

Flat (-1)
North (0-22.5)
Northeast (22.5-67.5)
East (67.5-112.5)
Southeast (112.5-157.5)
South (157.5-202.5)
Southwest (202.5-247.5)
West (247.5-292.5)
Northwest (292.5-337.5)
North (337.5-360)
60 Kilometers

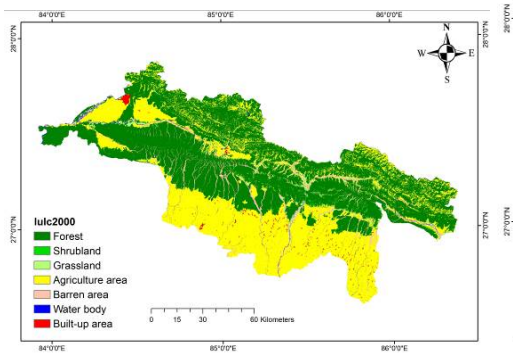

slope
High : 88.4954
Low : 0
60 Kilometers

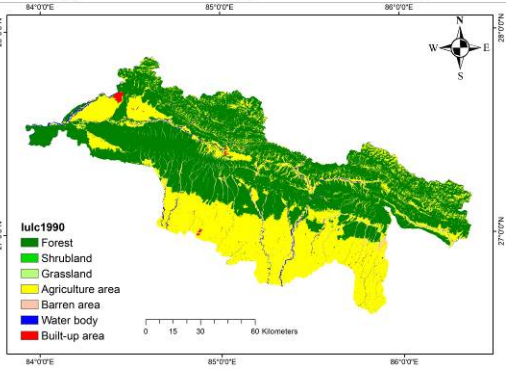

Road
Road
Road Distance in Degree
High : 0.285475
Low : 0
60 Kilometers


River
River Distance
High : 0.0792446
Low : 0
60 Kilometers


NDVI
High : 0.821322
Low : -0.322743
60 Kilometers


lulc2017
Forest
Shrubland
Grassland
Agriculture area
Barren area
Water body
Snow/glacier
Built-up area
60 Kilometers


lulc2000
Forest
Shrubland
Grassland
Agriculture area
Barren area
Water body
Built-up area
60 Kilometers


lulc1990
Forest
Shrubland
Grassland
Agriculture area
Barren area
Water body
Built-up area
60 Kilometers

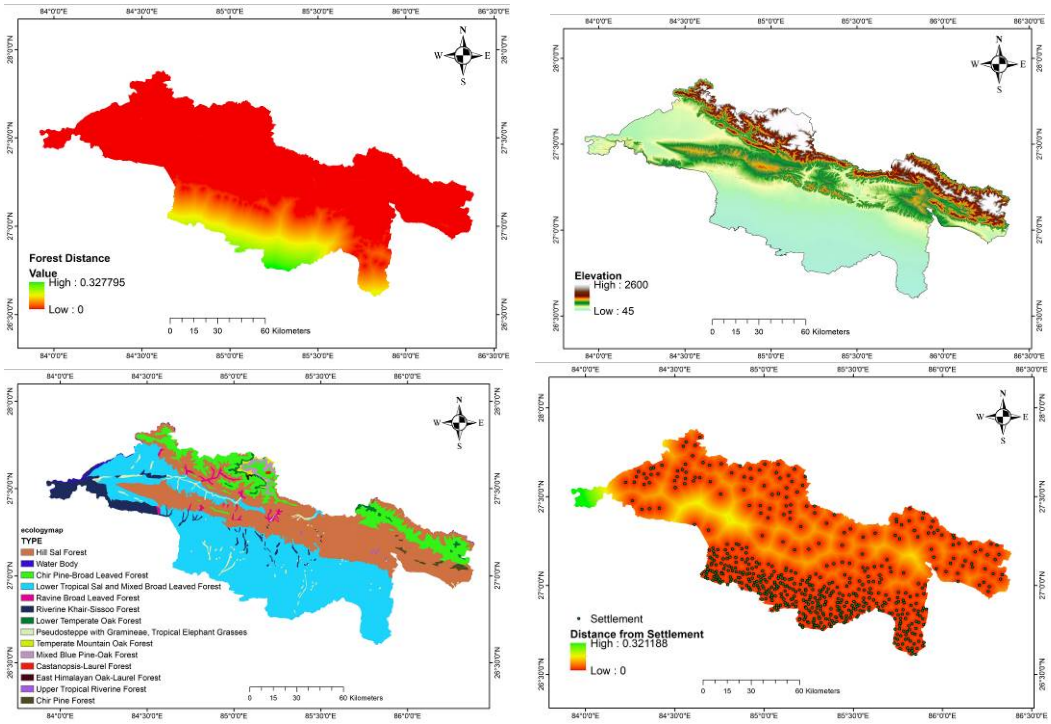


Figure 3: 12 Environmental variables used for analysis of Maxent.

Soil types showed highest (64.9%) heuristic estimate of relative contribution to the maxent model. Similarly forest distance contribute 10.2%, Elevation contribute 9.7%, Slope 3.7%, Road distance 3.4%, LULC 3.1%, NDVI layer 2.1%, ecology 1%, Eco-region 0.6 % and less contribution by river distance 0.3%. The response curve (AUC or Area under curve) for the model showed fairly accurate trend for elephant suitability. Predicted Probability of elephant occurrence decreased with the increase in distance from forest vegetation. Same was the case with proximity to settlement and proximity to water bodies.

Analysis of omission/commission

The following picture shows the test omission rate and predicted area as a function of the cumulative threshold, averaged over the replicate runs. The omission rate should be close to the predicted omission, because of the definition of the cumulative threshold.

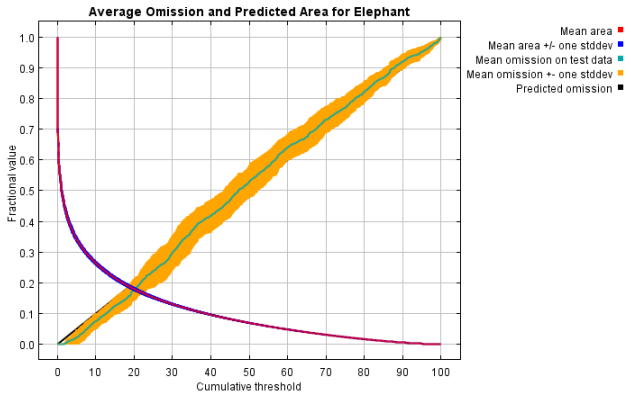


Figure 4: Analysis of omission and commission

The next picture is the receiver operating characteristic (ROC) curve for the same data, again averaged over the replicate runs. Note that the specificity is defined using predicted area, rather than true commission (see the paper by Phillips, Anderson and Schapire cited on the help page for discussion of what this means). The average test AUC for the replicate runs is 0.898, and the standard deviation is 0.008.

