The Rufford Small Grants Foundation

Final Report

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

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. 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. 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 Modelling to assess Asian Elephant (*Elephus maximus*) habitat suitability, migratory routes and Human Elephant interface in Eastern Nepal
RSG reference	13977-1
Reporting period	July- August 2014
Amount of grant	£5766
Your email address	ashokrink11@gmail.com
Date of this report	22 August 2014

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
1. To assess the current migratory routes of wild elephants of eastern Nepal through geospatial modelling.			Fully achieved	
Assessment of migratory routes			Fully achieved	
2. To assess the habitat status & habitat suitability through land cover land use change and multi-criterion evaluation Analytic Hierarchy Process (AHP)			Fully achieved	
Land use Land cover change study using supervised classification			Fully achieved	
Habitat status study using Simpson Index and Shannon Weiner Index.			Fully achieved	
Habitat suitability through AHP			Fully achieved	
Habitat suitability study by using MAXENT model			Fully achieved	
3. To assess and map out the human elephant interface in Eastern Nepal			Fully achieved	
HEC map prepared			Fully achieved	
HEC VDCs identified			Fully achieved	
4. To conduct conservation awareness program through media and conservation			Fully achieved	Conservation education material, Calendars distributed

education materials. (Quiz contest, Essay competition, school class conduction in 5 different schools)				to school kids and Quiz contest, Essay competition and school education classes were conducted among high school kids and middle school kids in Sunsari, Saptari and Morang districts.
Elephant Conservation Committee (ECC) formation in three districts (Sunsari, Morang and Saptari)			Fully achieved	7 member committees, These committees were used for conservation awareness, field work and stakeholder consultation. ECC has also organized 12 episode “Save the elephants” radio program from Popular FM Sunsari.
Save the Elephants : a radio program, 12 episodes			Fully achieved	A 12 episodes Elephants conservation Radio Program was broadcasted from local Popular FM, Inaruwa, Sunsari.
Publication materials: Postures and Calendars printed, distributed for educating local people about the conservation of wild elephants.			Fully achieved	1500 copies of postures and 1500 copies of Elephant conservation related calendars were printed and distributed in the local communities for educating local people for mitigating Human Elephant Conflict (HEC).

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

There is a gap in Nepalese policies for the conservation of migratory Wild elephants outside the protected areas. There is no any proper management practices adopted for conserving wild elephants. While Asian elephant from West Bengal, India came to Bahundangai-Jhapa, Nepal; Everybody (Government & Local people) concern is to divert it to home habitat, not to manage in the new destination. And this is an unforeseen difficulty that nobody wants to take the ownership for conserving this mega herbivore. As a result retaliatory killings, people's property loss and fatal incident also takes place. To mitigate HEC; Government of Nepal has made a provision to compensate by giving reliefs (human casualties, crop damage, and property damage) but people were hardly getting relief of human casualties and fatalities. This project had explored the time and duration of elephant migration, migratory routes, human elephant conflict area, conflict status and ultimately it will help to prepare proper management options and policies for conservation of this mega herbivore.

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

3.1 Geospatial analysis and modelling of Asian elephant habitat

a. Land use land cover detection for Habitat suitability study
b. Habitat suitability analysis using multiple ring buffer to habitat variable and using AHP multi criteria evaluation method
c. Habitat suitability study using MAXENT modeling

3.2. Land use land cover detection for Habitat suitability study

Land use land cover change (LULC) detection map was prepared to identify forest condition in the study area. Six LULC classes were derived from satellite data interpretation for study area using supervised classification techniques, viz forest, grass lands, agriculture, water bodies and other (settlements and roads) with accuracy 91.89 %. The details of supervised classification are given here in figure 1, 2 &3.

1. Figure: Supervised classified Image 1990

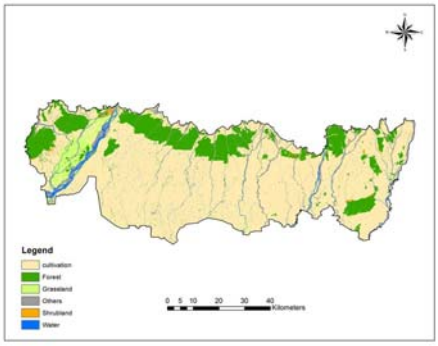


Fig:1, Classified image 1990.

2. Figure: Supervised classified Image 2000

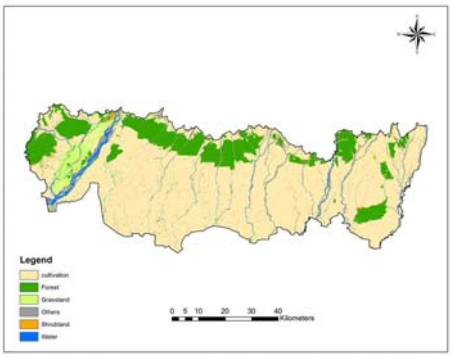


Figure:2, Classified image2000.

3. Figure: Supervise classified map 2013.

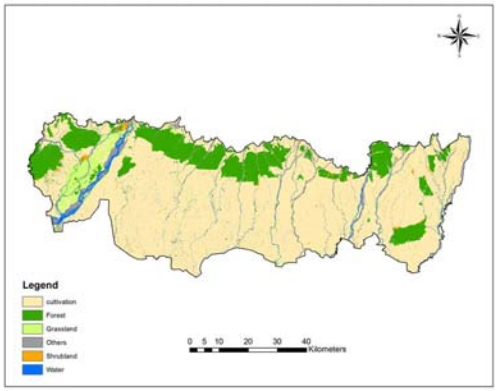


Figure:3, Classified image 2013.

