CEPF FINAL PROJECT COMPLETION REPORT

Organization Legal Name:	Conservation International
Project Title:	Update the Forest Cover and Change Analysis of the Eastern Arc and Coastal Forests Region of East Africa
Date of Report:	November 24, 2014
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CEPF Region: Eastern Arc and Coastal Forests Region of East Africa

Strategic Direction: Improve biological knowledge (all eligible sites)

Grant Amount: 112937.00

Project Dates: 2012/1/1 – 2014/09/30

Implementation Partners for this Project (please explain the level of involvement for each partner):

Conservation Impacts

Please explain/describe how your project has contributed to the implementation of the CEPF ecosystem profile.

This proposal has activities linked to Priority 4: "Availing biological and forest change data to leverage REDD+ and REDD Readiness for the EACF" and LoI 4: "EACF data management and LOI 4 "Information dissemination to consolidate conservation outcomes and inform REDD+ processes " www.cepf.net/where_we_work/regions/africa/ eastern_arc_coastal_forests/Pages/consolidation.aspx

Please summarize the overall results/impact of your project.

1. We produced an updated of the habitat cover and change map for circa 2010.
2. We provided capacity building in the latest methods and software for satellite-image analysis for monitoring deforestation. Through this project we have improved our preprocessing and classification approaches and experimented with open source GIS software. The new approaches included atmospheric correction, cloud masking, and producing gap-filled mosaics of Landsat imagery. This methods attempts to eliminate any cloud artifacts providing cloud-free windows and improving ease of classifying the images. We also used a random forest classifier for the first time. This classifier is an ensemble learning model for decision trees to improve classification accuracies. The use of open source GIS software was intended to provide capacity for partners who don't have access to expensive licenses software.
3. Aerial surveys were conducted in 2012 to collect high resolution imagery in areas that are routinely cloudy or difficult to interpret the land cover in satellite imagery. The Arial data was processed into ortho-mosaics and used to assist image interpretation when creating training data for the classification.
4. Validation of the updated deforestation analysis was performed
5. Statistics of habitat status and trends for administrative units, KBAs, protected areas, and forest reserves were calculated. These results are included in the final report.

Project Approach - Describe the proposed strategy and **Planned Long-term Impacts - 3+ years (as stated in the approved proposal):**

This project has long-term impacts in two important ways. By building capacity in the government in monitoring deforestation, Tanzania will have a greater ability to reduce rates of deforestation and its associated impacts on biodiversity, climate and ecosystem services. This will be via generating greater confidence in the investment community and the international community in Tanzania's ability to demonstrate its successes in REDD+. It will also be via its increased ability to detect where REDD+ efforts are having greater or lesser success and thus respond to needs, via enforcement, increased incentives, or modification of its REDD+ strategy. By training key people in the government in monitoring, expertise will be

increased that will then allow their training of the next generation's cadre of scientists who could serve this role in the future. To achieve these long-term impacts, we will 1) continue capacity building and bring much-improved analysis methods, and 2) we produce products that will provide fundamental information related to Tanzania's REDD+ planning.

Actual Progress Toward Long-term Impacts at Completion:

We produced an updated habitat cover baseline that can be used to inform future mapping of habitat change in the region. The investments informed by the map and statistics will have long-term conservation impacts in the region. The capacity building in the latest remote sensing and mapping methodologies to government officials and students at Sokoine University of Agriculture will also have long-term impacts as attendees may apply their learned skills to new projects and in-country capacity for mapping is recognized by the government and external partners.

The first capacity building training in pre-processing methods for habitat monitoring with Landsat was conducted in December 2012. Nine professors and students from the Sokoine University of Agriculture participated in an eight day training course with the following agenda:

- introduction course to conservation remote sensing
- overview of CI's VCS approved forest monitoring methodologies
- instructions and hands-on support for installation of required freeware for atmospheric correction and gap-filling
- recommendations for image selection
- running LEDAPS for atmospheric correction and cloud masking
- running the gap filling algorithm to fill no-data holes from clouds and SLC-off striping
- creating training data for decision-tree classifier

Above: Max Wright teaches as introduction to remote sensing course during first training session December, 2012.