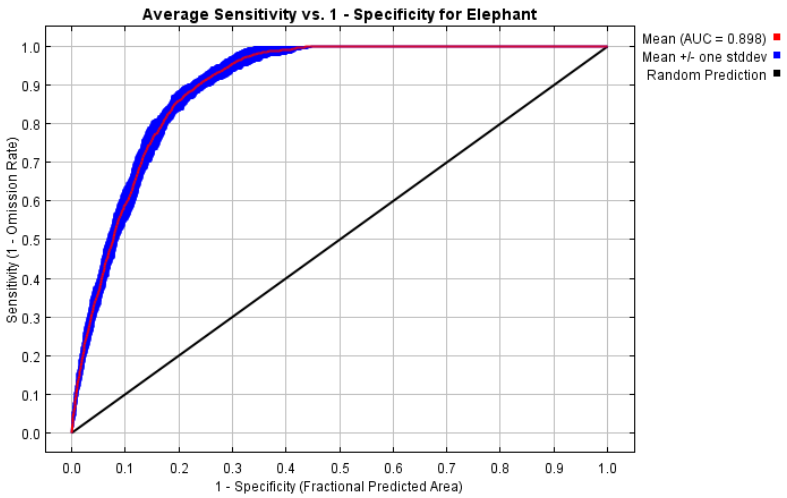


Figure 5: Average sensitivity vs specificity

Pictures of the model

The following two pictures show the point-wise mean and standard deviation of the 15 output grids. Other available summary grids are min, max and median.

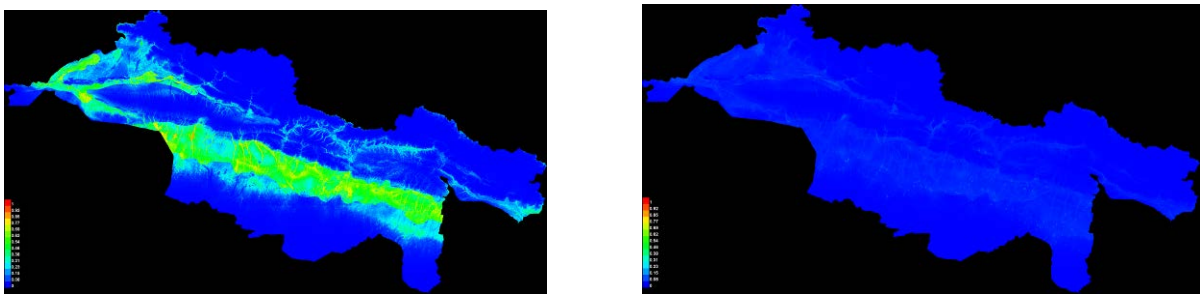
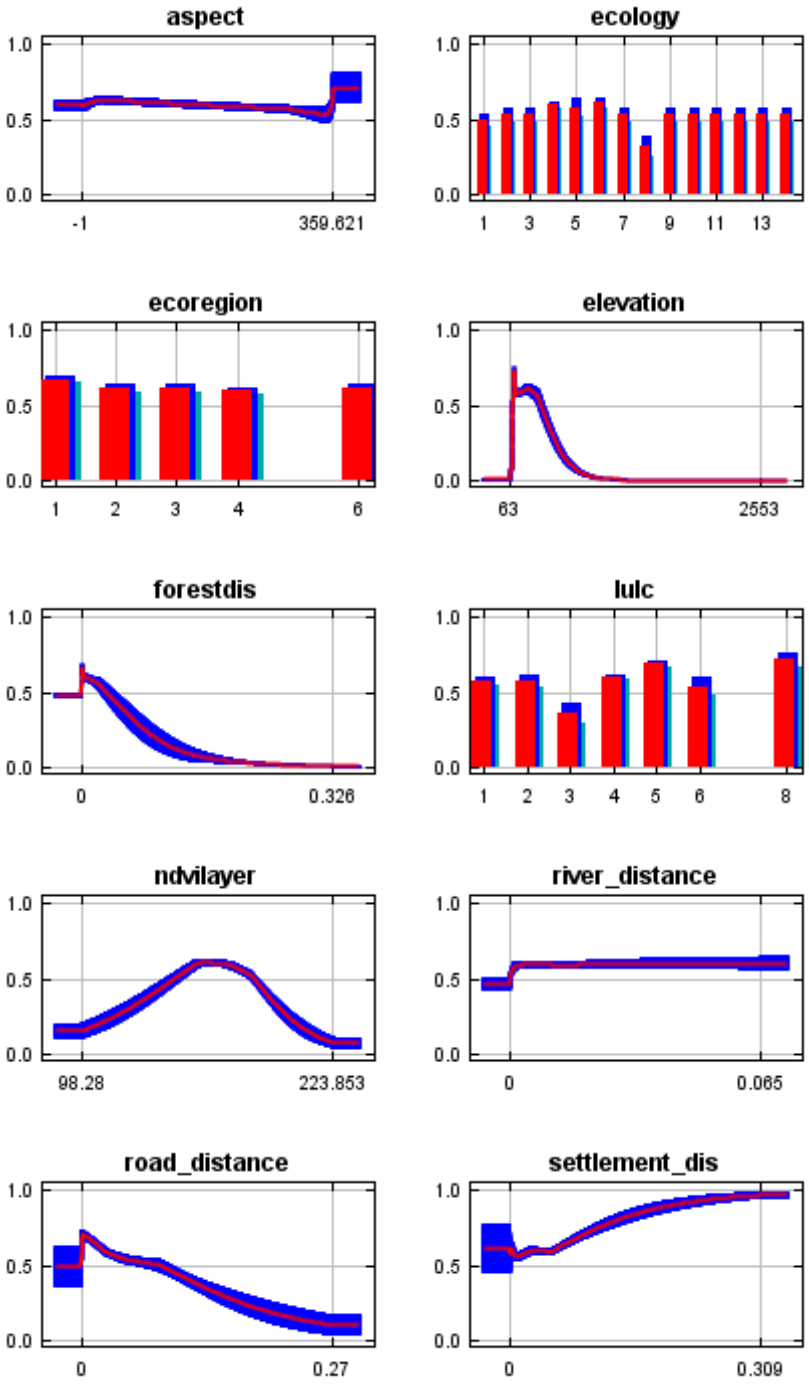


Figure 6: Model pictures.