4. Figure: Land use Land cover change detection 1990-2000

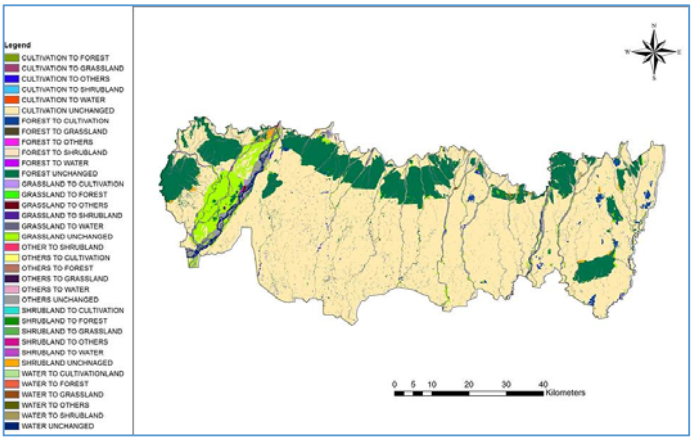


Figure 4: Land use change image 1990-2000.

5. Land use Land cover change detection map 2000-2013.

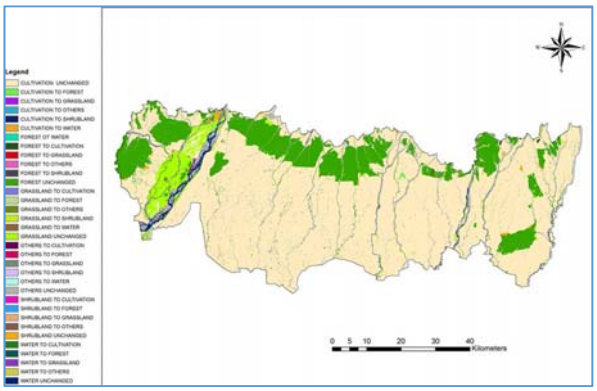


Figure 5 : Land use change 2000-2013

3.2.1 Land use Land cover change

LULC shows that forest is decreased by 0.55% in 2000 in comparison to 1990 and 0.07% increase in 2013 (it is due to extension of community forestry program, increasing kerkha plantation in jhapa, and greenery increased due to increase in tea cultivation) in comparison to 2000. Similarly shrub land is decreased by 0.03% in 2000 and increased 0.07% in 2013. In case of grassland, it is decreased by 0.10% in 2000 and 0.11% in 2013. The overall increment was seen in agriculture & settlement expansion. There is 0.46% agriculture increase seen in 2000 and 0.03% increase seen in 2013. In case of water bodies, it seems increased by 0.18% in2013, it is due to large and devastating flood of Koshi in 2008. Koshi has diverted into settlement and agriculture and it seems little bit water bodies is increased. Over all increment in cultivation seems unpredictable in 2000 because of encroachment by hill migrants in Terai, and it seems controlled in 2013. Due to increase in agriculture and settlement, infrastructure and decrease in wild elephant habitat variable suitable habitat is seen decreased during LULC study.

3.3 Habitat status study:

Forest inventory was done during transect survey. 560 plots were used for detail inventory to plants to assess habitat status. All the plants in the quadrates were identified and counted. There are altogether 218 species of plants found in the study area during transect survey. In which 69 species of trees, 37 shrubs, 87 herbs, 21 species of climbers and five species of fern were recorded. Among 218 species, Elephant as bulk feeder and habitat generalist, could use 31 species as food during their grazing and browsing. Details of habitat types and food species found during field observation is given in Plant diversity in both habitat types were calculated by using the Simpson diversity index and Shannon Weiner diversity index. Shannon-Weiner (S-W) compares the diversity between two or more ecosystems which goes beyond the most basic species-per-unit-area. Shannon-wiener index diversity (H') varied from protected area (PA-KTWR, H'=3.18) to forest outside PA (H'=3.24). Finally we predicted that plant species diversity is higher outside the protected area rather than in protected area. (Koshi Tappu Wildlife Reserve- KTWR).

Similarly we had also calculated Simpson's Index of Diversity (1 – D), which value ranges between 0 and almost 1. Simpson index shows 0.91 and 0.87 respectively in KTWR and forest outside the protected area. In both cases Simpson value is near 1, therefore species diversity in both area seems higher and better. In the meantime Sorensen Index (Index of similarity- ISS) was also calculated to find out the similarity and dissimilarity between two habitats. The result shows that 60% of plant species are similar among two habitat types (KTWR area and forest outside PA). The Sorensen index of similarity was used to compare the habitat composition between the (KTWR area and forest outside PA).Therefore, habitat study shows elephant has used 60% similar habitat in both areas.

3.4 Elephant impacts study using Index of species Reduction:

Elephants' impact on vegetation depends upon habitat type. Riverine and flood plain habitat was impacted than hardwood and mixed hardwood forest. Tree species *Jalebi (Pithecellobium dulce)* 8.47 is severely impacted followed by *Mallotus phillipensis 6.35, Phyllanthus imblica 4.72. Pithecellobium species, Mallotus philipensis, Accaica* catechu and *Bombax ceiba* were found severely impacted by elephants in the study area.

3.5. Habitat suitability analysis.

Multiple ring buffer were generated by giving appropriate habitat variable value on the basis of habitat and feeding ecology as well as migration pattern and elephant impacts on habitat. With these multiple ring buffer values, habitat suitability map were generated using spatial analyst tool for habitat suitability map preparation and by combining these all maps final habitat suitability map was prepared.

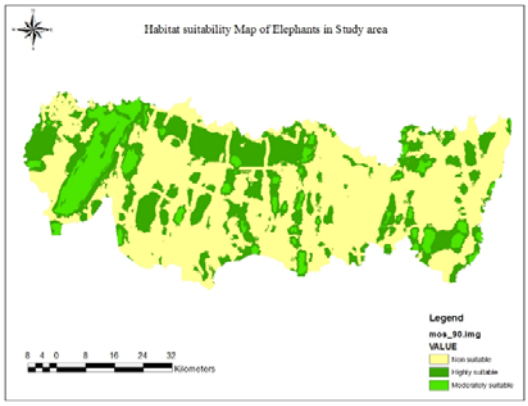


Figure: 6, Habitat suitability using DEM and multiple ring buffer.

3.6. Analytic Hierarchy Process (AHP)

AHP value in the hierarchy tree for habitat criteria and alternatives were calculated on the basis of multiple judgment, iteration and eigenvector calculation methods (Satty, 2008) and get the following result for final habitat suitability analysis.

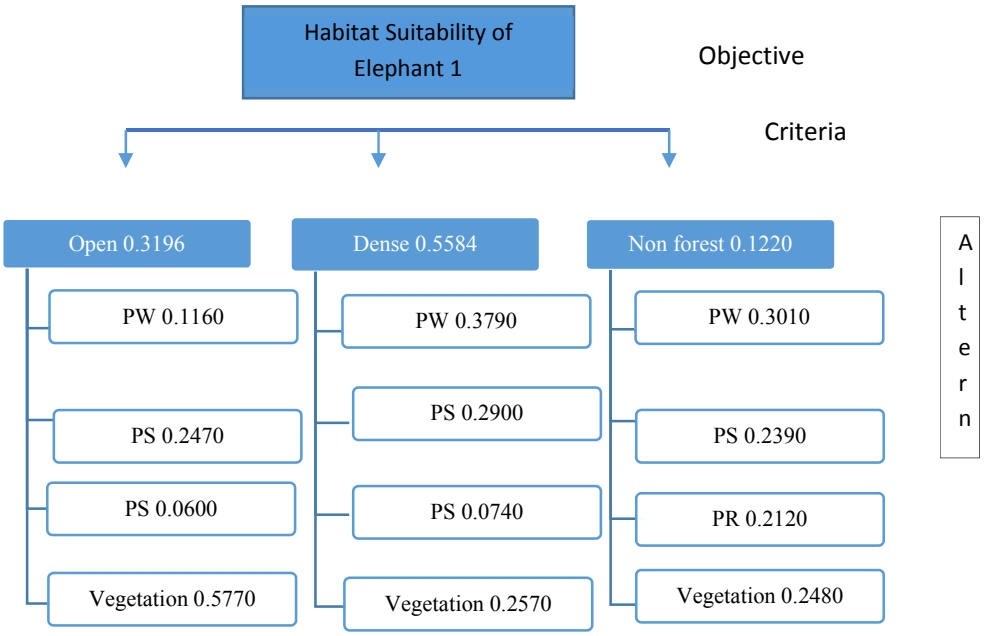


Figure: Value of Criteria and alternatives given in hierarchy tree.

(Where PW= Proximity to water, PR= Proximity to road, PS= Proximity to settlement and VEG= Vegetation. OF= Open forest, DF=Dense forest, NF= Non-forest)

Finally, a little more steps of matrix algebra is calculated to get the solution toward the AHP for habitat suitability analysis and multiply following two matrices we got final results and these values were incorporated to prepare final habitat suitability map. Please see the following steps.

Table showing matrices of criteria and alternatives.

Open Forest	DF	NF
0.1160	0.3790	0.3010 PW
0.2470	0.2900	0.2390 PS
0.0600	0.0740	0.2120 PR
0.5770	0.2570	0.2480 VEG

Criteria ranking
Open forest 0.3196
Dense forest 0.5584
Non forest 0.1220

By multiplying above two matrices we can get;

PW 0.3060

PS 0.2720

PR 0.0940

VEG 0.3280 and therefore Vegetation is highest suitable area for elephants.

The highest AHP value is incorporated in the final habitat suitability and get the best suitable habitat for Asian elephant in Eastern Nepal. The set of input layers were run on Arc Map 10 using weighted sum spatial analyst. Input set of factors in the raster format were run using weighted sum approach and the vector layers were converted into raster format. Then each of the input raster were multiplied with a corresponding factor weight, derived from above AHP method and then summed to arrive at a final suitability map of Asian elephants in Eastern Nepal. (See Figure 7)

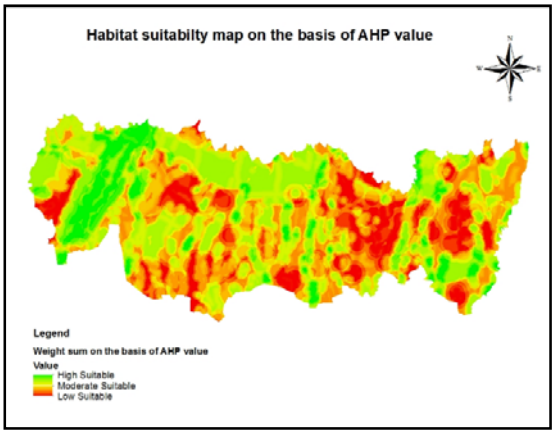


Figure 7:Habitat suitability map using AHP value.

3.7. MaxEnt Modelling

Maximum entropy modelling of species geographic distributions (MaxEnt) was used for predicting probability of occurrence of Elephant. 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.

Fifteen split-sample models for elephant were created using Maxent (software) version 3.3.3k. 195 presence records used for training, 65 for testing & 10000 points used to determine the Maxent distribution (background points and presence points). AUC value ranging from 0 and 1. The Regularized training gain is 0.508, training AUC is 0.784, regularized training gain is 0.547. Unregularized test gain is 0.635, Test AUC is 0.810 and standard deviation is 0.022 (calculated as in DeLong, DeLong & Clarke-Pearson 1988, and equation 2). The algorithm converged after 1180 iterations (18 seconds). Maxent software was run by using environmental layers (all continuous): proximity to dem (rastert_dem2), proximity to forest (rastert_forest1), proximity to river (rastert_river1), proximity to road (rastert_road1), proximity to settlement (rastert_settle2) and get the regularization values: linear/quadratic/product: 0.050, categorical: 0.250, threshold: 1.000, hinge: 0.500.

Continuous predictor variables as forest vegetation, proximity to water bodies, proximity to road, proximity to settlement and DEM. Land use land cover map were used as independents to evaluate the habitat variables that effectively defines elephant presence. Forest vegetation showed highest (36.1%) heuristic estimate of relative contribution to the maxent model. The variable DEM (relative

to altitude) had least contribution (2.4%). 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.

3.7.1. 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
rastert_forest1	39.2	45.8
rastert_settle2	28.5	24.9
rastert_road1	25.1	24.5
rastert_river1	4.6	4.1
rastert_dem2	2.6	0.7

Table 1: Percentage contribution of AUC and permutation

Habitat suitability map was also prepared by using AUC contribution to show the best suitable habitat for elephants. This map showed that forest, shrubs and grasslands were most suitable habitat in the study area.

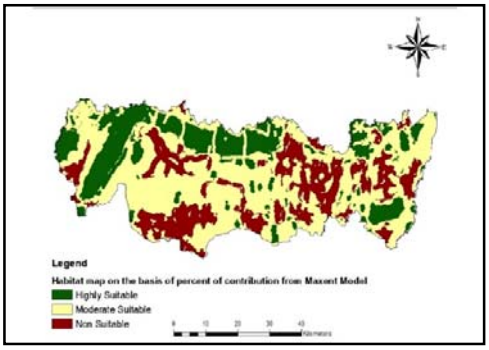


Figure 8: MAXENT Model map on the basis of % contribution of AUC.

The following picture shows the results of the jackknife test of variable importance. The environmental variable with highest gain when used in isolation is proximity to forest

(rastert_forest1), 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 rastert_forest1, which therefore appears to have the most information that isn't present in the other variables.

Values shown are averages over replicate runs. (See fig 10)

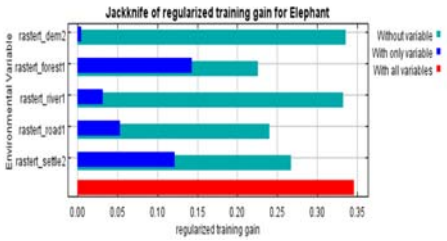


Figure 9: Jackknife of regularized training gain for elephant.

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.

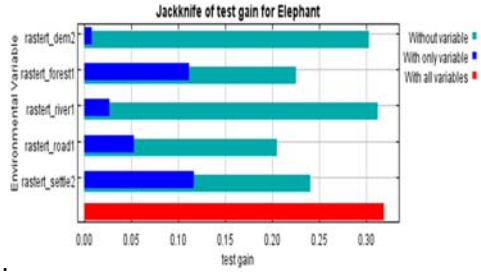


Figure 10: Jackknife of test gain for elephants.

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

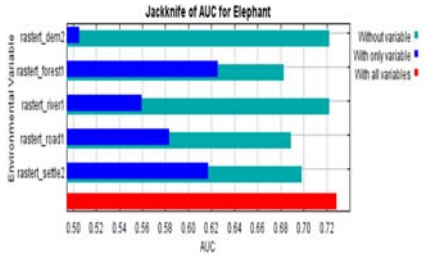


Figure 11: Jackknife of AUC for elephants.

3.7.2. Analysis of omission/commission

The following 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.

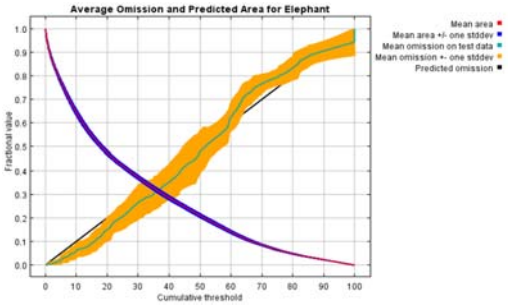
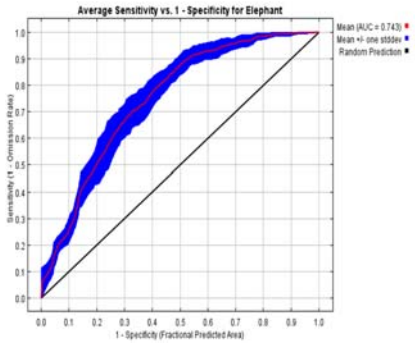


Figure 12: Average omission and predicted areas for elephants.

The next picture is the receiver operating characteristic (ROC) curve for the same data, again averaged over the replicate runs and the specificity is defined using predicted area, rather than true. The average test AUC for the replicate runs is 0.743, and the standard deviation is 0.020 Figure 13: Average sensitivity VS 1-specificiety for elephant



Maxent model has finally generated a habitat suitability map (Fig.14). The map was reclassified based on the habitat variable and specific probability thresholds to classify suitability map into different three suitability classes as highly suitable, moderate suitable and non-suitable.

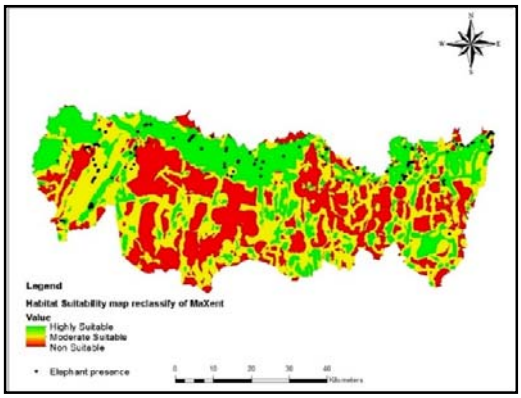


Figure 14: Reclassified Maxent model map.

26.33% (126224.65 hectare) is highly suitable, 41.96% (200852.60 hectare) is moderately suitable and 31.68% (151632.92) is non-suitable area for Asian elephants in the eastern Nepal. (See fig 14). Maxent model showed that only forest habitat is highly suitable for elephant whereas grassland,

water bodies, shrub land and agriculture are moderately suitable and settlement as well as other development infrastructure is non-suitable for elephants.