The second capacity building training was held in August, 2014 and included an introduction to change detection techniques using a new global forest cover change dataset and map validation methodologies. Four students and two professors attended that hands-on training. Suring the course of the training the students generated the stratified random sampling points for the actual map validation.

Planned Short-term Impacts - 1 to 3 years (as stated in the approved proposal):

First, we continue capacity building and bring much-improved analysis methods. Second, we produce products that will provide fundamental information related to Tanzania's REDD+ planning. This process will include providing processing and analysis improvements that have been requested by the government. It will also include providing updated aerial survey data for validation as well as finer-resolution sample estimates. This short-term impacts are critical to enabling the long-term impacts noted above.

Actual Progress Toward Short-term Impacts at Completion:

The short-term impacts of this project are the production of an updated habitat cover and change map for the region and the aerial survey database. The fine resolution aerial data, habitat cover

and change map, and habitat status and trend statistics generated from the maps can be used to inform priority setting and target conservation investments. The capacity building sessions at Sokoine University of Agriculture have immediate results of increasing remote sensing knowledge and mapping capacity in-country. The training workshops also provide tools and help generate awareness and interest in remote sensing from the attendees who may choose to pursue the subject further in their studies or careers.

Please provide the following information where relevant:

Hectares Protected:
Species Conserved:
Corridors Created:

Describe the success or challenges of the project toward achieving its short-term and long-term impact objectives.
We were successful on delivering all components of the project. We developed the most current methods for the mapping analysis and provided the training and open source tools to students and government officials in the region. We also produced a 2010 habitat cover and change map and a fine resolution, aerial survey database of ortho-mosaics for the region. We also provided the statistics on trends for habitat cover within administrative boundaries and conservation areas.

One major challenge to achieve this project's goals was time constraint on our in-country consultant/partner to complete the technical work given the poor quality of the available Landsat data and the availability of the consultants given their other commitments. Due to the cloudy scenes and SLC-Off striping, no-data gaps were filled with data from three or more scenes making the gap-filled mosaics very difficult to interpret and classify. In addition, delays in the project both from the World Bank contract process (which delayed this consultancy 9 months) and constraints on the consultant's time that was not anticipated when the original commitment was made. In the end the consultant was unable to deliver the complete classified map product in time due and we had to complete the mapping product, validation, and stats in-house. We still delivered on all the capacity building objectives of the project and delivered all the products.

The development of new methods for this mapping and analysis using open-source software has the short-term impact of testing and applying the most up-to-date and most accurate methods. The technical trainings of these methods conducted for students and key technicians in the government has both immediate and long term impacts of building in-country capacity for remote sensing. The updated map and statistics on habitat trends has the immediate impact of informing conservation priorities and investments. The conservation outcomes of decisions will contribute to the long-term impact of CEPF's investments in the region.

Were there any unexpected impacts (positive or negative)?
The decision to complete the mapping product in-house forced us to employ a quick method of using a global 30-m change dataset to update the previous circa 2000 baseline. This 30-m Landsat-based change data was just released last year and is being utilized as a monitoring tool to update existing habitat baselines for many countries and REDD+ sites. The draw-back of using this method is that a global dataset will not be as accurate as a regional dataset and this may cause and increase in map errors in the change classes. However, this was an opportunity for us to test and validate these methods that are being implemented as a standard monitoring tool for CI's own metrics as well as for REDD+ national-level monitoring.

Project Components

Project Components: *Please report on results by project component. Reporting should reference specific products/deliverables from the approved project design and other relevant information.*

Component 1 Planned: Acquire and preprocess satellite data and develop strategy for aerial surveys data acquisition.