Response curves

These curves show how each environmental variable affects the Maxent prediction. The curves show how the predicted probability of presence changes as each environmental variable is varied, keeping all other environmental variables at their average sample value. Click on a response curve to see a larger version. Note that the curves can be hard to interpret if you have strongly correlated variables, as the model may depend on the correlations in ways that are not evident in the curves. In other words, the curves show the marginal effect of changing exactly one variable, whereas the model may take advantage of sets of variables changing together. The curves show the mean response of the 15 replicate Maxent runs (red) and the mean +/- one standard deviation (blue, two shades for categorical variables).



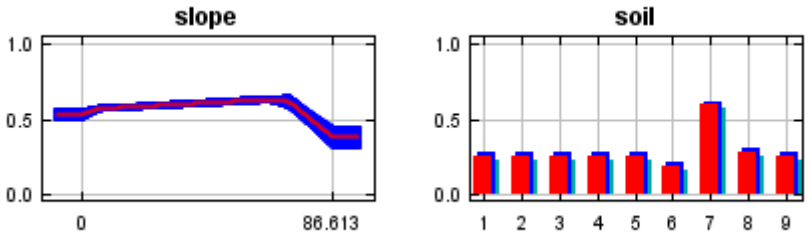
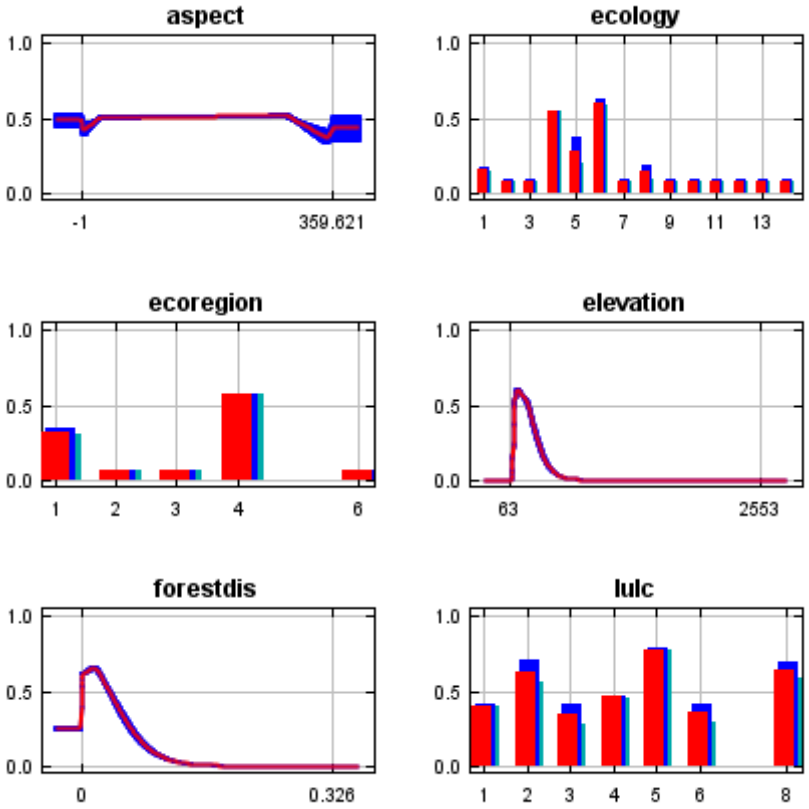
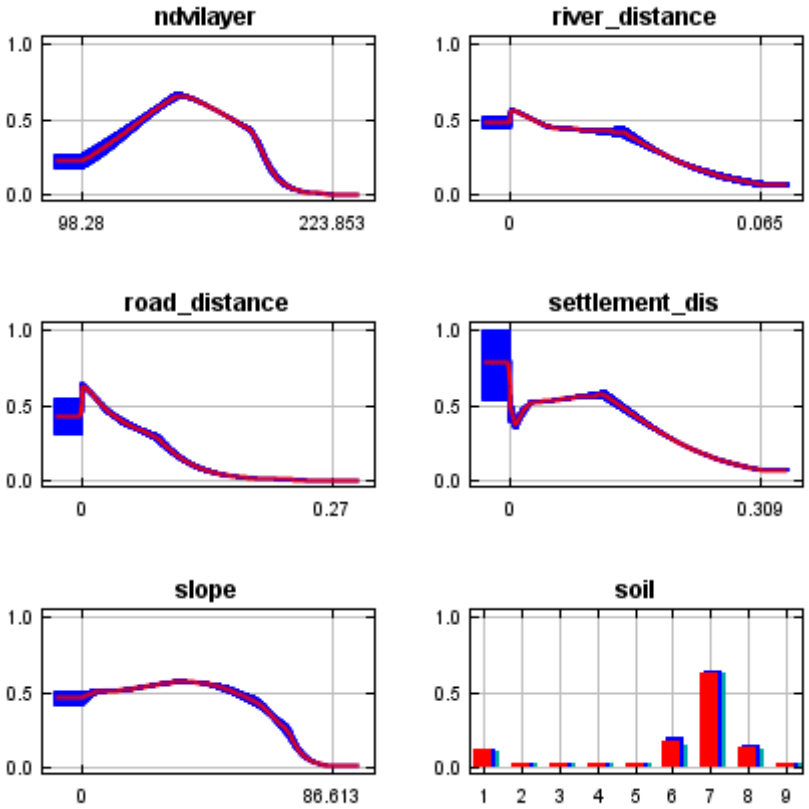


Figure 7: Response curve.

In contrast to the above marginal response curves, each of the following curves represents a different model, namely, a Maxent model created using only the corresponding variable. These plots reflect the dependence of predicted suitability both on the selected variable and on dependencies induced by correlations between the selected variable and other variables. They may be easier to interpret if there are strong correlations between variables.





