Darwin Initiative Annual Report

Important note:

To be completed with reference to the Reporting Guidance Notes for Project Leaders – it is expected that this report will be about 10 pages in length, excluding annexes

Submission deadline 30 April 2009

Darwin Project Information

Project Ref Number	17027
Project Title	Market Based Scheme for Conservation in La Primavera Forest Mexico
Country(ies)	Mexico
UK Contract Holder Institution	DICE- University of Kent
Host country Partner Institution(s)	ITESO
Other Partner Institution(s)	University of Twente, La Primavera Natural Protected Area, UNAM, ALICEA AC, Corazon de la Tierra, Fomento y Protección Bosque La Primavera
Darwin Grant Value	100,481
Start/End dates of Project	2009-04-01 to 2012-03-31
Reporting period (1 Apr 200x to 31 Mar 200y) and annual report number (1,2,3..)	1 April 2009 to 31 Mar 2010, Annual Report Number 1
Project Leader Name	Dr. Jon C. Lovett
Project website	Under construction
Author(s) and main contributors, date	Arturo Balderas Torres, Jon Lovett 28th April 2010

1. Project Background

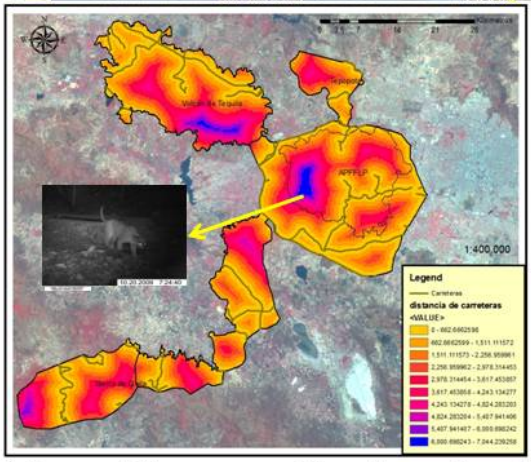
This research will explore the potential for capturing environmental values in a market-based scheme based on above-ground carbon accounting in order to develop habitat conservation and restoration activities in and around the La Primavera forest, Mexico. La Primavera's Natural Protected Area was created in 1981, and was categorized as a Biosphere Reserve in 2006. It consists of 30500 ha of pine-oak forest located in western Mexico next to the second biggest city in the country, Guadalajara Metropolitan Area (CONANP, 2000). Cougars (*Puma concolor*) are the top predator in the forest; however biological corridors are needed to maintain a long term viable population. Urban pressure and land use change are isolating La Primavera and closing natural biological corridors for wildlife.

During fieldwork undertaken in summer 2009, while establishing the project monitoring plots, the La Primavera executive office received reports of felid sightings. The team found scats and footprints (picture) of what later was confirmed to be a puma. A camera trap installed by another research group from Universidad de Guadalajara, in coordination with La Primavera office provided firm evidence. This is an important discovery since puma were driven to local

extinction by hunting in the mid 70's and their recent sighting confirms that the wildlife corridors are still open. The scat collected by the team is preserved and can serve for future DNA analysis. [Note added 31 April 2010 – a new photograph dated 23 April 2010 confirms the Puma is still in La Primavera]

Figure 1. Identification of the project area.

a) Localization of study area in the National Context



c) Generated "distance to roads" model, matching with the area where the puma was photographed.

b) La Primavera (BLP) and principal forested areas and expected corridors.

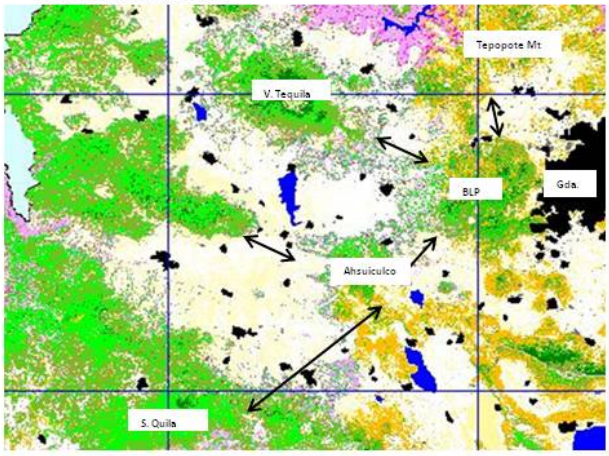


Figure 2. Puma scats and footprint found during fieldwork.

The project is investigating the potential for implementing a local voluntary payment based on carbon-sequestration values of the La Primavera and surrounding forests in order to enhance conservation and restoration activities to halt habitat loss of the oak-pine forests. Firstly the potential for carbon production will be estimated for 30500 ha of La Primavera and 30000 ha of adjacent land; fieldwork and data analysis related to this phase are nearly completed. This will be achieved through ground surveys and analysis of satellite images. Secondly, the implementation, transaction and opportunity costs and the landowner's willingness to supply ecosystem services will be estimated through questionnaire surveys and interviews. Thirdly, the potential for payments for ecosystem services from citizens and organizations in Guadalajara will be estimated through surveys; WTS and WT will be concluded during the second year of the project. Finally an assessment of the viability of a voluntary scheme will be assessed and a proposal for implementation put forward.

2. Project Partnerships

The lead institution in the UK changed from the University of York to the Durrell Institute of Conservation and Ecology at the University of Kent in Canterbury. The Darwin Initiative office was notified of the change in July 2009 and it was agreed on 12 Oct 2009. The change had no effect on ongoing project work and was facilitated by the collaborating institutions in Mexico (ITESO) and in the Netherlands (University of Twente).

The current operational structure for the project is as follows. The project is administered by the University of Kent. Arturo Balderas is an externally based AIO at the University of Twente where he holds scholarships from CONACYT and SEP from the Mexican Government. UoT provides administrative support for organisation of resources. The project is coordinated in Mexico by Arturo Balderas Torres (lecturer at ITESO on leave to pursue his Ph.D.). He is responsible for implementation of the activities described in the project logical framework. Local administrative support is provided by the NGO ALICEA AC; operative support for the

development of fieldwork activities within La Primavera is provided by the reserve's executive office. A group of local NGOs, Fomento y Protección Bosque La Primavera AC and Corazon de la Tierra AC act as advisors for the project and provide support during specific phases (e.g. contacting key local stakeholders, and providing volunteers for the surveying).

As part of the local collaboration an agreement has been made with ITESO to include undergraduate students in the project activities as part of their Professional Application Projects in which they develop their final year work prior to receiving their undergraduate degree. La Primavera's executive office works as a link to coordinate efforts with other local actors (academic and non-academic); any issues that emerge regarding the project during its implementation, revision of the timetable and presentation of results is communicated via frequent skype meetings (2-3 times a week) between the field team and project leader.

After discovery of puma presence in the area Jon Lovett established contact with Dr. Sam Wasser from the University of Washington in order to build a partnership to analyse the DNA of the collected sample with the potential to perform a more detail study of the active wildlife corridors. We have jointly applied for additional funding to use Dr Wasser's 'conservation canines' to track puma in the area and are awaiting the application outcome.