3.8. Conservation Awareness program:

Conservation education material, Calendars distributed to school kids and Quiz contest, Essay competition and school education classes were conducted among high school kids and middle school kids in Sunsari, Saptari and Morang districts. 7 member ECC committees were formed in three districts, Sunsari, Morang and Saptari. These committees were used for conservation awareness, field work and stakeholder consultation. ECC has also organized 12 episode "Save the elephants" radio program from Popular FM Sunsar. A 12 episodes Elephants conservation Radio Program was broadcasted from local Popular FM, Inaruwa, Sunsari. 1500 copies of postures and 1500 copies of Elephant conservation related calendars. In this conservation education program 500 students, 500 local people and 53 teachers were participated directly and indirectly & benefited.

3.9. Assessment of migratory routes

Migratory route was identified by using transect survey, social survey, stakeholder consultation, elephant presence and absence status study and frequency of conflicts in the study area. Etrex10 GPS headsets were used to collect presence absence of elephants in the study area. Land use change detection map for 1990-2000 and 2000-2013 periods were prepared for analysing the land use change to show the change in elephant migratory routes. Asian elephants use forest area as their ancestry migratory routes during last three decades and they occasionally come to settlement due to large chunk of forest but due to shrinkage in forest habitat and increment in the agriculture and settlement as well as development infrastructure. In this study we had found that elephant used these area as their ancestry corridor and migratory routes and human elephant interaction take place. NDVI analysis was done and NDVI maps were prepared for three time series (1990, 2000 & 2013) and presence of healthy vegetation was identified. We have overlaid GPS points having elephant presence/ absence on the NDVI map and obtained elephant presence map and elephant encountered map of the study area. Finally joining elephant presence points, we have achieved current migratory route of elephant. (See figure 17.)

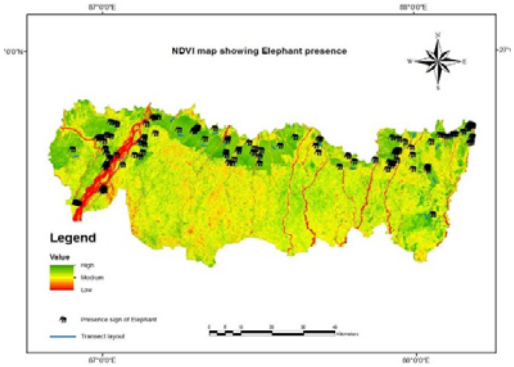


Figure 15 :Elephant presence sign in NDVI map of 2013.

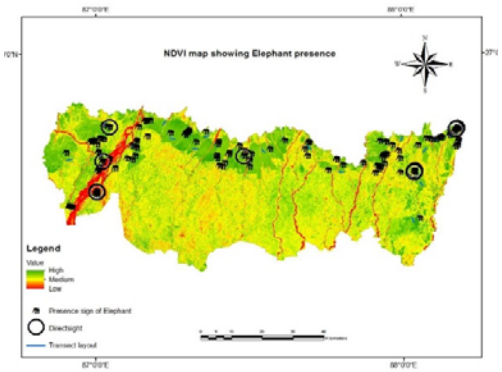


Figure 16: Direct sighting and indict sighting of elephants in the study area.

This study has identified the following migratory routes and it can be presented in map also:

1. West Bengal - MECHI KHOLA-Bahundangi (Nepal) - Deviganja - Thimai - Kudanabari - Dahijhora jungle - Thugari (village bordering Ilam district) –Danabari-Arjun dhara- Sanischare-Chulachulli-Damak Np- Jante-Belbari-Sundar pur-Salakpur-Kerabari-Yansila- Pachkanya-Bharaoul-Dharan-Barahchetra-KTWR- Saptari- or Thoksila-Purandah/ Tapeswori- Fatepur

2. West Bengal - MECHI KHOLA-Bahundangi (Nepal) - Deviganja - Thimai - Kudanabari - Dahijhora jungle - Thugari (village bordering Ilam district) –Danabari- Mechikhola- Domukha-Satashidham-Chulachuli- Jante-Belbari-Sundar pur-Salakpur-Kerabari-Yansila- Pachkanya-Bharaoul- Dharan-Barahchetra-KTWR- Saptari- or Thoksila-Purandah/

3. MECHI KHOLA - Bahundangi (Nepal) -Deviganja - Thokla –Thimai- Kujanabari - Dhaijora jungle -Thugari (village bordering Ilam district) - Sissaou plantation -Parajungi Dhukurpani - Beldangi (refugee camp) - Marongijilal - Barne jungle- Katle Jungle - Shathijora- Baukajora - Tarahara - Patnali - Sripur Jabdi - Koshi - Rampur thoksila (Udayapur)-Ambasi-Fatepur- Siraha (See figure: 17)

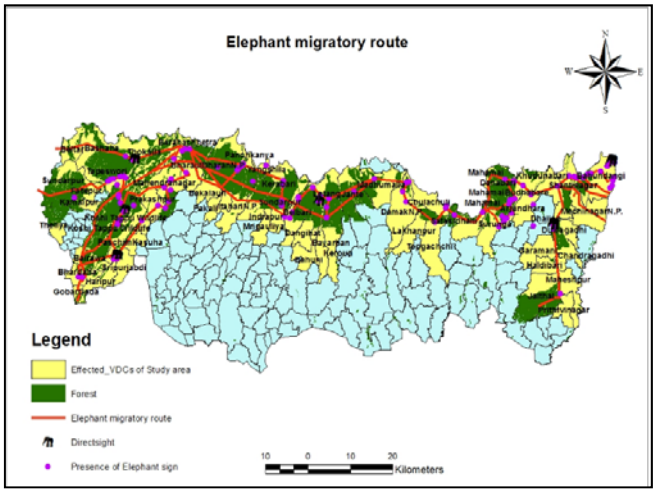


Fig: 17 Migratory routes of elephants in eastern Nepal

3.10. Human Elephant interface study

Human wildlife conflict is a global burning issue for wildlife conservation. HEC is one of them. Asian elephants are concentrated in 13 range countries and faces severe challenges interacting with human in form of HEC. Nepal has four isolated population of Asian elephant (eastern, central, mid-western and far western). This study is concentrated to eastern population. Source population of eastern elephant is from Assam & West Benagal, India. Pradhan, 2007; EAP, 2009; Velde 1996; Yadav 2002& 2005 have expressed that there are 7-15 residential population were in this study area. The highest migratory population seen in Bahundangi were 400 individuals in 2004. (Acharya K.P *et al.,* 2010)

3.11 Status of Elephants in eastern Nepal:

We have completed our field work (transect walk) on 45 days immediately after monsoon with nights and days camping inside the forest. During our study we have encountered two elephant sub population (one in Jhapa and another in KTWR) which was previously 7-15 (Velde, 1997). This study shows, 11-13 elephants seen in KTWR with 7 males (4 sub adults male, 3 adult male) & 5 females (having 2 adult female with 1 kid and 2 sub adult female) and 2 makunas. Similarly 7-11 elephants were encountered in Jhapa (5 in Baundangi, 3 in Charalli forest, 2 in Bahuwan forest, 1 in Hanse Dumse community forest, Beldangi. (See Figure 18.)

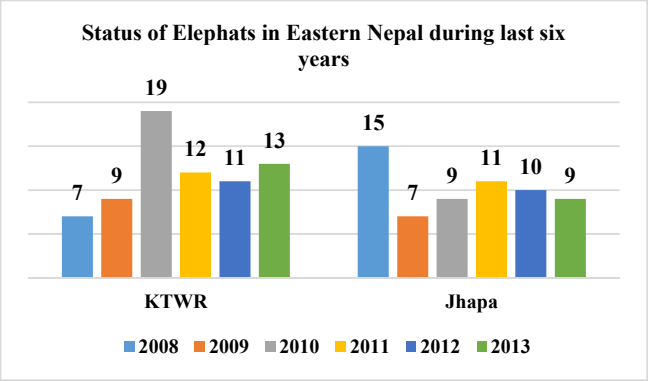
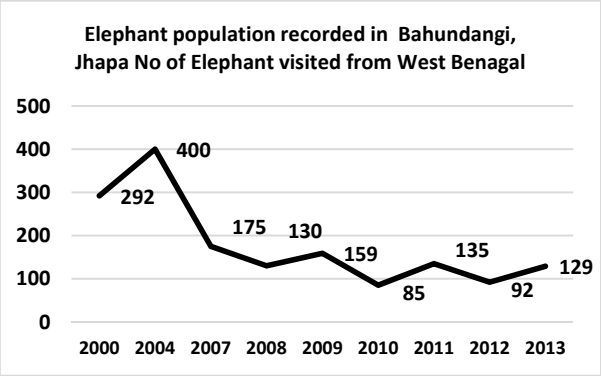


Figure 18: Data source: KTWR and Jhapa DFO

The migratory elephant herd came every year from India (Assam and West Bengal) to Bahundangi Jhapa. They were checked in Bahundangi and get back to India. (See fig 19)



Data source: DFO jhapa, NCS Jhapa, EAP 2009 & social survey 2013.

Figure 19: Migratory elephant visit trends in Bahundangi, Jhapa.

3.12 Nature and extent of HEC in Jhapa

The maximum extent of conflict took place in 11 VDCs of Jhapa (Bahundangi, Dhaijan, Khudnabari, Shantinager, Arjundhara, Surunga, Prithwinagar, Budhbare, Lakhanpur, Garamani and Beldangi). Out of these VDCs, Bahundangi, Budhware and shantinager is severely impacted by elephants. There are two types of elephant herds were seen in Jhapa. A small residential herd between 7-15 elephants (VELDE 1997, Prdhan 2007), among which; 7-9 sighted during field study in 2013) and another herd is migratory seasonal herd (85-400) which visit Jhapa seasonally in maize and paddy season.

Between January 2008 and December 2013, 44 human casualties were occurred. Among 44 cases 19 people got dead and 25 people get injured severely. Among these incidents female having age group 16 to 88 and 21-84 year age group size were found in fatality. People lost property having value NRs 6441280 in Bahundangi from 102 damages during in a single year 2070 (2013) and we can easily assumed the severity of conflict. 18 people were killed and 19 people were injured during last 5 years in Jhapa. The frequencies of conflict and human casualties are given in figure 20.

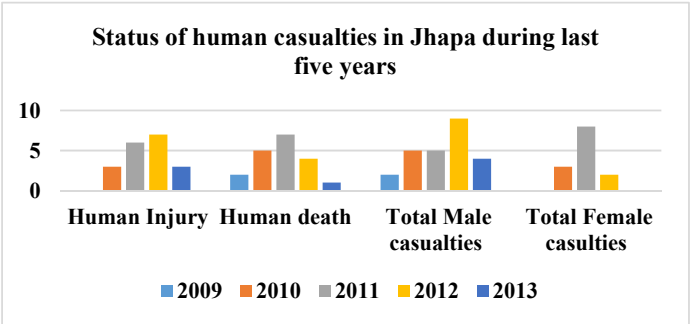


Figure 20: Frequencies of Human casualties' incident in Jhapa in different VDCs

3.13 Nature and extent of HEC in Koshi Tappu Wildlife Reserve (KTWR) and Buffer zone

The human-elephant conflicts were found higher in two areas (Bahundangi- Jhapa and KTWR buffer zone) in comparison to other areas in eastern Nepal. The intensity of conflict had been increased during last five year as increase in the elephant's number and duration of stay in KTWR. Previously 2/3 elephants stayed in KTWR & chure foot hills (Velde 1996) and recently these population are 11-13. Between January 2008 and December 2013, 324 households from the buffer zones of ktwr having 16 VDCs were found effected by HEC.Amog 324 HHs 2 HHs lost their cousin and 7 people get injured form 7 HHs, 97 people lost their houses and property inside it and rest of the people has gotten crop damage.

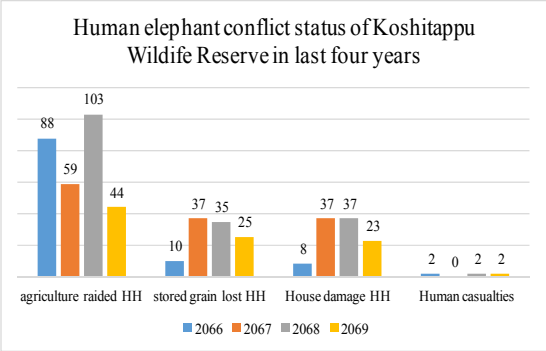


Figure: 21, Human elephant conflict status in KTWR

3.14. Human elephant conflict pattern in the study area

There are 61 VDCs were under the effective area of human elephant interface in six district of eastern Nepal. Major human elephant conflict areas were Jhapa district and Koshitappu Wildlife Reserve and its buffer zone. There are 11 VDCs under highest conflict in Jhapa district (Bhaundangi, Prithwi Nagar and Shantinagar is highly impacted in Jhapa). Similarly there are 16 VDCs were impacted in Koshi Tappu Wildlife Reserve buffer zone and five VDCs (Hariur, Sripur, Purwa pipra, Odraha and Tapeswori).

In the meantime elephant travels 102-150 kilometer distance from jhapa to Saptari for searching of food and mates during migration. Habitat fragmentation (in the form of encroachment, forest depletion, infrastructure, agriculture and settlements) obstruct elephants during migration in their migratory route from Jhapa to Koshi River. Bahundangi, Shantinagar, Budhbare, Kudnabari, Domukha, Chulachuli, Madhumalla, Letang, Kirtiman village, Lohondra, Belbari, Chatra are some areas where habitat connectivity is lacking and as a result these area faces higher human elephant interface in eastern Nepal. In all the migration obstruction area, there was higher the conflict occurred and severe human casualties were made. The most damage was seen during paddy and maize season ie. Kartik/ mansir (Paddy ripening) and Jestha/ Asadh (Maize ripening), when elephant visit to KTWR. Althogh Elephant were seen through out the year as residential population.

3.15. Spatial pattern of HEC

Spatially human elephant conflict (HEC) was distributed in the whole study area where elephant travels in eastern Nepal. Among 61 VDCs 31 were severely impacted and Spatial pattern of HEC has shown that HEC is highest in close proximity to Protected areas as well as proximity to forest outside the Pas in both cases Jhapa and KTWR (See figure 53). The majority of incidence were taking place in between 0.5 kilometer (km) to 4.5 km and least incident occurred outside 4.5 km. It was also recorded by (DiFonzo, 2007) and he said that area between (0.5-4.5) outside protected area act as elephant refuges.

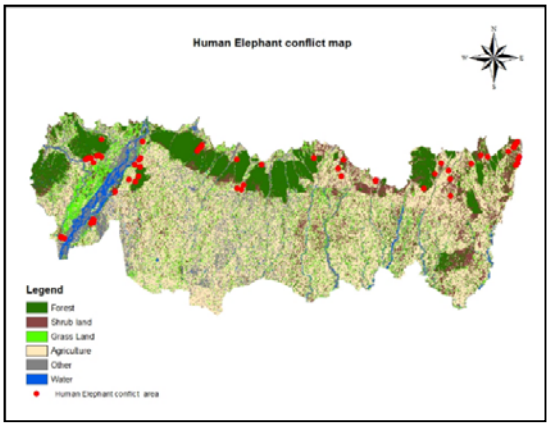


Figure:22, Habitat fragmentation and human elephant conflict area.

Distance from the villages to forest or protected forest influenced HEC intensity, with decreasing conflict incidents as the distance from the forest boundary increases (Lahkar *et al*., 2007; Panta, G.). The frequency of HEC incident was high within a distance of one kilometre from park boundary in Chitwan National Park studied by (Panta G, 2012.) However, HEC incidents were concentrated in few locations and there are distance farther than 4.5 km in Jhapa and KTWR.

Maxent model also predicted that probability of occurrence of Elephant within 1 km from the forest boundary is higher and within 1 km was highly suitable areas for elephants but within 1 km from the settlement boundary is non-suitable for elephants.

3.16. Mitigation measure adopted by local people in Jhapa and KTWR

Animal deterrent light, , Chilly dust, Drum, fire arms, Fire, Blasting dust, tractors, gun fire in air, were used to check elephants from the settlement and farm as traditional elephant control practice. Solar fence, Elephant deterrent view tower, trenches, Arm force and police patrol for elephant deterrence were conducted in Jhapa and KTWR to control elephants form settlements and farms but it is insufficient to deter elephants. These traditional methods were regular program for local people as well as protection units. Armed police force, Civil police and Nepal Army were used to control and check elephants in Jhapa and Koshi Tappu to minimize damages and human casualties in the severe HEC areas.

These all the practices for deterring elephants were only painkiller to elephants, because these all strategies were short and immediate strategies to response for elephant control, therefore these programs were unable to control the elephant and severity of damage would be increased day by day and it needs long term human elephant coexistence program to conserve elephant as well as peoples properties and life.

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

I had good understanding of the project area and good rapport with the local people and therefore I had planned to work with community through Elephant conservation committees (ECC). 3 ECC were formed (each in a districts) by using the existing CFUGS, BZUGs, local CBOs and a person from village development committee for sustaining in the long run for elephant conservation. ECC had gotten funds from this project for completion of conservation awareness program.

ECC had conducted quiz contest, Essay competition among school kids. 12 episode radio program (Save our Elephants) conducted from local Popular FM-Inaruwa, Audi visual program and also distributed calendars and postures were printed and distributed by local ECC.