Analysis of variable contributions

The following table gives estimates of relative contributions of the environmental variables to the Maxent model. To determine the first estimate, in each iteration of the training algorithm, the increase in regularized gain is added to the contribution of the corresponding variable, or subtracted from it if the change to the absolute value of lambda is negative. For the second estimate, for each environmental variable in turn, the values of that variable on training presence and background data are randomly permuted. The model is reevaluated on the permuted data, and the resulting drop in training AUC is shown in the table, normalized to percentages. As with the variable jackknife, variable contributions should be interpreted with caution when the predictor variables are correlated. Values shown are averages over replicate runs.

Variable	Percent contribution	Permutation importance
soil	64.9	16
forestdis	10.2	13.6
elevation	9.7	48.8
slope	3.7	2.3
road_distance	3.4	8.9
lulc	3.1	0.9

ndvilayer	2.1	4.6
ecology	1	1.4
ecoregion	0.6	0.9
settlement_dis	0.5	1.4
aspect	0.4	0.9
river_distance	0.3	0.4

The following picture shows the results of the jackknife test of variable importance. The environmental variable with highest gain when used in isolation is soil, which therefore appears to have the most useful information by itself. The environmental variable that decreases the gain the most when it is omitted is soil, which therefore appears to have the most information that isn't present in the other variables. Values shown are averages over replicate runs.

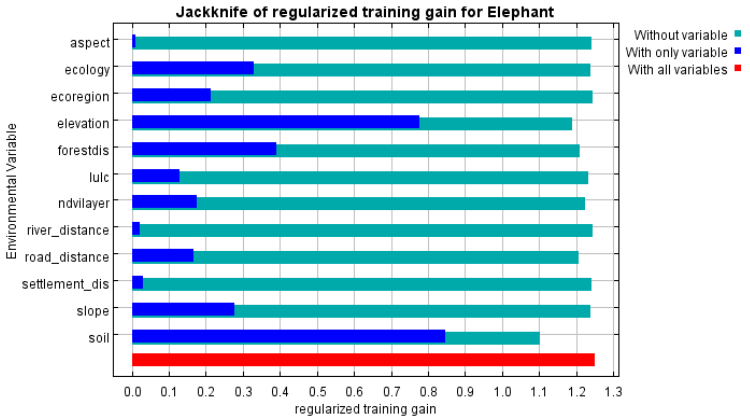


Figure 9: jackknife of regularized training gain for elephants.

The next picture shows the same jackknife test, using test gain instead of training gain. Note that conclusions about which variables are most important can change, now that we're looking at test data.

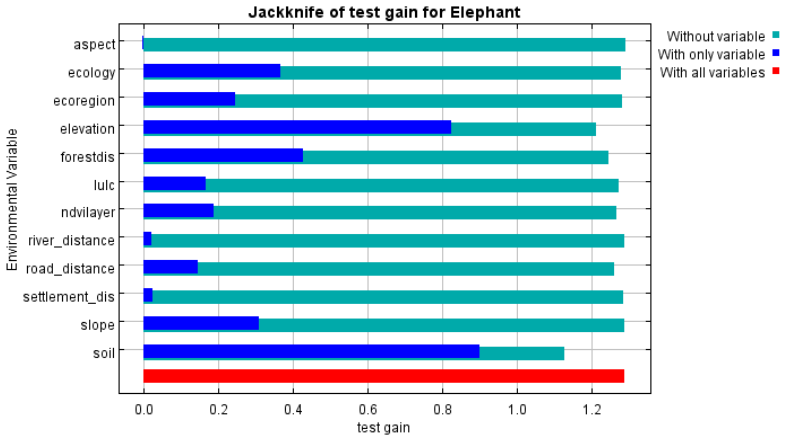


Figure 10: jackknife of regularized test gain for elephants.

Lastly, we have the same jackknife test, using AUC on test data.

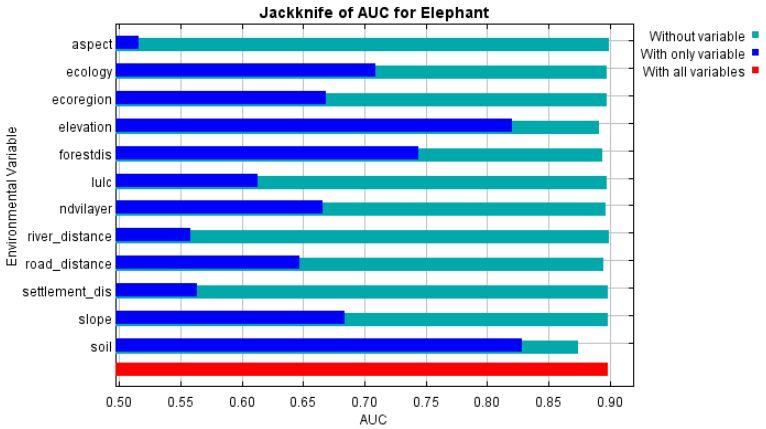


Figure 11: Jackknife of AUC for elephants.

Habitat suitability analysis using Land use change (LULC) dynamics:

Land use / land cover classification map was prepared by using supervised classification (Awasthi KD, 2004; Cianfrani C. et al., 2010; Ellis, E. 2007) targeted to model Asian elephant habitat suitability study. Four LULC classes were derived from satellite data interpretation for study area using supervised classification techniques, viz forest, grass lands, shrubs, agriculture and others (settlements and roads) with accuracy 92.81 %. Overall classification accuracy is 92.45% in 2013, 91.57% in 1990 and 91.50% in 2000. Similarly overall Kappa Statistics is 0.9001 in 1990, 0.9101 in 2000 & 0.9100 in 2017.

Class	1990		2000		2017	
Forest	731939	55.70%	694890	52.89%	686065	52.21%
Shrubland	3044	0.23%	7642	0.58%	4996	0.38%
Grassland	16255	1.24%	31851	2.42%	17266	1.31%
Agriculture area	518290	39.44%	509165	38.75%	538233	40.96%
Barren area	22762	1.73%	53530	4.07%	47453	3.61%
Water body	18429	1.40%	9832	0.75%	10470	0.80%
Built-up area	3463	0.26%	6958	0.53%	9609	0.73%

LULC shows that forest is decreased by 2.89 % in 2000 in comparison to 1990 and 0.68% in 2017 in 1.11% in 2017. In case of grassland, it is increased by 0.24% in 2000 and increased by 0.18% in 2013. The overall increment was seen in agriculture & settlement expansion. There is 0.69% agriculture decrease seen in 2000 and 2.21% increase seen in 2017. Increment seen is unpredictable in built up area and agriculture because of migration from hill and ultimately pressure goes to the forest destruction in Terai. The overall change from 1990-2013 shows that forest is decreased and it contributed grassland and built up area expansion & this result shows that there is remarkable decrease seen in Asian elephant habitat in eastern Nepal. Please see the figure below.

i. Land use change during 1990 and 2000

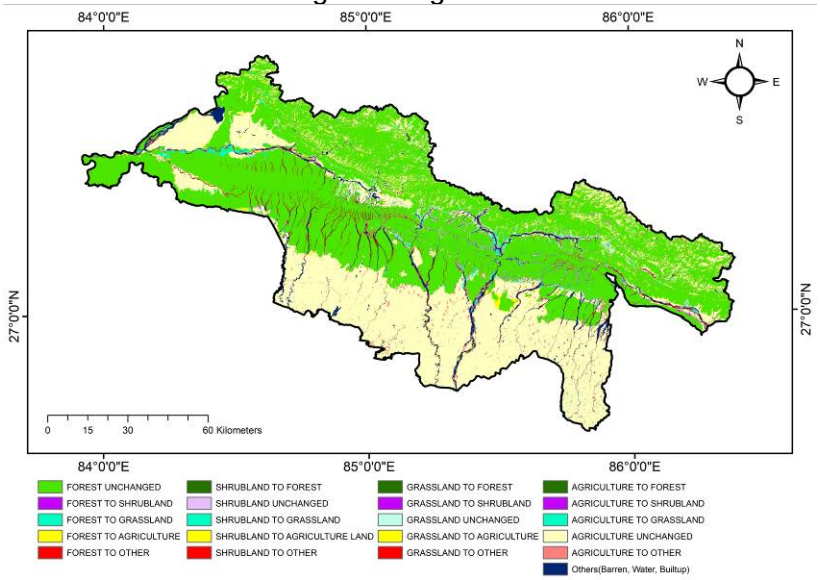


Figure 11: Land use change map between 1990-2000.

ii. Land use change during 2000-2017

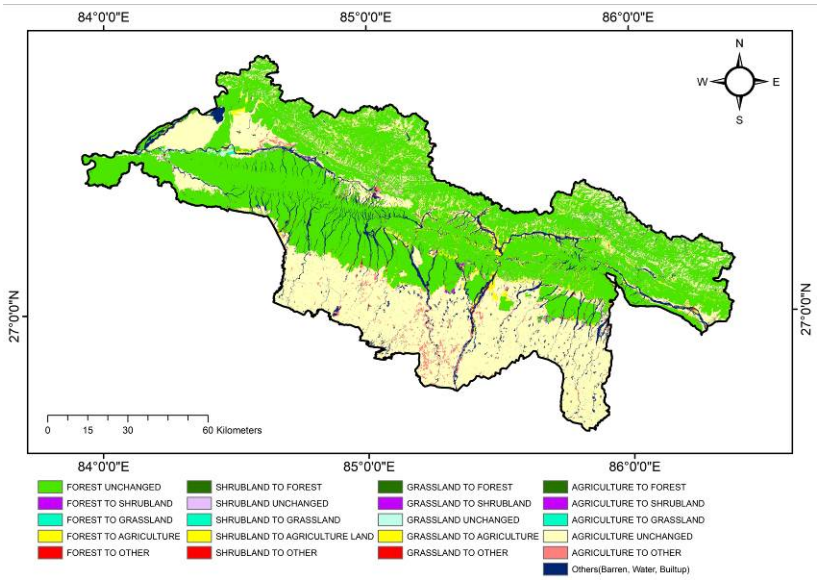


Figure 13: Land use change map between 2000-2017

Land use change matrix: 1990-2000

1990-2000	Forest	Shrubland	Grassland	Agriculture area	Barren area	Water body	Built-up area	
Forest	683184	3600	7623	30061	6760	414	26	**731668**
Shrubland	431	1771	271	492	70	9	0.0	**3044**
Grassland	674	189	3147	4469	7129	619	17	**16245**
Agriculture area	9723	1948	18111	463905	18133	2690	3564	**518075**
Barren area	656	74	1314	3914	15597	1184	16	**22755**
Water body	207	60	1370	5986	5831	4906	54	**18414**
Built-up area	14	15	142	5	6	0.0	3281	**3462**
	694890	**7656**	**31978**	**508833**	**53526**	**9821**	**6958**	

Land use change matrix: 2000-2017

2000-2017	Forest	Shrubland	Grassland	Agriculture area	Barren area	Water body	Built-up area	
Forest	665484	2206	390	25310	1223	252	17	**694881**
Shrubland	1749	2165	780	2678	215	52	2	**7642**
Grassland	3427	156	6214	18915	2413	623	99	**31847**
Agriculture area	12047	348	7196	468038	16847	2168	2422	**509066**
Barren area	3045	97	2205	20802	25339	1938	99	**53525**
Water body	99	25	481	2390	1392	5434	11	**9832**
Built-up area	0	0	0	0	0	0.0	6958	**6958**
	685850	**4996**	**17266**	**538132**	**47430**	**10467**	**9607**	

Suitable Habitat available for elephant:

We have prepared final map of habitat suitability by using MaxEnt software and found that our study area covers 1385744.44 hectare (13857.44 square kilometre). Among the total area 28109.61 hectare is highly suitable, 90160.84 hectare is moderately suitable, 175146.66 hectare is low suitable and 1092327.30 hectare area is non-suitable for elephants. This non suitable area covers settlement, barren land, Chure ridge, Agriculture and some parts of forest.

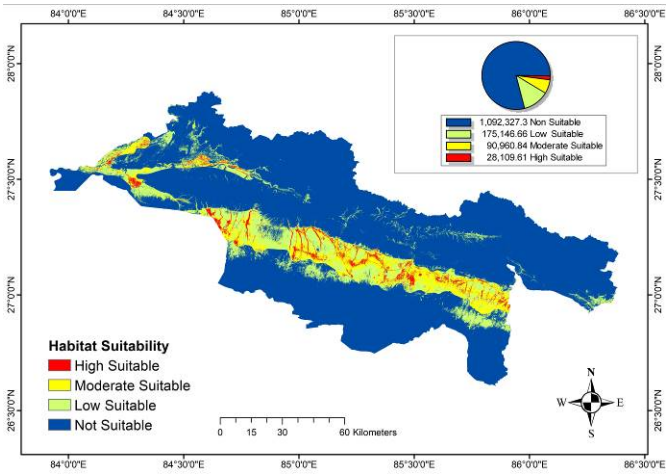


Figure14: Habitat suitability map of the study area

A. Elephants status and migratory routes used by elephants

There are four isolated population of Asian elephants in Nepal (Pradhan et al., 2007). This study shows that there are only two sub population in Nepal i.e. Eastern and Western. This study is focused on the some part of eastern population. Eastern Elephant population travels from Jhapa to Sarlahi and intermixed with Chitwan Parsa Population. In this study we found that elephants are migrated from east to west and sometimes vice versa. Elephants from eastern Nepal (Koshi Tappu Wildlife Reserve, Sunsari) travel west through chure foot hills and by crossing Saptari, Siraha, Udapypur, Dhanusa, Sindhuli, Mahotari and then come to Sarlahi.

In this way elephant migration takes place in eastern to central Nepal. In all cases, sub adult males are only found migrated such a large distance from Jhapa to Parsa. Small female herds were found migrated from Jhapa to Sindhuli. One elephant has also gave a birth of baby elephant in Sindhuli district.

During our field visit; we have found 5 different herds of elephants. Solitary bulls are found most problematic and highly involved in human elephant conflict. We have found five sub adults bulls in Sindhuli, 1 bull in Dhanusa dham area, 2 bulls in Sarlahi, 5 bulls along with Dhrube, Gobinde and Ronaldo in Chitwan Parsa Complex.

Similarly, two herds having 25 found in Parsa National Park, one herds having 12 individuals were recorded during our study. So we have estimated 52 to 66 elephants are residing the study area. The details of elephants seen in the study area.

Sn	Area	No of Elephant sighted	Age group(Adult Male, Adult female, sub adult male, sub adult female, calf and un-identified	Remarks
1	Sindhuli	8	Sub adult males	This elephant population
2	Dhanusa	1	Solitary male	
3	Bara	1	Solitary male	

4	Parsa	32	Solitary Adult male 5, Adult male in the group 3, Adult female 15, Young calf having 2-3 year age 4 (sex unidentified), 2-3 month age calf 5. (Total 32)	status is estimated as per guestimate.
5	Chitwan (Thori and Amuwa)	13	Solitary males 3 (Dhrube, Gobinde and Ronaldo), Adult males in the group 2, adult Female 7, Calf 2 (3 year age), One month age 2.	

Elephant migration routes assessment:

- Jhapa> Kosi Tappu Wildlife Reserve>Saptari used chure foot hills>Siraha Bandipur> Kamala River> Dhanusa> Ranibas> Maikhola> Paniprant> khayar khola Mahotari> Isworpur-Sarlahi>Paurahi-Nunthar Rauthat> Judibela> Gaidatar> Singaul Bara> Nijgarh> Parsa National Park> Chitwan National Park.

Alternate migratory routes

- Jhapa> Kosi Tappu Wildlife Reserve> Belaka udaypur>Ghaighat>Jaljale>Kamalpur>Madhupati>crossed Balan River> Taregana Siraha> Bandipur> Kamala River> Dhanusa> Ranibas> Maikhola> khayar khola>Sarlahi>Rauthat> Parsa National Park> Chitwan National Park.
- Bandipur Siraha> Godar> Dhanusa dham> Mahendranagar Dhanusa> Mahotari Bardibas> Sagarnath Forest Mahotari> Sarlahi> Rauthat thrugh Gaidatar and Judibla> Nijgardh>

District wise bottlenecks/ hindrance in the elephant migratory routes:

- Bandipur serves as a bottleneck while crossing towards west Sindhuli from Siraha district.
- Bardibas settlement is another hindrance
- Khayarkhola settlement Mahotari district.
- Siwalik settlement in Sarlahi: Setebhir, Bhalu khop, Narayandanda, Narayan khola, Dayanikhola, Patharkot and Nunthar in Sarlahi district.
- Judibela, Gaidatar in Rautahat district.
- Singaul, Nijgarh, Ratanpuri, Amlekhganj in Bara district.
- Vegetation survey for identifying habitat status

We have used 10*10 square meter plots for trees & poles, 5*5 square meter plots for shrubs and regenerations, 1*1 square meter plots for herbs and NTFPs. All the vegetation were enumerated, identified and recorded on notebook for habitat analysis.

489 species of plants found during transect survey; 369 trees, 26 shrubs, 87 herbs, 26 species of climbers and 7 species of ferns were recorded.

Shannon-wiener index diversity (H') varied from protected area (PA-CNP and PNP, H'=3.16) to forest outside PA (H'=3.26). Simpson index shows 0.93 and 0.87

respectively for PNP_CNP and forest outside the protected area. As in both areas the Simpson value is near 1 species diversity seems higher and better. Sorensen Index (Index of similarity- ISS) showed that 78% of plant species are similar among two habitat types (Pas area and forest outside PA).

Faunal survey:
Mammals, birds, herpeto-fauna and other animals detected during field work were also noted. Rhino, Blue bull, tiger, deer, different variety of birds were also recorded, counted except Elephants in the study area.

Human elephant coexistence study:
Social survey and stakeholder consultations were accomplished by using structured closed ended questionnaire. 15 stakeholder consultations were made with DFOs, National park and local CBOs. Altogether 215 HH were surveyed in the different conflicted vicinity of 8 districts of the study area.

Major human elephant conflicting areas were identified selected for human elephant coexistence study. There are 81 people killed in human elephant conflict during last 15 years in the study area and 26 people were injure. In the meantime 2 elephants were killed in retaliation in Sarlahi district. The district wise details of human death, injury, crop damage and property damage is given the following figures.

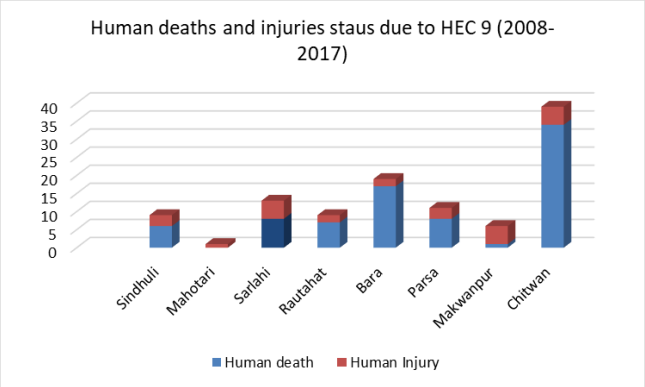


Figure15: Human death and injury.

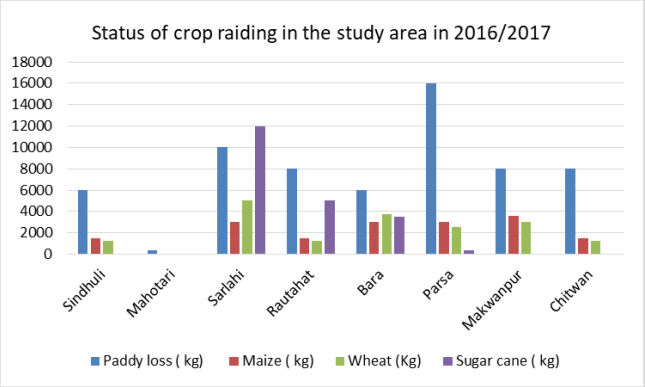


Figure 16: District wise crop raiding in terms of amount of crops in Kg.

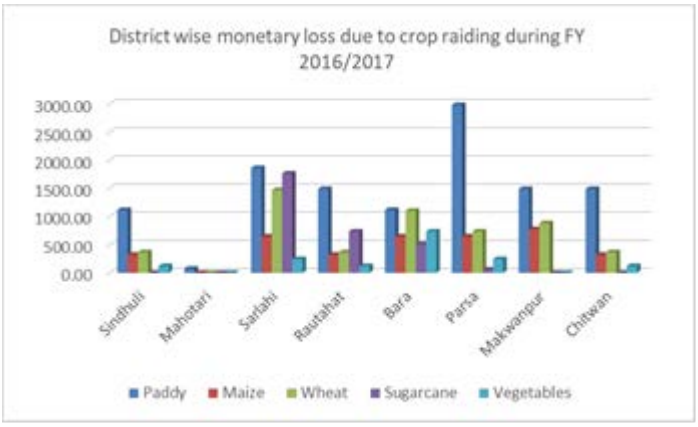


Fig17: District wise monetary loss due to crop raiding by elephants FY 2016/2017.

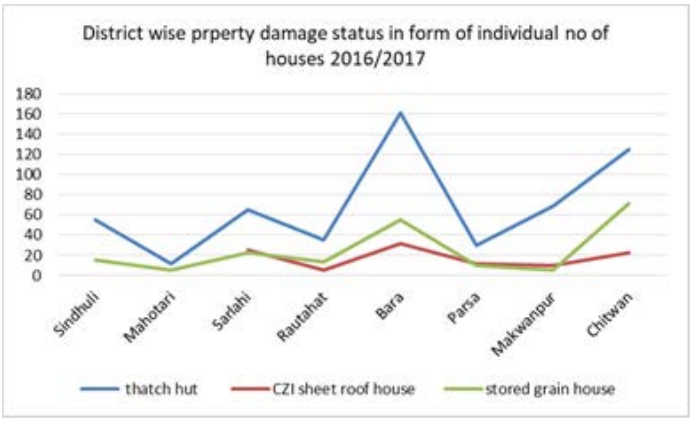


Fig 18: District wise property damage status in FY 2016/2017

B. Conservation Awareness raising work.

30 people from five identified CBAPOs, BZUCs, and CFUGs will be trained and mobilized for organizing conservation education. 50 conservation classes will be organized in 20 different higher secondary and secondary schools. 12 episodes Conservation Radio program on "Save our Nature and Elephants" will be forecasted from Local FM Radio. 1000 piece conservation related posters, calendars will be published and distributed in the study area.

- Eco-clubs formation cum activation of old and defunct ecoclubs for conducting conservation awareness program. We have conducted 5 meetings for activation of local Ecoclubs and it was reformed. These are eco-clubs formed in Bara district.

i. Namuna eco-club Pathalaiya, Bara under chairmanship of Kabin Yadav.
ii. Braham kali Eco-club, Manhari 7, Makawanpur.
iii. Rastriya Aadharbhut bidhyala eco-club, Manhari 7, Makwanpur.
iv. Baljyoti Ecoclub

- Elephant conservation rally: On the occasion of World Environment day 2017, an Elephant conservation rally was conducted by Namuna youth Eco-club

Pathalaiya. Park staffs, District forest office staffs, buffer zone user committee members, local Arm Police force, local people, school kids, Drinking water and sanitation user committee, local school teachers were also participated. This rally was jointly conducted by local BZ user committee, BZ community forest user groups, Pathaliya ecoclub and local people.

- Elephant conservation radio program: A seven episodes of 15 minutes conservation radio program on" Save the Elephants" with main slogan "Hatti Mero Sathi" were prepared and forecasted through local FM radio, Radio Samarpan 98.2 .MHz. This FM has broader coverage and have better response from local students, local people and other stakeholders.

- Eco-clubs selection cum reformation: 2 Eco-clubs which were previously in existence were used for this conservation education program. And 3 more eco-clubs will be formed in Sarlahi districts which will be used for school education on conserving elephants.

- School program: 20 schools were selected for school education on elephant conservation along with biodiversity conservation outside the protected areas.

i. Other works under progress:

- School education cum conservation classes are undergoing for educating kids of higher secondary schools of Bara, Parsa, Sarlahi and Makwanpur district through local eco-clubs.

- Education material postures: Brochure and pamphlets were printed and distributed during school education and stakeholder consultation.

- Field work for Geospatial study for habitat suitability and migratory corridor, coexistence stud were completed.

- Social survey was completed within most severe human elephant conflict area.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

We have been working with community since 1997 through buffer zone development program. We did work on conservation awareness, community development and conservation works with community. Community people are also fond of working with us. This project is developed to accomplish with a synergic work. Some program were conducted by local CBOs and Eco-clubs. We have also include 3 different teachers' network to implement school education, conservation rally and community awareness work. Local people were also involved in stakeholder meeting, preparing a project work plan and execution of it.