3. Project progress

3.1 Progress in carrying out project activities

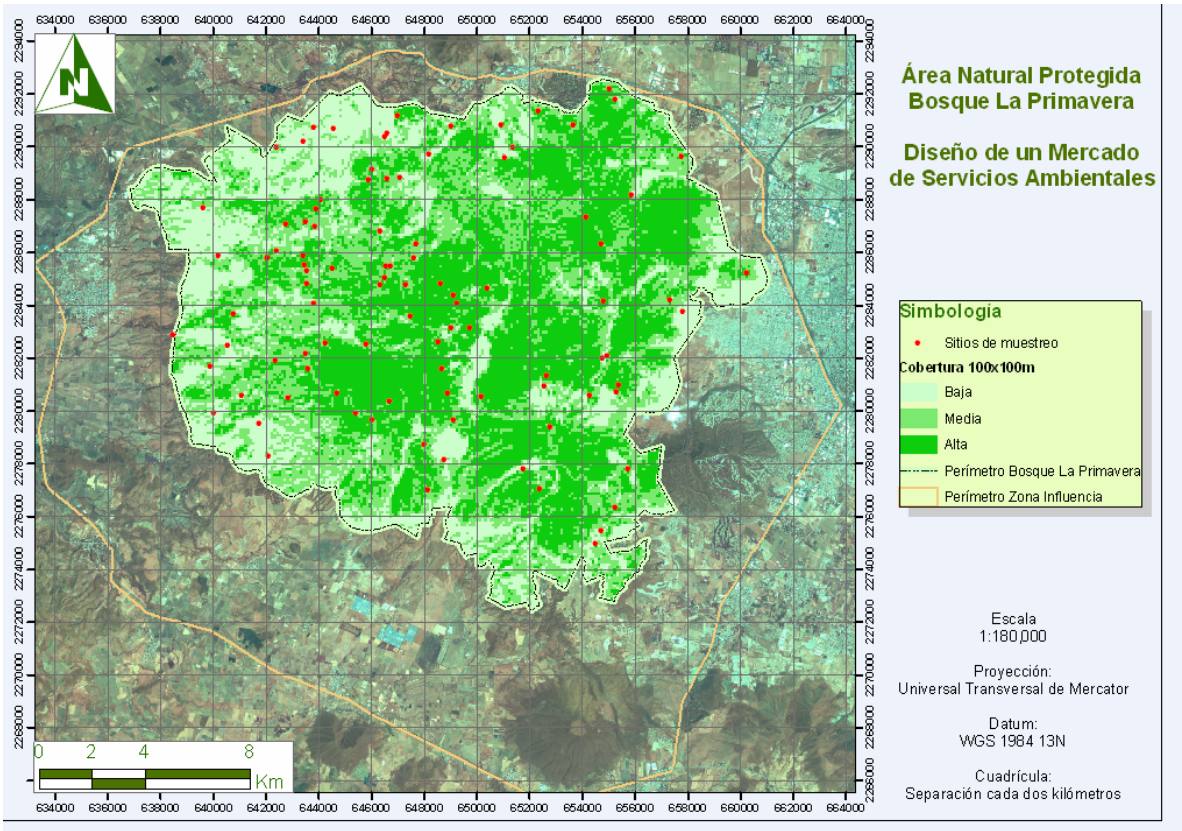
Project activities have been carried out according to plan during the first year. Activities related to the first component of the project, quantification of carbon sequestration and storage services in La Primavera, are nearing completion. Fieldwork in spring 2009 was delayed for a few weeks due to emergency sanitary restrictions put in place following outbreak of AH1N1 flu. During the first stage of the project reference information was gathered, including information on national and regional forest inventories and satellite images.

Contacts were established with local researchers at the Universidad de Guadalajara to share their knowledge of the hydrological services in the watershed of Rio Salado in La Primavera. Integration of undergraduate students into the fieldwork teams included ITESO students from environmental and civil engineering and Universidad de Guadalajara students from the biological sciences program. Students received training on the background of the project, the aims and goals of the Darwin Initiative and techniques related to specific tasks they participated in. Students were asked to prepare a final report of the activities they completed during their 3-4 month collaboration, which were evaluated to assess their performance.

During the first year, groups of students participated in the project in three different periods. In summer 2009, the main activities were related to identification of biological corridors using GIS analysis and establishment of the measurement plots. GIS analysis was also used to identify suitable areas for reforestation in the study area; estimation of carbon emissions from forest fires; and land use analysis. During autumn 2009, activities consisted of capturing and cleaning information from the forest inventory and development of a carbon calculator to estimate emissions from households and the private sector. In spring 2010 analysis has continued on land use and feasibility of wildlife passes in the roads surrounding La Primavera. In total 13 undergraduate students have participated in the project. Their individual contributions will be integrated into the reports and academic publications.

The forest inventory involved establishment of 103 sites to monitor above-ground arboreal biomass. More than 3500 trees were measured (diameter at breast height, total height, height at the base of living crown, and two crown diameters); tree shades were drawn to verify local canopy cover.

Figure 3. Layout indicating the localization of monitoring plots.



The objective of data analysis is to show the expected changes in biomass and hence carbon content as a function of variables such as tree density, mean dbh, basal area and local canopy cover, for the different types of vegetation studied (oak, oak-pine, pine-oak and pine forests). Fourteen tree species were recorded, however the sample is dominated by *Quercus resinosa* and *Pinus oocarpa*. During fieldwork the presence of a locally endemic species *Mammillaria jaliscana* was documented and reported to the La Primavera executive office to update their data bases.

Figure 4. *Mammillaria jaliscana*.

In August 2009, Arturo Balderas joined the organization CABEMAS which is a group of postgraduate students working in Mexico on carbon modeling in ecosystems and climate change affairs. This group is linked to the leading research body of the Mexican Carbon Program (PMC). In October 2009 PMC organized the first International Symposium of Carbon in Mexico. The preliminary results of the project were presented to the national community. Other dissemination activities developed during this period were publication in the journal Ecological Economics of the methodology that will be used for modeling costs of provision of carbon services. A poster outlining findings from this paper was presented as part of Forest Day 3 in Copenhagen during the 15th Conference of the Parties of the United Nations Framework Convention on Climate Change. The basic theoretical framework for evaluating the potential of the valuation for environmental services for rural development used in the project was presented in the Proceedings of the XIII World Forestry Congress in Argentina. Local dissemination of the project results included newspaper reports in regional media and in ITESO's nationally distributed magazine Magis. The project presentations have also been made in local Universities and conferences.

After meeting with personnel from the La Primavera executive office and local consultants working with communities in the Reserve, it was proposed to change the order in which the activities of the second and third components of the projects will be implemented. The second stage relates to the study of the provision costs and landowners willingness to participate in the proposed market mechanism. The third stage relates to the study of the potential demand for carbon services and willingness to pay. Rather than first studying the costs needed to be covered to implement sequestration and conservation activities, after some deliberation it was decided to study first the potential demand for the services and potential financing. This decision was taken as a proof of goodwill towards local landowners since traditionally they have been the object of study and research has seldom ended in tangible projects and local benefits. The shift in the timetable does not imply a major change to the project since activities and outcomes are independent from each other; however assessing first the potential demand for ecosystem services and financing available will pose more realistic scenarios to landowners. Moreover it might be possible to identify sectors across the population and private sector that might be willing to start the project and a proposal for a pilot intervention could be drawn up.

3.2 Progress towards Project Outputs

Output 1. Maps and Satellite images showing estimated carbon content and potential sequestration for the 30,500 ha of La Primavera and the biological corridors in 30,000 ha of the surrounding area. Most of the activities to complete the first Output of the project have been carried out, the final ongoing activity relates to the writing of academic articles. Fieldwork to establish 103 tree plots was completed. The model to generate the maps will be derived from the network of measurement plots. Writing and dissemination of results related to Output 1 are planned to start on 1st quarter of the second year. Preliminary results were presented in the First International Symposium of Carbon in Mexico in 2009.

Activities related to Outputs 2 and 3, started during the second half of the first year of the project. According to the plan they will be completed by the end of the second year.

Output 2. Cost curves for the 30,500 ha of La Primavera and in 30,000 ha of the surrounding area, showing project's viability. 90 surveys from landowners in the 13 ejidos comprising La Primavera

Output 3. Financing potential from survey results and estimation for Guadalajara's Metropolitan Area following the socioeconomic and demographic profiles. 300 surveys from citizens, institutions and organizations from Guadalajara Metropolitan Area.

3.3 Standard Measures

It is not possible to plan exactly how many undergraduate students will enrol in the project; spaces for participation are open but ultimately the students take the final decision. Two formal sessions take place at the beginning of the period for the students to present the common basis of the project, then follow up is provided regarding the specific topic assigned to each student (e.g. GIS analysis, forest inventory, emissions factors). The visit of Jon Lovett was planned for the first half of April 2010, but had to be postponed due to grounding of flights caused by the volcano in Iceland. A plan suggesting management practices will be produced indicating practices to enhance carbon storage and sequestration. A computer based database has been established for the network of monitoring plots; and the La Primavera species database has been enhanced for *Mammillaria jaliscana*. Three press releases have been published in Mexico in local newspapers and ITESO's magazines.

Table 1 Project Standard Output Measures

Code No.	Description	Year 1 Total	Year 2 Total	Year 3 Total	Year 4 Total	Total to date	Number planned for this reporting period	Total planned from application
4A	Number of undergraduate students to receive training	13				13	NA	NA
4B	Number of training weeks to be provided							
6A	Number of people to receive other forms of education/training (which does not fall into categories 1-5 above)							
6B	Number of training weeks to be provided							
7	Number of (ie different types - not volume - of material produced) training materials to be produced for use by host country							
8	Number of weeks to be spent by UK project staff on project work in the host country	1						
9	Number of species/habitat management plans (or action plans) to be produced for Governments, public authorities, or other implementing agencies in the host country		1			-		
10	Number of individual field guides/manuals to be produced to assist work related to species identification, classification and recording		1					
11A	Number of papers to be published in peer reviewed journals	1				1	NA	NA
11B	Number of papers to be submitted to peer reviewed journals	1				1	NA	4
12A	Number of computer based databases to be **established** and handed over to host country		1			1	1	1
12B	Number of computer based databases to be **enhanced** and handed over to host country		1					1
14A	Number of conferences/seminars/ workshops to be **organised** to present/disseminate findings							
14B	Number of conferences/seminars/ workshops **attended** at which findings from Darwin project work will be presented/ disseminated.							
15B	Number of local press releases in host country(ies)	3					3	
15D	Number of local press releases in UK							
19C	Number of local radio interviews/features in host country(ies)							
22	Number of permanent field plots to be established during the project and continued after Darwin funding has ceased	103					103	
23	Value of resources raised from other sources (ie in addition to Darwin funding) for project work							
New - Project specific measures								

Table 2 Publications

Type (eg journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
Journal	Balderas Torres, A., Marchant, R., Lovett, J.C., Smart, J.C.R., Tipper, R. (2010). Title in Sect. 8	Ecological Economics, Elsevier, Amsterdam	Ecological Economics journal website.	
Proceedings of the XIII World Forestry Congress.	Balderas Torres, A., Lovett, J.C., Skutsch (2009). Title in Sect. 8	Argentina, 18-23 October 2009.	http://www.cfm2009.org/es/programapost/resumenes/uploads/assesing_the_feasibility_linking_local_rural_FD.pdf.	
UNFCCC Conference of the Parties. Poster	Balderas Torres, A., Marchant, R., Lovett, J.C., Smart, J.C.R., Tipper, R. (2010).		http://www.cifor.cgiar.org/publications/pdf_files/cop/cop15/FD3ProgrammeBook_web.pdf	

3.4 Progress towards the project purpose and outcomes

Project progress made against the planned activities is satisfactory. The first stage is near to completion while the second and third stages are ongoing. The project carbon production figures are a solid basis to help delineate valuation of the ecosystem services. A critical assumption is involvement of local policymakers to generate the necessary incentives to implement any policy for conservation.

3.5 Progress towards impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits

It is expected that the information being generated by the project will contribute to the conservation and restoration of La Primavera forest and its wildlife corridors when oak-pine mixes are present. The approach and results generated will also contribute to the conservation of these types of vegetation outside the project's borders as the project is receiving interest from other groups in Mexico.

4. Monitoring, evaluation and lessons

During this first year periodic meetings and presentations have taken place with the main stakeholders in the host country (La Primavera Office, ITESO and ALICEA AC). In these meetings the work plans have been presented and discussed, particularly the activities related to access to the La Primavera protected area since entry to specific areas of the reserve is controlled. Follow up meetings have been carried out to present the preliminary results and relevant findings (e.g. puma footprint). Constant communication is in place between the project leader and the project coordinator to follow up issues related to budget lines and progress in the timetable. Once the activities were defined, monitoring and evaluation was related to the follow up in the implementation of activities and creation of verifiable indicators such as the establishment of measurement plots, dissemination documents submitted and number of students participating in the project.

5. Actions taken in response to previous reviews (if applicable)

NA.

6. Other comments on progress not covered elsewhere

NA

7. Sustainability

In large part due to the network provided by La Primavera office, local actors interested in conservation have been contacted. The project has been presented and positive comments have been received regarding practicality and usefulness of the project. They are keen to receive the results which might be used to take forward implementation of a pilot project making the potential for a sustainable exit strategy for the project look promising. The project has also attracted interest from other Universities in Mexico who would like to duplicate the research in new locations.

8. Dissemination

So far, dissemination activities have been focused on the publication of academic articles presenting the methodologies, theoretical framework and preliminary results. General dissemination articles (newspapers and magazines) have been focused on the description of the project objectives and actors because the activities generating the main outputs have not been yet completed. It is expected that by the end of the second year dissemination activities will shift to present the results of the project in both academic and general dissemination publications.

Arturo Balderas Torres, Rob Marchant, Jon C. Lovett, James C.R. Smart, Richard Tipper (2010). Analysis of the carbon sequestration costs of afforestation and reforestation agroforestry practices and the use of cost curves to evaluate their potential for implementation of climate change mitigation. *Ecological Economics*. Volume 69, Issue 3, 15 January 2010, Pages 469-477. This is the first peer reviewed published article where the support from the Darwin Initiative is acknowledged, the use of break even analysis is proposed to identify sequestration costs in Chiapas Mexico; this methodology will be used for the research in La Primavera. A summary of the findings were presented at the UNFCCC COP 15. Audience: international academia and policymaking related to the valuation of carbon services.

-Balderas Torres, A., Lovett, J.C., Skutsch (2009). Assessing the feasibility to link urban and rural areas through local markets for forest's carbon services and the potential for local development: a methodological proposal. Proceedings of the XIII World Forestry Congress. Forest in Development a Vital Balance, Argentina, 18-23 October 2009. (Working Paper) http://www.cfm2009.org/es/programapost/resumenes/uploads/assesing_the_feasibility_linking_local_rural_FD.pdf. The approach presented in the article is the basis for the analysis of the potential that valuation of environmental services might have for rural sustainable development. Audience: international academia and policymaking related to the valuation of carbon services.

-Balderas Torres, A., Ontiveros Enríquez, R., Lovett, J. C., Skutsch, M. 2009. Estudio de la biomasa aérea arbórea en bosques de encino-pino en el Bosque La Primavera. Resultados preliminares. I Simposio Mexicano del Carbono. Programa Mexicano del Carbono 7 al 9 de Octubre, 2009. Ensenada México. (Poster).. The preliminary results of the forestry inventory developed in summer 2009 were presented to the national community working on carbon to receive feedback, this information is critical to estimate the provision of carbon services of La Primavera.

9. Project Expenditure

Table 3 Project expenditure during the reporting period (Defra Financial Year 1 April 2008 to 31 March 2009)

Item	**Budget** (please indicate which document you refer to if other than your project application or annual grant offer letter) Darwin Initiative Grant Claim form submitted by U of Kent	**Expenditure**	**Variance**
Overhead costs			
Travel and subsistence			
Others (specify) laptops (2,668.80), printing (565.00)			
Others (Fieldwork Operating Costs)			
Salaries (specify by individual) (Details below)			
TOTAL			

Staff employed	**Proportion of time spent on this work**	**Date work commenced and finished**	**Cost (£)**
Professor D Macmillan	5%	01/09/09 to 31/03/10	
Arturo Balderas, Co-ordinator	100%	01/09/09 to 31/03/10	
Jon Lovett	10%	01/09/09 to 31/03/10	
Sara Torres	50%	01/09/09 to 31/03/10	

Note: this budget reflects the revised budget submitted by the University of Kent in October 2009 and does not include expenditure by the University of York from April – September 2009.

10. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes

I agree for LTS and the Darwin Secretariat to publish the content of this section

Annex 1 Report of progress and achievements against Logical Framework for Financial Year: 2009/10

Project summary	Measurable Indicators	Progress and Achievements April 2009 - March 2010	Actions required/planned for next period
Goal: *To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve* *The conservation of biological diversity,* *The sustainable use of its components, and* *The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources*			*(do not fill not applicable)*
Purpose Identification of the potential of a local payment scheme for environmental values independent from public budget in La Primavera to provide resources for rural development, enhancing ecosystem's services, protecting biological corridors and halting land-use change in the oak-pine forest.	Project findings show the recommended implementation stages to develop the local market, the potential areas to work in, the estimated carbon content and expected project's costs, the willingness to supply by landowners and willingness to pay by population/organizations.	The activities planned for the first year of the project were implemented successfully, mostly related to the study of aboveground biomass on oak-pine forest. The analysis of data from this stage and further dissemination is close to completion.	During the last quarter of the first year, it was decided to shift the order of stages 2 and 3; it made more sense to assess first the willingness to pay for the conservation of the environmental service in the city and then moving forward with more specific proposals to assess the willingness to accept among landowners. Overall the timetable is not modified and both stages might be completed by the end of the second year of the project.
Output 1. Carbon content in vegetation within La Primavera and its immediate surroundings, and	Maps and Satellite images showing estimated carbon content and potential sequestration for the	Fieldwork to establish 103 measurement plots was completed, data has been analyzed and academic papers and reports are being written. The model to generate the maps will be derived from the network of	

carbon sequestration potential for areas that can be restored by reforestation estimated.	30,500 ha of La Primavera and the biological corridors in 30,000 ha of the surrounding area.	measurement plots. Writing and dissemination of results related to Output 1 are planned to start on 1st quarter of the second year of the project. Preliminary results were presented in the First International Symposium of Carbon in Mexico in 2009.
1.1 Identify the biological corridors and delimit study area		Completed. The area was visited initially in spring 2009; subsequent activities have followed the roads around La Primavera to identify the corridors to Tesitán mountain range (North), Volcan de Tequila (West) and Ahuisculco and Quila (South, South West). Final GIS analysis are to be concluded as part of the academic papers and reports.
1.2 Classify the study area according to land-use and tree crown		Completed. Analyses have been done using reference images provided by the La Primavera office and CONAFOR (SPOT images from 2005), Landsat images (1993-2009) have been also used. Final classification will take place in parallel to the writing of reports and academic papers.
1.3 Set carbon measuring points and field work logistics		Completed. 103 sites were established following a stratified sampling design by canopy cover. Areas including different forest mixes (oak, oak-pine, oak-pine and pine) were included. Recent reports from La Primavera indicate the unusual presence of felids; the inclusion of extra measurement plots in specific areas were felids are reported will be evaluated, with a maximum of 5 -10 more sites to be included.
1.4 Provide training to work team		Completed. Two teams of 4 persons each participated in the fieldwork.
1.5 Perform field work		Completed
1.6 Data analysis to determine carbon content and sequestration potential		90% Completed. Final analyses are being done in parallel to the writing of reports and academic papers, especially regarding statistical techniques, and GIS analysis.
1.7 Writing and dissemination of the first part of the report		On going.

Output 2. Implementation, transaction and opportunity costs, and landowners' willingness to conserve/supply ecosystem services in La Primavera and surrounding area assessed.	Costs curves for the 30,500 ha of La Primavera and in 30,000 ha of the surrounding area, showing project's viability. 90 surveys from landowners in the 13 ejidos comprising La Primavera.	After having preliminary meetings with representatives of the landowners at the beginning of the second semester of year 1, it was decided to shift the order of activities for Outcomes 2 and 3. Other environmental programs (governmental) and researchers have already assessed the willingness of landowners to conserve natural habitat, or participate in environmental services without having a specific proposal to offer. Thus the activities related to the assessment of the demand for environmental services and willingness to pay for conservation and carbon sequestration are being done first; then the assessment of provision costs and willingness to supply will be finalised.
2.1 Identify the strategies to conserve and enhance carbon services		On going. Derived from the model in Output 1. (30%)
2.2 Identify the technical requirements and local costs (transport, plant production, biodiversity issues labour and materials)		On going, 40%.
2.3 Identify transaction costs of the UNFCCC REDD and Voluntary Market Schemes		On going, 30%, more specific outcomes about REDD were expected at Copenhagen.
2.4 Identify the local opportunity costs in the study area (land use and productivities)		On going, 50%. Opportunity costs from agricultural activities have been documented, those from grazing and housing are still under study.
2.5 Design the surveying instrument to verify local opportunity costs and willingness to supply the environmental services		On going 40%. The final version of the survey will be available by the end of the first semester year two.
2.6 Define the logistics to apply the surveys/workshops		Deferred (Output 3); planned for autumn 2010, to be concluded on the second half of the second year
2.7 Provide training to the work team		Deferred (Output 3); planned for autumn 2010, to be concluded on the second half of the second year

2.8 Apply the surveys to verify opportunity costs and determine willingness to supply		Deferred (Output 3); planned for autumn 2010, to be concluded on the second half of the second year
2.9 Data analysis to determine the costs and willingness to supply		Deferred (Output 3); planned for autumn 2010, to be concluded on the second half of the second year
2.10 Writing and dissemination of the second part of the report		Deferred (Output 3); planned for autumn 2010, to be concluded on the second half of the second year.
Output 3.Local financing potential for ecosystem conservation and restoration in the Guadalajara Metropolitan Area, expressed on a per ton-CO_2 basis estimated.	Financing potential from survey results and estimation for Guadalajara's Metropolitan Area following the socioeconomic and demographic profiles. 300 surveys from citizens, institutions and organizations from Guadalajara Metropolitan Area.	As explained above the activities related to Output 3 will be shifted in order with those from Output 2 in order to have a better idea of what could be offered to landowners. The bulk of activities related to both Output 2 and 3 will be completed by the end of the second year of this project.
3.1 Identify the general profile of citizens, institutions and organization in GMA from official statistics		90% completed. General profiles include income, academic background and geographic distribution in the city
3.2 Define the subsample for each representative group		70% completed. The final details of the methodology to be used (e.g. choice modelling using a market-stall approach, MacMillan et al 2005) are being considered to define the details for implementation of the valuation experiment.
3.3 Design the surveying instrument to assess carbon footprint, financing potential and preferred scheme		75% completed. The final details of the questionnaire to be used (choice modelling using a market-stall approach, MacMillan et al 2005) are being considered to define the details for implementation of the valuation experiment. Trade offs between cost, carbon sequestered, species conserved and local benefits will be assessed.

3.4 Define the strategy to apply the surveys/workshops		75% On going. Once the final details for the questionnaire and subsample are defined, invitations to participate in the study will be sent.
3.5 Provide training to work team		Planned 1st Q second year, sequenced to activities 3.1-3.4. The material for the training of the support team is on development.
3.6 Apply the surveys to assess carbon footprint, financing potential and preferred scheme		Planned 1st Q Second year. The carbon calculator has been completed.
3.7 Data analysis to determine local financing potential on a per ton-CO2 basis		Planned 1st and 2nd Q Second year.
3.8 Writing and dissemination of the third part of the report		Planned 2nd and 3rd Q Second year.
Output 4. Voluntary market-based for environmental services valuation and rural development in La Primavera and its immediate surroundings proposed.	Critical route for the development of the proposed scheme. Technical documents proposed for the operation and follow up of the scheme.	Without changes in relation to original Logical Framework, activity 4.1 will start on the 3rd Q. of the second year, the bulk of activities will start on the third quarter of this second year.
4.1 Define the characteristics of the proposed market-based scheme		Without changes.
4.2 Identify and contact the relevant, local, regional and national actors involved in environmental incentives policymaking		Without changes. Meetings were held during the first quarter of the project to set the agenda of the research, results will be presented gradually.
4.3 Consult the relevant actors involved in policymaking about feasibility of the proposed scheme		Without changes.

4.4 Identify the critical route for development of the proposed scheme	Without changes.
4.5 Elaborate the final technical documents and training material proposed for the operation and follow up of the scheme	Without changes.
4.6 Dissemination of the proposed scheme among relevant local stakeholders	Without changes.
5.1 Quarterly Report	Activities and preliminary results have been presented to the executive office of La Primavera and other participating institutions.
5.2 Yearly Reports	Without changes.
5.2 Final Report	Without changes.

Project's full current logframe

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Goal: Effective contribution in support of the implementation of the objectives of the Convention on Biological Diversity (CBD), the Convention on Trade in Endangered Species (CITES), and the Convention on the Conservation of Migratory Species (CMS), as well as related targets set by countries rich in biodiversity but constrained in resources.			
Sub-Goal: La Primavera's Oak-Pine forest is well conserved and landowners are receiving incentives from a local environmental valuation market; new areas have been reforested inside and outside the Natural Protected Area creating biological corridors, halting habitat loss and increasing the probability of maintaining a viable habitat for cougars (*Puma concolor)*.	-Proposal for a Voluntary Market Scheme based on the results of this project, including the following: -Satellite surveys and maps indicating potential areas for reforestation/forestation. -Landowners' willingness to provide the environmental services. -Guadalajara's society willingness to pay for these services.	-Surveys hard copies and analysis. -Satellite images and data from the forest inventory of the National Forestry Commission (CONAFOR) and technical information from La Primavera Management Office. -Voluntary Market Scheme Proposal. -DI Closed Project Evaluation.	
Purpose Identification of the potential of a local payment scheme for environmental values independent from public budget in La Primavera to provide resources for rural development, enhancing ecosystem services, protecting biological corridors and halting land-use change in the oak-pine forest.	Project findings show the recommended implementation stages to develop the local market, the potential areas to work in, the estimated carbon content and expected project's costs, the willingness to supply by landowners and willingness to pay by population/organizations.	Voluntary Market Scheme Proposal obtained as a result of this research project and surveys results.	-The environmental valuation expressed by the participants in the surveys reflect their true intentions and are enough to cover the implementation, transaction and opportunity costs of the scheme. -Local, regional and national policymakers positively receive this kind of policy instrument.

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Outputs 1. Carbon content in vegetation within La Primavera and its immediate surroundings, and carbon sequestration potential for areas that can be restored by reforestation estimated.	Maps and Satellite images showing estimated carbon content and potential sequestration for the 30,500 ha of La Primavera and the biological corridors in 30,000 ha of the surrounding area.	The body of the report and a map scale 1:50,000.	Atypical massive forest fires do not occur changing the estimated carbon estimations.
2. Implementation, transaction and opportunity costs, and landowners' willingness to conserve/supply ecosystem services in La Primavera and surrounding area assessed.	Costs curves for the 30,500 ha of La Primavera and in 30,000 ha of the surrounding area, showing project's viability. 90 surveys from landowners in the 13 ejidos comprising La Primavera.	The body of the report and a map scale 1:50,000. Landowners' surveys.	Truthful participation of landowners in the surveying process.
3. Local financing potential for ecosystem conservation and restoration in the Guadalajara Metropolitan Area, expressed on a per ton-CO_2 basis estimated.	Financing potential from survey results and estimation for Guadalajara's Metropolitan Area following the socioeconomic and demographic profiles. 300 surveys from citizens, institutions and organizations from Guadalajara Metropolitan Area.	Body of the report and surveys	Truthful participation of citizens, institutions and organizations in the surveying process.
4. Voluntary market-based for environmental services valuation and rural development in La Primavera and its immediate surroundings proposed.	Critical route for the development of the proposed scheme. Technical documents proposed for the operation and follow up of the scheme.	Voluntary market-based scheme proposal.	Local, regional and national policymakers remain open to the approval of this kind of instruments.

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Activities (details in workplan) 1.1 Set carbon measuring points and field work logistics 1.2 Provide training to work team 1.2 Perform field work 1.3 Data analysis to determine carbon content and sequestration potential 2.1 Identify the technical, transaction and opportunity costs 2.2 Provide training to the work team 2.3 Apply the surveys to verify opportunity costs and determine willingness to supply 2.4. Data analysis to shape the supply side of the scheme. 3.1 Identify the general profile of citizens, institutions and organization in the Metropolitan Area of Guadalajara 3.2 Provide training to work team 3.3 Apply the surveys to assess carbon footprint, financing potential and preferred scheme 3.4 Data analysis to shape the demand side of the scheme 4.1 Define the characteristics of the proposed market-based scheme 4.2 Consult the relevant actors involved in policymaking about feasibility of the proposed scheme 4.3 Identify the critical route for development of the proposed scheme 4.4 Data analysis and writing of the final report 4.5 Dissemination of results			
Monitoring activities: Quarterly, yearly and final reports including measurement of project's progress providing quantifiable follow-up and description of tasks realized, specifically progress in measuring points in the study area, surveying process (landowners, citizens, organizations and institutions), and main results obtained.			

Proposed updated version of the timetable.

	Activity	Months	Year 1				Year 2				Year 3			
			1	2	3	4	1	2	3	4	1	2	3	4
1.1	Identify the biological corridors and delimit study area	1 (100%)	X											
1.2	Classify the study area according to land-use and tree crown	1 (100%)	X											
1.3	Set carbon measuring points and field work logistics	1(100%)	X											
1.4	Provide training to work team	1(100%)	X											
1.5	Perform field work	7(100%)	X	X	X									
1.6	Data analysis to determine carbon content and sequestration potential	3(90%)			X	X								
1.7	Writing and dissemination of the first part of the report	5(25%)					X					X	X	
2.1	Identify the strategies to conserve and enhance carbon services	5 (30%)						X	X					
2.2	Identify the technical requirements and local costs (transport, plant production, biodiversity issues labour and materials)	2 (40%)						X	X					
2.3	Identify transaction costs of the UNFCCC REDD and Voluntary Market Schemes	1 (30%)				X	X	X	X	X	X			
2.4	Identify the local opportunity costs in the study area (land use and productivities)	2 (50%)						X						
2.5	Design the surveying instrument to verify local opportunity costs and willingness to supply the environmental services	2 (40%)				X	X	X						
2.6	Define the logistics to apply the surveys/workshops	1						X						
2.7	Provide training to the work team	1						X						
2.8	Apply the surveys to verify opportunity costs and determine willingness to supply	6							X	X				

	Activity	Months	Year 1				Year 2				Year 3			
			1	2	3	4	1	2	3	4	1	2	3	4
2.9	Data analysis to determine the costs and willingness to supply	4								X	X			
2.10	Writing and dissemination of the second part of the report	4									X	X	X	
3.1	Identify the general profile of citizens, institutions and organization in GMA from official statistics	1 (90%)				X								
3.2	Define the subsample for each representative group	1 (70%)				X								
3.3	Design the surveying instrument to assess carbon footprint, financing potential and preferred scheme	3 (75%)				X	X							
3.4	Define the strategy to apply the surveys/workshops	1(75%)					X							
3.5	Provide training to work team	2					X							
3.6	Apply the surveys to assess carbon footprint, financing potential and preferred scheme	7					X	X						
3.7	Data analysis to determine local financing potential on a per ton-CO2 basis	5							X	X	X			
3.8	Writing and dissemination of the third part of the report	4									X	X	X	
4.1	Define the characteristics of the proposed market-based scheme	1						X	X	X	X			
4.2	Identify and contact the relevant, local, regional and national actors involved in environmental incentives policymaking	2		X						X				
4.3	Consult the relevant actors involved in policymaking about feasibility of the proposed scheme	5								X	X	X		
4.4	Identify the critical route for development of the proposed scheme	3								X	X			
4.5	Elaborate the final technical documents and training material proposed for the operation and	3										X	X	

	Activity	Months	Year 1				Year 2				Year 3			
			1	2	3	4	1	2	3	4	1	2	3	4
	follow up of the scheme													
4.6	Dissemination of the proposed scheme among relevant local stakeholders	3											X	X
5.1	Quarterly Report	3	X	X	X	X	X	X	X	X	X	X	X	
5.2	Yearly Reports	3			X				X				X	
5.3	Final Report	1												X

Annex 2 Onwards – supplementary material (optional but encouraged as evidence of project achievement)

This may include outputs of the project, but need not necessarily include all project documentation. For example, the abstract of a conference would be adequate, as would be a summary of a thesis rather than the full document. If we feel that reviewing the full document would be useful, we will contact you again to ask for it to be submitted.

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¿Para qué sirve La Primavera?

POR ALFONSO GUTIÉRREZ FOTOS LUIS PONCIANO

Un grupo de especialistas desarrolla un estudio sobre los servicios ambientales que produce el bosque vecino a Guadalajara, para diseñar un plan de aprovechamiento sustentable del área de 35,500 hectáreas

Distintos debates se han generado sobre el bosque La Primavera y el aprovechamiento sustentable de los servicios ambientales que provee esta área protegida de 35,500 hectáreas, vecina a la zona metropolitana de Guadalajara. Y sobre este tema un grupo de universidades e investigadores ha emprendido la tarea que pasará por conocer el estado actual del bosque, el número de árboles, sus dimensiones y el potencial para almacenar y fijar el carbono en la biomasa arbórea.

El estudio se llama "Diseño de un mercado de servicios ambientales para la conservación en el bosque La Primavera", e incluye a especialistas del ITESO, de las universidades de York en Inglaterra y de Twente de los Países Bajos. El proyecto, que se realizará en diferentes etapas durante tres años, comenzó actividades en mayo de 2009.

El objetivo principal es evaluar la factibilidad de desarrollar un mecanismo local de valoración de servicios ambientales y su potencial para mantener la conectividad ecológica en el bosque jalisciense. El estudio cuenta con el apoyo de la Iniciativa Darwin, del Departamento de Medio Ambiente, Alimentación y Desarrollo Rural del Reino Unido.

El estudio revisa a detalle la relación entre la provisión de los servicios del bosque La Primavera y su uso por los ciudadanos, empresas e instituciones en la zona metropolitana de Guadalajara, con especial atención en los servicios de almacenamiento de carbono para la mitigación del cambio climático y los de conservación de la biodiversidad. Los resultados de la investigación serán muy útiles en el desarrollo de políticas y proyectos ambientales en la región, y podrían contribuir al desarrollo rural, la mitigación del cambio climático y el mantenimiento de servicios ambientales (desde biodiversidad, hidrológicos, paisaje, hasta la conservación del suelo).

"Es una tarea complicada, son muchos datos y son muchas las preguntas por resolver. Hemos establecido cien sitios de muestreo para conocer el estado actual del bosque, el número de árboles, sus dimensiones y el potencial para almacenar y secuestrar el carbono en la biomasa arbórea", expresa Ricardo Ontiveros Enríquez, quien es responsable, con Arturo Balderas Torres, de los trabajos por parte del ITESO.

"La realidad que vive el bosque es compleja y se debe abordar desde diferentes perspectivas. Por ejemplo, el hecho de que dentro del bosque existe propiedad privada, ejidos y áreas del gobierno de Jalisco. Al evaluar la provisión de los servicios ambientales, esto se debe tomar en consideración", puntualiza Balderas. "Existen estudios sobre el bosque desde hace mucho tiempo, pero el tema de servicios ambientales y cambio climático es relativamente nuevo y buscamos sumar a los esfuerzos que ya se realizan desde distintas esferas, como la académica y la oficial", añade Ontiveros.

El gobierno británico apoya a los países ricos en biodiversidad pero que cuentan con recursos financieros limitados para desarrollar investigación constante. Su participación en los proyectos, generalmente propuestos por universidades, es mediante el Convenio sobre la Diversidad Biológica (CDB), con el financiamiento de iniciativas de colaboración en las que se involucren las capacidades de expertos en biodiversidad.

Los proyectos financiados por la Iniciativa Darwin deben ser colaborativos, además de contemplar la participación de instituciones locales o comunidades en el país donde se lleven a cabo.

Balderas explica que los trabajos que realizan en el bosque La Primavera han servido para identificar otros aspectos, como la urgencia de mantener corredores biológicos para la fauna que lo habita. "El bosque se está aislando, ya no cubre las necesidades de desarrollo y mantenimiento de algunas especies como el puma, que es el mamífero más grande que transitaba por la zona, desde Canadá hasta el sur de América; ahora esa especie está en riesgo y se puede extinguir localmente, al igual que otras", afirma la estudiante Gloria Isabel López Reyes.

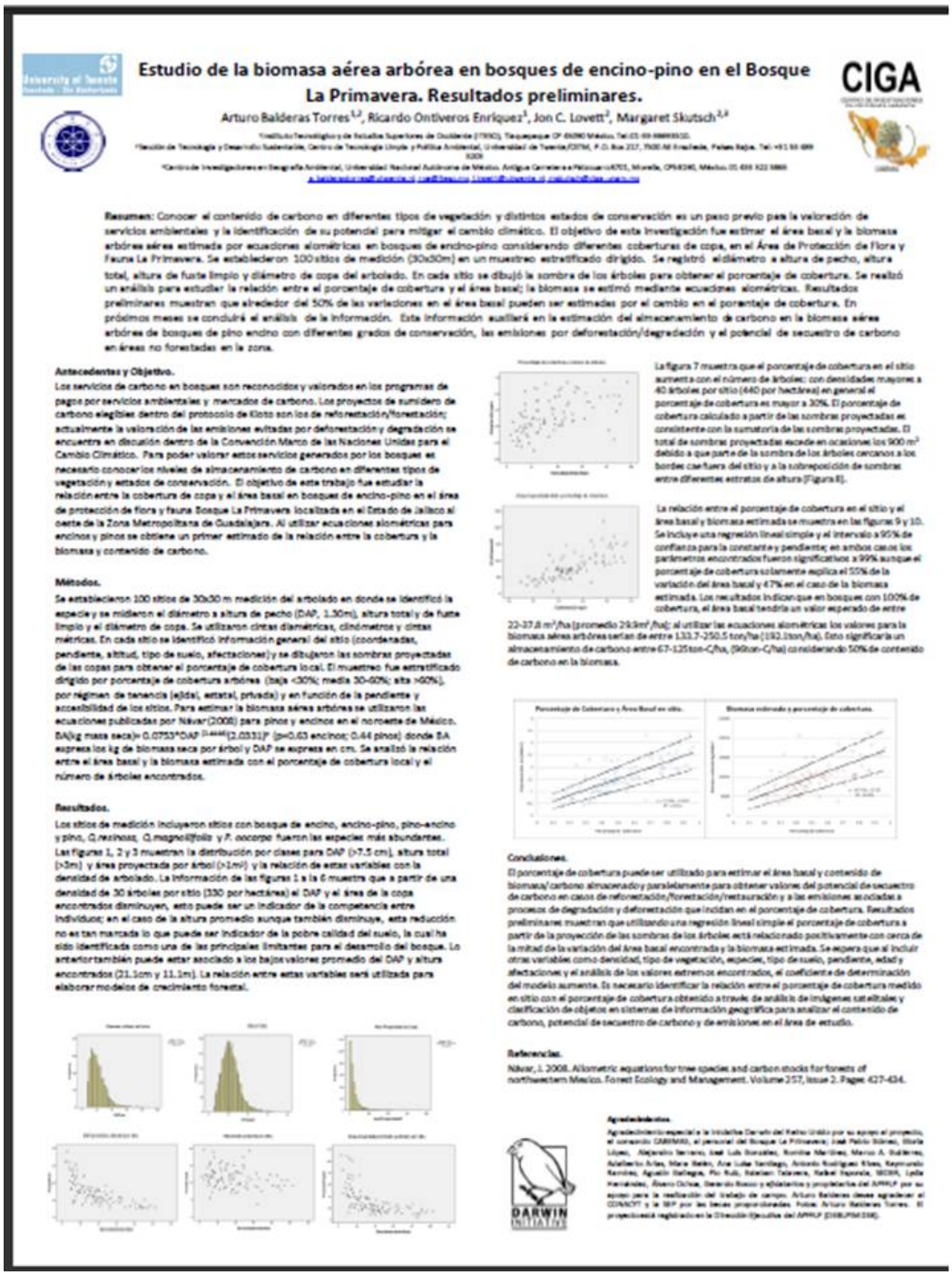
Con los académicos Balderas y Ontiveros participa un grupo de estudiantes que se renovará cada seis meses, como parte del programa universitario Proyecto de Aplicación Profesional (PAP). Entre los de Ingeniería Ambiental están José Pablo Barrón, Gloria Isabel López Reyes, Mario Gutiérrez, Mariel Rivera, Miguel Calderón, David Manzano, además de Alejandro Serrano, de la licenciatura en Ciencias Políticas y Gestión Pública, y José Luis González, de Ingeniería Civil. "El trabajo realizado por los muchachos ha sido grandioso", indica el doctor Jon C. Lovett, líder del proyecto desde Enschede, en los Países Bajos.

Actualmente los académicos y los futuros ingenieros ambientales revisan los datos de la primera etapa del trabajo de campo, con lo que esperan conocer el potencial para la mitigación del cambio climático de la zona. Los resultados preliminares del proyecto fueron presentados por el maestro Ontiveros en el I Simposio Internacional del Carbono en México, celebrado del 7 al 9 de octubre de 2009 en Ensenada, Baja California.

Las siguientes etapas del proyecto consisten en el estudio de los costos de mantenimiento de los servicios ambientales, el estudio de la demanda potencial entre los usuarios y la propuesta del esquema operativo. El principio básico que rige la investigación consiste en reconocer la responsabilidad de los actores que generan emisiones de efecto invernadero, a la vez que se reconocen los beneficios que generan quienes conservan y mantienen el bosque. m.

http://www.magis.iteso.mx/hemeroteca

Poster presented at the International Simposium on Carbon, October 2009.



Estudio de la biomasa aérea arbórea en bosques de encino-pino en el Bosque La Primavera. Resultados preliminares.

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Resumen: Conocer el contenido de carbono en diferentes tipos de vegetación y distintos estados de conservación es un paso previo para la valoración de servicios ambientales y la identificación de su potencial para mitigar el cambio climático. El objetivo de esta investigación fue estimar el área basal y la biomasa arbórea aérea estimada por ecuaciones alométricas en bosques de encino-pino considerando diferentes coberturas de copa, en el Área de Protección de Flora y Fauna La Primavera. Se establecieron 100 sitios de medición (30x30m) en un muestreo estratificado dirigido. Se registró el diámetro a altura de pecho, altura total, altura de fuste limpio y diámetro de copa del arbolado. En cada sitio se dibujó la sombra de los árboles para obtener el porcentaje de cobertura. Se realizó un análisis para estudiar la relación entre el porcentaje de cobertura y el área basal; la biomasa se estimó mediante ecuaciones alométricas. Resultados preliminares muestran que alrededor del 50% de las variaciones en el área basal pueden ser estimadas por el cambio en el porcentaje de cobertura. En próximos meses se concluirá el análisis de la información. Esta información auxiliará en la estimación del almacenamiento de carbono en la biomasa aérea arbórea de bosques de pino encino con diferentes grados de conservación, las emisiones por deforestación/degradación y el potencial de secuestro de carbono en áreas no forestadas en la zona.

Antecedentes y Objetivo.

Los servicios de carbono en bosques son reconocidos y valorados en los programas de pagos por servicios ambientales y mercados de carbono. Los proyectos de sumidero de carbono elegibles dentro del protocolo de Kioto son los de reforestación/forestación; actualmente la valoración de las emisiones evitadas por deforestación y degradación se encuentra en discusión dentro de la Convención Marco de las Naciones Unidas para el Cambio Climático. Para poder valorar estos servicios generados por los bosques es necesario conocer los niveles de almacenamiento de carbono en diferentes tipos de vegetación y estados de conservación. El objetivo de este trabajo fue estudiar la relación entre la cobertura de copa y el área basal en bosques de encino-pino en el área de protección de flora y fauna Bosque La Primavera localizada en el Estado de Jalisco al oeste de la Zona Metropolitana de Guadalajara. Al utilizar ecuaciones alométricas para encinos y pinos se obtiene un primer estimado de la relación entre la cobertura y la biomasa y contenido de carbono.

Métodos.

Se establecieron 100 sitios de 30x30 m medición del arbolado en donde se identificó la especie y se midieron el diámetro a altura de pecho (DAP, 1.30m), altura total y de fuste limpio y el diámetro de copa. Se utilizaron cintas diamétricas, clinómetros y cintas métricas. En cada sitio se identificó información general del sitio (coordenadas, pendiente, altitud, tipo de suelo, afectaciones) y se dibujaron las sombras proyectadas de las copas para obtener el porcentaje de cobertura local. El muestreo fue estratificado dirigido por porcentaje de cobertura arbórea (baja <30%; media 30-60%; alta >60%), por régimen de tenencia (ejidal, estatal, privada) y en función de la pendiente y accesibilidad de los sitios. Para estimar la biomasa aérea arbórea se utilizaron las ecuaciones publicadas por Návar (2008) para pinos y encinos en el noroeste de México. BA(kg masa seca)= 0.0753*DAP$^{[1.4446+(2.0331)F]}$ (p=0.63 encinos; 0.44 pinos) donde BA expresa los kg de biomasa seca por árbol y DAP se expresa en cm. Se analizó la relación entre el área basal y la biomasa estimada con el porcentaje de cobertura local y el número de árboles encontrados.

Resultados.

Los sitios de medición incluyeron sitios con bosque de encino, encino-pino, pino-encino y pino. *Q.resinosa*, *Q.magnolifolia* y *P. oocarpa* fueron las especies más abundantes. Las figuras 1, 2 y 3 muestran la distribución por clases para DAP (>7.5 cm), altura total (>3m) y área proyectada por árbol (>1m²) y la relación de estas variables con la densidad de arbolado. La información de las figuras 1 a la 6 muestra que a partir de una densidad de 30 árboles por sitio (330 por hectáreas) el DAP y el área de la copa encontrados disminuyen, esto puede ser un indicador de la competencia entre individuos; en el caso de la altura promedio aunque también disminuye, esta reducción no es tan marcada lo que puede ser indicador de la pobre calidad del suelo, la cual ha sido identificada como una de las principales limitantes para el desarrollo del bosque. Lo anterior también puede estar asociado a los bajos valores promedio del DAP y altura encontrados (21.1cm y 11.1m). La relación entre estas variables será utilizada para elaborar modelos de crecimiento forestal.

La figura 7 muestra que el porcentaje de cobertura en el sitio aumenta con el número de árboles: con densidades mayores a 40 árboles por sitio (440 por hectárea) en general el porcentaje de cobertura es mayor a 30%. El porcentaje de cobertura calculado a partir de las sombras proyectadas es consistente con la sumatoria de las sombras proyectadas. El total de sombras proyectadas excede en ocasiones los 900 m² debido a que parte de la sombra de los árboles cercanos a los bordes caen fuera del sitio y a la sobreposición de sombras entre diferentes estratos de altura (Figura 8).

La relación entre el porcentaje de cobertura en el sitio y el área basal y biomasa estimada se muestra en las figuras 9 y 10. Se incluye una regresión lineal simple y el intervalo a 95% de confianza para la constante y pendiente; en ambos casos los parámetros encontrados fueron significativos a 99% aunque el porcentaje de cobertura solamente explica el 55% de la variación del área basal y 47% en el caso de la biomasa estimada. Los resultados indican que en bosques con 100% de cobertura, el área basal tendría un valor esperado de entre 22-37.8 m²/ha (promedio 29.9m²/ha); al utilizar las ecuaciones alométricas los valores para la biomasa aérea arbórea serían de entre 133.7-250.5 ton/ha (192.1ton/ha). Esto significaría un almacenamiento de carbono entre 67-125ton-C/ha, (96ton-C/ha) considerando 50% de contenido de carbono en la biomasa.

Conclusiones.

El porcentaje de cobertura puede ser utilizado para estimar el área basal y contenido de biomasa/carbono almacenado y paralelamente para obtener valores del potencial de secuestro de carbono en casos de reforestación/forestación/restauración y a las emisiones asociadas a procesos de degradación y deforestación que incidan en el porcentaje de cobertura. Resultados preliminares muestran que utilizando una regresión lineal simple el porcentaje de cobertura a partir de la proyección de las sombras de los árboles está relacionado positivamente con cerca de la mitad de la variación del área basal encontrada y la biomasa estimada. Se espera que al incluir otras variables como densidad, tipo de vegetación, especies, tipo de suelo, pendiente, edad y afectaciones y el análisis de los valores extremos encontrados, el coeficiente de determinación del modelo aumente. Es necesario identificar la relación entre el porcentaje de cobertura medido en sitio con el porcentaje de cobertura obtenido a través de análisis de imágenes satelitales y clasificación de objetos en sistemas de información geográfica para analizar el contenido de carbono, potencial de secuestro de carbono y de emisiones en el área de estudio.

Referencias.

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Poster presented at the Forest Day of the UNFCCC CoP 15 in Copenhagen Dec 2009

Carbon sequestration costs of agroforestry practices under CDM and Voluntary schemes

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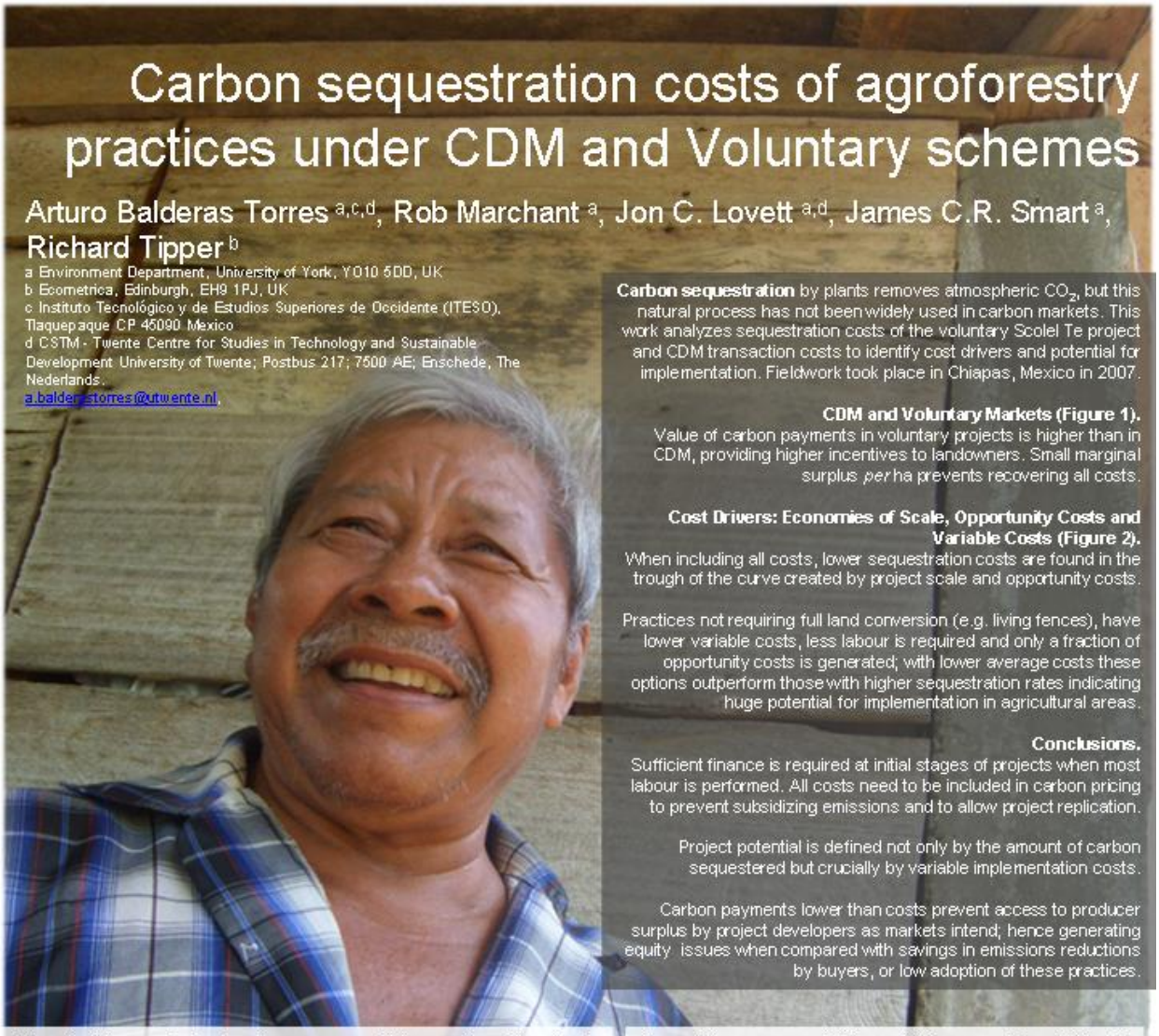


Carbon sequestration by plants removes atmospheric CO_2, but this natural process has not been widely used in carbon markets. This work analyzes sequestration costs of the voluntary Scolel Te project and CDM transaction costs to identify cost drivers and potential for implementation. Fieldwork took place in Chiapas, Mexico in 2007.

CDM and Voluntary Markets (Figure 1).
Value of carbon payments in voluntary projects is higher than in CDM, providing higher incentives to landowners. Small marginal surplus *per* ha prevents recovering all costs.

Cost Drivers: Economies of Scale, Opportunity Costs and Variable Costs (Figure 2).
When including all costs, lower sequestration costs are found in the trough of the curve created by project scale and opportunity costs.

Practices not requiring full land conversion (e.g. living fences), have lower variable costs, less labour is required and only a fraction of opportunity costs is generated; with lower average costs these options outperform those with higher sequestration rates indicating huge potential for implementation in agricultural areas.

Conclusions.
Sufficient finance is required at initial stages of projects when most labour is performed. All costs need to be included in carbon pricing to prevent subsidizing emissions and to allow project replication.

Project potential is defined not only by the amount of carbon sequestered but crucially by variable implementation costs.

Carbon payments lower than costs prevent access to producer surplus by project developers as markets intend; hence generating equity issues when compared with savings in emissions reductions by buyers, or low adoption of these practices.

Figure 1. Net present value of carbon revenues and labour performed to reforest one hectare (352ton CO_2/ha, price 3.54$USD/ton CO_2 with and without discounting 10%).

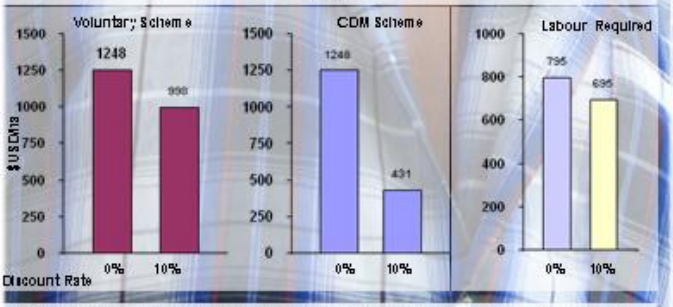
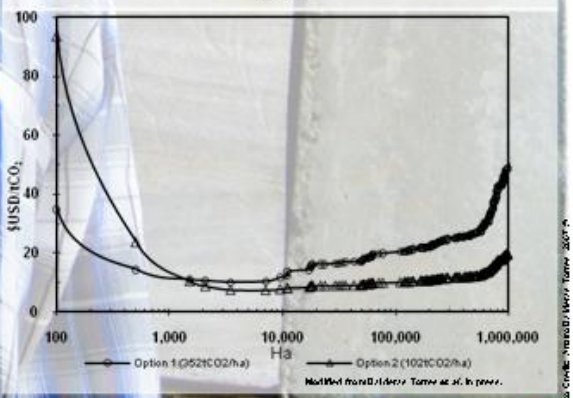


Figure 2. Average sequestration cost for improved fallow (Option 1) and living fence (Option 2) on agricultural area in Chiapas Mexico, considering implementation, opportunity and voluntary transaction costs.



This poster is a summary of Balderas Torres et al. (in press. "Analysis of the carbon sequestration costs of reforestation and reforestation approaches by practices and the use of cost curves to evaluate their potential for implementation of climate change mitigation." Ecological Economics.

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