Along with ECC, local people were very much cooperative to the project team throughout the project period. Their participation in transect survey for habitat suitability study, Migratory route assessment, Human elephant interface study and conservation awareness program, semi-structured questionnaire survey and focus group discussion was commendable.

This project has been successful in collecting the scattered information on habitat status, migratory routes and Human Elephant Interface status in Eastern Nepal together. Local people knew about the habitat status, migratory routes and its fragmentation status, Conflict area, ecology of elephants, mitigation measures and how to drive elephants from their settlements which will help to fight and cope with ongoing HEC on their territories. The progress of this project was disseminated through trimester meetings of ECC and through Radio program. The local people also became aware about the existing directives of 2012 on compensating victims of Human Wildlife Conflict. Besides ECC, My project team had also included people from different sectors i.e. local people (involved in CFUG, BZCFUG, CBOs), Government staff (KTWR and District forest office staffs (DFO), school teachers. Koshi Tapppu Wildlife Reserve had assisted in tracking elephant movement by providing 2 staffs (Assistant conservation officer and a game scout). Similarly, CFUGs had helped in collecting information related to HEC, School teachers had assisted for conducting quiz contest & essay competition through school wetland clubs. ECC had conducted quiz contest, essay competition, audio visual program and also guide us in all research activities. ECC had also involved in planning, implementing and monitoring project activities. ECC, KTWR staffs, DFO staffs, local CBOs and local community helped us in data collection in the field for ground truthing and transect sweeping in the forest habitat.

In this way community people were involved in each activities of this project, got sound knowledge about driving elephants and coping with HEC and they had benefitted from this project in terms of monetary value also.

5. Are there any plans to continue this work?

Sure, the project team has planned to continue this work in the adjoining area. Asian elephants migrates towards the adjoining districts ie. Dhanusa and Sarlashi to west. There are several incident regarding HEC is experienced in Siraha, Dhanusha, Mahotari and Sarlahi. It is a serious issue experienced in Sarlahi and at present. Therefore we are planning to continue the Geospatial study regarding HEC in the adjoining areas of the current study area. The team plan to establish a HEC relief fund that will undoubtedly help the victims to recover at least from human casualties and human injury. For this the project team will undoubtedly need financial support from the organisations like The Rufford Small Grants Foundation.

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

The report will be presented in relevant workshops and seminars. If possible, this effort will presented in Rufford small grant foundation grantee meeting.

The findings of the project will be compiled into the form of a brief report and will be distributed to the relevant stakeholders in the Department of National Parks and Wildlife Conservation, Kathmandu. The final report of the project will be developed publish in one of the relevant international journal.

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

Activities	Proposed schedule (Time in month)	Actual time it took (in month) Revision in time schedule	Comments
Preliminary Field visit	July- Aug 2013	Aug-Sep 2013	Due to late approval of Rufford Grant, it was approved only in Sept, 2013
Formation of Elephant conservation Committees (ECC)	Aug- Sept 2013	Sep-Oct 2013	
Transect and plot layout	Aug- Sept 2013	Sep-Oct 2013	

Land use Land cover change study	Oct- Dec 2013	Oct-Jan 2013	
Habitat suitability study	Jan – Mar 2014	Feb-April 2014	
Conservation Awareness program	Jan-May 2014	Jan-May 2014	
Data analysis, Report preparation and Submission	Jun-July 2014	July- Aug 2014	

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.

Item	Budgeted Amount	Actual Amount 1 £ sterling=106.42 (taken from the project application)	Difference	Comments
Preliminary field visit to all the possible HEC areas in the study area	200	273	-73	
Tea & Snacks for progress meetings	150	150	0	
Tea & snacks for coordination and consultation meetings	150	150	0	
Daily allowances for field level assistants (data collection and field survey	1185	1185	0	
Allowance (DSA) for Team leaders	1595	1595	0	
Landsat 4-5 image, Land sat 8 OLI having 30 meter	0	0	0	

resolution will be downloaded from USGS				
Topographic maps etc. acquired from Department of Forest Research and Survey	0	0	0	
Save Our Elephants (12 episodes Radio program broadcasted for educating local people about Asian elephant ecology and progress of the project)	563	590	-27	
Project's progress publication in News paper	125	125	0	
Calendars producing, printing and distribution	600	600	0	
Support to ECCs for Audion visual program and conservation ralley	195	195	0	
Prize for winner of essay and quiz competition	117	117	0	
Progress related postures and booklets printing and distribution	195	195	0	
Support to KTWR buffer zone wetland clubs for street drama about elephant conservation and Local transportation for team leaders and assistants	273	200	+73	Conservation rally was not conducted (No of quiz and essay completion events were increased)
Data analysis, report preparation and submission	178	178	0	
Total	5766	5793	-27	

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

Asian elephant doesn't know the border of any country and travels as per ancestry routes. This study identified that Asian elephant travels west toward Chitwan National park from Jhapa(Bahundangi) but the detail elephant route is still lacking. Although this study had explored the geospatial status of Asian elephant migratory routes and habitat status as well as status of human elephant interaction in eastern Nepal. Looking ahead, I think the same study is required from Siraha to west of Parsa Wildlife Reserve; which gives the better idea of elephant migration in Nepal and detail conflict as well as habitat status of Asian elephant (*Elephus maxius*) in eastern to central Nepal.

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

I had used RSGF logo for preparing conservation awareness material i.e. Calendars and postures for disseminating the progress of the project. During my project work, people raise question about logo and they were satisfied by answering that this project was funded by RSGF and some of them were interested to apply for RSG. In this way RSGF had received publicity during my project work.

11. Any other comments?

Human and Asian elephants have been in constant struggle in Nepal and several studies have been undertaken to assess the gravity of such conflicts and recommend way forwards to mitigate such conflicts. But Nepal still lacks even basic information on elephant migration within the country. The project team, thus, expects support from the organisation like the RSGF in its next step to prepare Asian elephant migration map of Nepal**.**