Conservation rally and "Save the Elephant radio" programs were jointly conducted by local Eco-clubs, Local sanitation & environment protection committee, Nepal Police, Armed Police force and Parsa National Park and with researcher team. Similarly 5 Eco-clubs from Bara, Parsa and Makwanpur districts were selected and mobilized for school education. They have conducted school conservation classes on twenty different secondary level schools of Bara, Parsa and Makwanpur district.

Local people were directly benefited by taking part on project planning and reviewing the progress. Similarly 100 students from 5 eco-clubs were sensitized and trained about elephant behaviour and elephant handling during human elephant conflict. Similarly 3000 students from 20 secondary level schools were sensitized and 200 teachers were also benefited by conducting this program.

People from the study area have better response for "Save the elephant Radio" program and they have requested to broadcast this conservation Radio program again. With this Radio program >5000 local people were benefitted. After conducting this radio program, 60% of HEC is reduced in Bara and Parsa district.

We also conduct stakeholder meetings by involving national park staffs, District forest office staffs, buffer zone user committee's members and Community forestry user group members. They were also happy and made a positive response that they knew a lot from this project and ultimately it will help to reduce human elephant conflict and make a conducive environment for human elephant coexistence.

5. Are there any plans to continue this work?

Yes, I have a plan to continue my work with elephants towards the west. Western Terai Arc Landscape has 80-120 elephant and some of 60 migratory elephants from Corbett National Park India. There is an issue of increasing population of elephant but actual population is lacking. Similarly detail distribution of elephant is also lacking in Nepal. So our next plan is to conduct research work on occupancy, population status, habitat and human elephant conflict assessment along public awareness for mitigating human elephant conflict. For this the project team will undoubtedly need financial support from the organizations like The Rufford Small Grants Foundation.

6. How do you plan to share the results of your work with others?

We shared the results of this project we in stakeholder meetings. Now we will share the final report to Department of National parks and Wildlife conservation (DNPWC) Nepal and request them to implement the recommendations of this project. I will also present this report on relevant workshops and seminars. If possible, this effort will presented in Rufford small grant foundation grantee meeting. I will publish the report findings local as well as international peer reviewed journal

7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?

Proposed research work was proposed to accomplish within Dec 2017. We have also completed field work and data analysis. But it will take more time in doing habitat suitability and GIS work. So I am unable to send it in the time frame. Although there is no any revision in the time schedule.

Activities	Proposed scheduled time (month)	Actual time it took	Revision in time schedule	Remarks
Preliminary Field visit	Nov 16-Dec 16	Nov 16-Dec 16		
Identification of CBOs	Dec 16-Jan17	Dec16-Jan 17		
Land use land cover change	Jan 17-Feb 17	Jan 17-Feb 17		
Habitat suitability analysis	Jan 17-Mar17	Jan 17-Mar17		
Conservation awareness program	Jan 17-May 17	Jan 17-May 17		
HEC study	July 17-Aug17	July 17-Aug 17		
Report preparation and submission	Sep 17-Oct17	May 18-June 18		

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used. 1 £ sterling = 4.44 Nuevo Sol

Item	**Budgeted Amount**	**Actual Amount**	**Difference**	**Comments**
Field work, logistic arrangement for 45 days with night camping (tea, snacks, food, breakfast arrangement for 10 naturalists during camping) 10*45@£3)	1350	1350		
12 episodes Save the Elephant Radio program operated by local CBAPOs 12 episode @£25	300	240	-60	
Communication, internet and report preparation (5 @£20)	100	160	60	
Topographic map, vector layer will be acquired from Department of survey freely	0			

Landsat data (Landsat 5 Tm, Landsat 7ETM+, Landsat OLI) for three different time series will be downloaded freely from USGS website.	0			
40 conservation classes will be organized in 20 different higher secondary and secondary schools (40@£10)	400	400		
Postures and calendar publication 1000 cop@£0.49	490	490		
Team leader (Daily subsistence allowance (180 man days@£6)	1080	1080		
5 Eco clubs formation and seed money granted for continuing conservation education program after completion of project (5 @£30)	150	150		
Daily allowance for field assistant, data collection, (5*60@£3)	900	900		
CBAPO, CFUG & BZUG members training, orientation and progress meeting (3 meetings@£40)	120	120		
Preliminary field visit to all the possible HEC areas in the study area (10 places@@£10)	100	100		
Totals:	4990	4990	0	

9. Looking ahead, what do you feel are the important next steps?

I am grateful to Rufford Foundation that I have been awarded by 2nd RSG grant to work with elephant. I did work on elephant in the aspects of habitat, migratory pattern and routes, human elephant conflict. During my study, I found that elephant population is increasing in Nepal and very less study on occupancy and elephant population study were carried out except by Pradhan et al., 2011. So there is a gap to study elephant population through genetic analysis. I am planning to do population status study in the next step from RSG grant.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

Yes, I have used the Rufford Foundation logo for preparing brochures and pamphlets. I have printed 500 copy of brochure and 500 copy of pamphlets having message of human elephant coexistence and elephant ecology and their aggression along with elephant handling procedure.

RSGF had certainly received publicity during my project work. Local people were very much interested to know about the Rufford foundation grant. We have deliver the speech to them and convince them also. Some of these postures and pamphlets were also send to Institute of Forestry Hetauda students and these students are interested to apply for future research work.

11. Any other comments?

We have selected 30 participants from 5 eco-clubs, 3 District Teachers Network, 5 Community based community based anti-poaching units (CBAPOs), 5 buffer zone user committees(BZCFUGs) and 10 community forest user group (CFUG) for sensitizing about the project and human elephant conflict mitigation measures. All these participants were participated in the training and they have learn about elephant behaviour, elephant handling method for reducing human elephant conflict. After completion of the training, we have mobilized Teachers network and eco-clubs for conduction conservation education classes in the 20 secondary level schools. This events were very much successful and rest schools were also asking for school kid's education.

We have provided the grant to Eco-clubs and BZUC for conducting conservation education, conservation rally and Save the elephant radio program from the local Radio Samarpan FM 98.2 MHZ.

The Rufford Foundation
www.rufford.org

The Rufford Foundation
www.rufford.org