Component 1 Actual at Completion:
Aerial survey plan was developed using existing Landsat imagery and local knowledge from consultants. Landsat images were selected from the archive, downloaded, and sent to consultants at Sokoine University of Agriculture (SUA). Materials and in-person training for cloud-masking and gap-fill tools were compiled and conducted.

Component 2 Planned: Pre-process satellite-imagery and conduct aerial surveys for ground-truthing and validation.

Component 2 Actual at Completion:
Satellite images were reprocessed by consultant and were delivered to CI on an external hard drive. All the imagery were co-registered and imported into Erdas Imagine format. Aerial survey was conducted in September 2012 and the orthomosaics were processed and delivered to partners to aid image interpretation.

Component 3 Planned: Produce and validate the updated deforestation map.

Component 3 Actual at Completion:

CI and consultants went through an extensive review process where classification iterations were sent to CI staff for review and then CI staff returned suggestions and edits for the next iteration. This process took place from June through September. After three such exchanges for all 12 scenes in the classification, it was clear that the consultant would not be able to deliver the final product in time. CI had to make a hard decision to use a different method in-house to be able to complete the classified product. The forest cover and change map was then produced using a global change product to update the previous 2000 baseline produced by CI. This method was taught to the consultants at the training session and completed during the training. The validation of the new change product was conducted in-house using high resolution imagery in google earth. The validation points for the stratified random sampling was generated at the training workshop and a short-term hire at CI interpreted the validation points and produced the accuracy assessment.

The final report was jointly written by consultants and CI. This report describes the drivers of change in the area and reports on the 2012 forest cover status and trends in forest cover by political units, KBAs, protected areas, and reserved areas.

Were any components unrealized? If so, how has this affected the overall impact of the project?

Despite some challenges already detailed in this document, we completed all the components in the project by adapting solutions that would work best for us and for our consultants.

Please describe and submit (electronically if possible) any tools, products, or methodologies that resulted from this project or contributed to the results.

1. Aerial survey database
2. Training documents on the updated classification methods
3. Validated map product of forest cover and change from cira 2000 to circa 2010

4. Statistics of forest cover and change for administrative units, KBA's protected areas, and reserved areas
5. Final report

Lessons Learned

Describe any lessons learned during the design and implementation of the project, as well as any related to organizational development and capacity building. Consider lessons that would inform projects designed or implemented by your organization or others, as well as lessons that might be considered by the global conservation community.

Project Design Process: (aspects of the project design that contributed to its success/shortcomings)

In the process of implementing all open-source software, we had to teach people how to install and use linux OS and command-line software. The first training included too many participants with varying technical expertise. If we had to teach a highly technical workshop again we would recommend only inviting a limited number of very technical experts to do the hands-on training. Only a short, broad over view of these technical methods should be given to a larger group so they know of the tools and how they can be used, but they can rely on a technician to implement them.

The aerial survey had mixed success in this region given the geography of the landscape. Most of the remaining forested areas are at high elevations which are difficult to image because of cloudiness and equipment limitations at high altitudes. Also the resulting orthomosaics were not particularly useful to aid image interpretation and validation because they didn't cover a large enough footprint to get a good idea of the landscape represented in a 900 m^2 Landsat pixel. We would recommend for a future project to purchase high resolution satellite imagery over areas that are not already covered in the Google Earth archives.

Project Implementation: (aspects of the project execution that contributed to its success/shortcomings)

We believe that the adaptive management of the project and the solution-orientated activities were responsible for the project success given the challenges that were presented. Also, we believe a large part of the project success was maintaining focus on capacity building local partners in the latest tools and methodologies for habitat monitoring. Despite finishing the mapping work in-house, our partners were fully trained on the methods and engaged in the development of the map product and its validation.

Other lessons learned relevant to conservation community:

We found the change update methodology using the 30-m Landsat product to be adequate but not reliable in this region. Detailed regional assessments are required giving the complex land cover dynamics of East Africa.

Additional Funding

Provide details of any additional funding that supported this project and any funding secured for the project, organization, or the region, as a result of the CEPF investment in this project.

Donor	Type of Funding*	Amount	Notes

***Additional funding should be reported using the following categories:**

A *Project co-financing (Other donors or your organization contribute to the direct costs of this project)*

B *Grantee and Partner leveraging (Other donors contribute to your organization or a partner organization as a direct result of successes with this CEPF funded project.)*

C *Regional/Portfolio leveraging (Other donors make large investments in a region because of CEPF investment or successes related to this project.)*

Sustainability/Replicability

Summarize the success or challenge in achieving planned sustainability or replicability of project components or results.

Summarize any unplanned sustainability or replicability achieved.

Safeguard Policy Assessment

Provide a summary of the implementation of any required action toward the environmental and social safeguard policies within the project.

Additional Comments/Recommendations

Information Sharing and CEPF Policy

CEPF is committed to transparent operations and to helping civil society groups share experiences, lessons learned, and results. Final project completion reports are made available on our Web site, www.cepf.net, and publicized in our newsletter and other communications.

Please include your full contact details below:

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*****If your grant has an end date other than JUNE 30, please complete the tables on the following pages*****

Performance Tracking Report Addendum

CEPF Global Targets

(Enter Grant Term)

Provide a numerical amount and brief description of the results achieved by your grant.
Please respond to only those questions that are relevant to your project.

Project Results	Is this question relevant?	If yes, provide your numerical response for results achieved during the annual period.	Provide your numerical response for project from inception of CEPF support to date.	Describe the principal results achieved from July 1, 2007 to June 30, 2008. (Attach annexes if necessary)
1. Did your project strengthen management of a protected area guided by a sustainable management plan? Please indicate number of hectares improved.	no			Please also include name of the protected area(s). If more than one, please include the number of hectares strengthened for each one.
2. How many hectares of new and/or expanded protected areas did your project help establish through a legal declaration or community agreement?	no			Please also include name of the protected area. If more than one, please include the number of hectares strengthened for each one.
3. Did your project strengthen biodiversity conservation and/or natural resources management inside a key biodiversity area identified in the CEPF ecosystem profile? If so, please indicate how many hectares.	no			
4. Did your project effectively introduce or strengthen biodiversity conservation in management practices outside protected areas? If so, please indicate how many hectares.	no			
5. If your project promotes the sustainable use of natural resources, how many local communities accrued tangible socioeconomic benefits? Please complete Table 1below.	no			

If you answered yes to question 5, please complete the following table

Table 1. Socioeconomic Benefits to Target Communities

Please complete this table if your project provided concrete socioeconomic benefits to local communities. List the name of each community in column one. In the subsequent columns under Community Characteristics and Nature of Socioeconomic Benefit, place an X in all relevant boxes. In the bottom row, provide the totals of the Xs for each column.

Name of Community	Community Characteristics								Nature of Socioeconomic Benefit													
									Increased Income due to:													
	Small landowners	Subsistence economy	Indigenous/ ethnic peoples	Pastoralists/nomadic peoples	Recent migrants	Urban communities	Communities falling below the poverty rate	Other	Adoption of sustainable natural resources management practices	Ecotourism revenues	Park management activities	Payment for environmental services	Increased food security due to the adoption of sustainable fishing, hunting, or agricultural practices	More secure access to water resources	Improved tenure in land or other natural resource due to titling, reduction of colonization, etc.	Reduced risk of natural disasters (fires, landslides, flooding, etc)	More secure sources of energy	Increased access to public services, such as education, health, or credit	Improved use of traditional knowledge for environmental management	More participatory decision-making due to strengthened civil society and governance.	Other
Total																						

If you marked "Other", please provide detail on the nature of the Community Characteristic and Socioeconomic Benefit: