TC ABSTRACT

I. Basic project data

▪ Country/Region:	Colombia
▪ TC Name:	Assessing Tropical Dry Forest Biodiversity and Ecosystem Services
▪ TC Number:	CO-T1395
▪ Team Leader/Members:	Co-Team leaders: Eirivelthon Lima (RND/CPE) y Onil Banerjee (INE/RND). Members: Michele Lemay, Enrique Ibarra, and Rosario Gaggero (INE/RND).
▪ Indicate if: Operational Support, Client Support, or Research & Dissemination.	Research & Dissemination
▪ Date of TC Abstract:	June 2014
▪ Beneficiary:	Colombia
▪ Executing Agency and contact name	Instituto de Investigación de Recursos Biológicos Alexander von Humboldt
▪ IDB Funding Requested:	USD$549,400
▪ Local counterpart funding, if any:	USD$117,600
▪ Disbursement period (which includes execution period):	24 months
▪ Required start date:	August 2014
▪ Types of consultants (firm or individual consultants):	Firm
▪ Prepared by Unit:	INE/RND
▪ Unit of Disbursement Responsibility:	INE/RND
▪ Included in Country Strategy (y/n); ▪ TC included in CPD (y/n):	N/A
▪ GCI-9 Sector Priority:	Climate change, sustainable (including renewable) energy, and environmental sustainability

II. Objective and Justification

2.1 The goal of this TC is to quantify plant biodiversity and regulatory ecosystem services (ES) provided by Colombian Tropical Dry Forests (TDF) across successional and environmental gradients. ES values derived from this study will be used to inform local land-use planning and decision-making to protect the remaining TDF and expand its coverage for the multiple benefits they generate for society at local and global scales.

2.2 TDF are among the most endangered ecosystems in the world[1] but have received little attention from researchers and policy makers[2] resulting in their over-exploitation[3]. Over 54% of the TDF are located in Latin American and Caribbean (LAC), where they are at very high risk of deforestation: 66% of the region's TDF have been converted to other uses and only 3.9% of the remaining TDF are under some form of protection[4]. Colombia's TDF once covered almost 9 million hectares and hold high levels of beta diversity and endemism with almost 2,600 plant species, 230 bird species, 60 mammal species, and 58 amphibian species[5].

2.3 Only 5% of the original TDF distribution remains and only 5% of what is left (0.025% of its original extension) is protected[6]. Ninety-five per cent of the remaining TDF are located on private land while over 12 million people reside within the natural range of the TDF. Immediate threats to the remaining TDF are clearing for agriculture, mining, hydropower, climate change and desertification. Given this precarious scenario, urgent efforts are required if the remaining TDF and their unique biological characteristics are to be protected.

2.4 Research on the ES TDF provide and the livelihoods they support is in its infancy[7]. Studies on TDF in other regions in LAC have shown that they provide life-sustaining and economically valuable ES[8] with climate and nutrient regulation among the most important[9]. For instance, with the degradation of the TDF in Colombia's Caribbean region, flooding damage cost estimates precipitated by the 2010-2011 "El Niño" event were US$5.5 million in flood regulation services[10].

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1 Janzen, D. H. 1988. Tropical dry forests; the most endangered major tropical ecosystems. Book (Biodiversity) Chapter 14:130–136; Portillo-Quintero, C. A., and G. A. Sánchez-Azofeifa. 2010. Extent and conservation of tropical dry forests in the Americas. Biological conservation 143:144–155.

2 Becknell, J. M., L. Kissing Kucek, and J. S. Powers. 2012. Aboveground biomass in mature and secondary seasonally dry tropical forests: A literature review and global synthesis. Forest Ecology and Management 276:88–95.

3 Miles, L., A. C. Newton, R. S. DeFries, C. Ravilious, I. May, S. Blyth, V. Kapos, and J. E. Gordon. 2006. A global overview of the conservation status of tropical dry forests. Journal of Biogeography 33:491–505; Portillo-Quintero and Sánchez-Azofeifa, 2010.

4 Portillo-Quintero, C. A., and G. A. Sánchez-Azofeifa. 2010. Extent and conservation of tropical dry forests in the Americas. Biological conservation 143:144–155.

5 Pizano, C. and García, H. editors. 2014. El Bosque Seco Tropical en Colombia. Instituto de Investigación en Recursos Biológicos Alexander von Humboldt. Bogotá, Colombia.

6 *Ibid.*

7 Maass, J. M., P. Balvanera, A. Castillo, G. C. Daily, H. A. Mooney, P. Ehrlich, M. Quesada, A. Miranda, V. J. Jaramillo, F. García-Oliva, A. Martínez-Yrizar, H. Cotler, J. López-Blanco, A. Pérez-Jiménez, A. Búrquez, C. Tinoco, G. Ceballos, L. Barraza, R. Avala, and J. Sarukhán. 2005. Ecosystem services of tropical dry forests: insights from long-term ecological and social research on the Pacific Coast of Mexico. Ecology and Society 10:1–17; Sánchez-Azofeifa, G. A., M. Quesada, J. P. Rodríguez, J. M. Nassar, K. E. Stoner, A. Castillo, T. Garvin, E. L. Zent, J. C. Calvo-Alvarado, M. E. R. Kalacska, L. Fajardo, J. A. Gamon, and P. Cuevas-Reyes. 2005. Research priorities for Neotropical dry forests. Biotropica 37:477–485; Portillo-Quintero and Sánchez-Azofeifa, 2010.

8 Maass et al., 2005; Quesada, M., G. A. Sánchez-Azofeifa, M. Alvarez-Añorve, K. E. Stoner, L. Avila-Cabadilla, J. C. Calvo-Alvarado, A. Castillo, M. M. Espírito-Santo, M. Fagundes, G. W. Fernandes, J. A. Gamon, M. Lopezaraiza-Mikel, D. Lawrence, L. P. C. Morellato, J. S. Powers, F. de S. Neves, V. Rosas-Guerrero, R. Sayago, and G. Sanchez-Montoya. 2009. Succession and management of tropical dry forests in the Americas: Review and new perspectives. Forest Ecology and Management 258:1014–1024; Birch, J. C., A. C. Newton, C. A. Aquino, E. Cantarello, C. Echeverría, T. Kitzberger, I. Schiappacasse, and N. T. Garavito. 2010. Cost-effectiveness of dryland forest restoration evaluated by spatial analysis of ecosystem services. Proceedings of the National Academy of Sciences 107:21925–21930.

9 Jaramillo, V. J., J. B. Kauffman, L. Renter a-Rodriguez, D. L. Cummings, and L. J. Ellingson. 2003. Biomass, carbon, and nitrogen pools in Mexican tropical dry forest landscapes. Ecosystems 6:609–629; Ellingson, L. J., J. B. Kauffman, and D. L. Cummings. 2000. Soil N dynamics associated with deforestation, biomass burning, and pasture conversion in a Mexican tropical dry forest. Forest ecology and Rentería, L. Y., V. J. Jaramillo, and A. Martínez-Yrizar. 2005. Nitrogen and phosphorus resorption in trees of a Mexican tropical dry forest - Springer. Trees.

10 Comisión Económica para América Latina y el Caribe (Cepal). 2012. Valoración de daños y pérdidas. Ola invernal en Colombia, 2010-2011. Bogotá: Misión BID-Cepal. Bogotá, Colombia;

As a response to the loss of regulatory ES provision, the Government of Colombia allocated over US$11 billion for the 2011 to 2014 wet seasons[11].

2.5 TDF are estimated to hold a total of 8.7 gigatons of carbon worldwide[12], representing a critical carbon sink for climate change mitigation. Finally, nutrient cycling and retention in TDF enrich forest soils and sustain soil, plant and animal biodiversity, as well as the provisioning ES they provide. Both carbon storage and nutrient cycling vary by forest age (successional stage) and environmental gradients. Understanding ES supply and values across these gradients is critical for prioritizing conservation efforts and allocating scarce resources for their protection.

2.6 The proposed TC will contribute to the IDB's objective of achieving sustainable growth. This is essential to, as stated in the IDB-9, confront the largest challenges of the century: environmental sustainability and meeting energy requirements in the face of climate change. With only 5% of Colombia's TDF remaining, previous development has not effectively balanced economic growth with the natural capital that underpins long run growth potential. Lack of understanding of the real economic value of ES has excluded natural capital considerations from standard cost-benefit calculus. The estimation of the value of the ES provided by TDF and mainstreaming these values into decision making should lead to the expansion of TDF if future growth is to be sustained.

2.7 To effectively respond to the IDB-9 sector priority of *protecting the environment, responding to climate change, promoting renewable energy and ensuring food security,* the development of scientifically rigorous quantitative measures of ES provision enables more defensible estimation of the economic value of ES. These estimates add value to standing forests thereby providing explicit economic rationale for their protection, enhancement and sustainable management. TDF are important not only for the regulatory services they provide, but also their role in generating provisioning services such as food and water which are fundamental to ensuring food security.

2.8 Environmental sustainability and risk prevention feature prominently in Colombia's National Development Plan, "Prosperity for All[13]" and the environment and climate change are key *Areas for Dialogue* in the IDB's Country Strategy for Colombia[14]. Furthermore, the National Development Plan acknowledges that it is upon Colombia's wealth of natural and cultural resources that its development strategies have been based. Although economic growth has improved income and welfare for its citizens, this has come at the cost of environmental degradation which is estimated to be equivalent to 3.7% of Colombia's GDP[15].

2.9 The importance of the TDF for Colombia and for the region, and the risks it faces was reinforced by the *Agencia Presidencial de Cooperación Internacional de Colombia*. This TC presents a unique opportunity for regional collaboration under the *Programa Regional de Cooperación con*

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11 DNP, 2011. National Development Plan, 2011 – 2014, Prosperity for All. Bogota: DNP.

12 Saatchi, S. S., N. L. Harris, S. Brown, M. Lefsky, E. T. Mitchard, W. Salas, B. R. Zutta, W. Buermann, S. L. Lewis, and S. Hagen. 2011. Benchmark map of forest carbon stocks in tropical regions across three continents. Proceedings of the National Academy of Sciences 108:9899–9904.

13 DNP, 2011. National Development Plan, 2011 – 2014, Prosperity for All. Bogota: DNP.

14 IDB, 2012. Colombia Country Strategy, 2012 – 2014. Washington DC: IDB.

15 DNP, 2011. National Development Plan, 2011 – 2014, Prosperity for All. Bogota: DNP.

Mesoamérica whose purpose is to contribute to south-south development cooperation through the sharing of experiences and knowledge on issues with an inherent regional dimension.

III. Description of Activities

Activity	Description	Outputs	Results
1. Assess TDF plant diversity.	• A detailed plant inventory of TDF will be conducted in 1 ha plots across environmental and successional gradients.	• Detailed plant inventory and herbarium samples.	• Data on plant community composition of TDF across gradients collected and published through SiB-Colombia[16]. • Herbarium samples scanned and published through the TDF digital herbarium[17]. • Pictures taken from the field expeditions to TDF advertised and published through Humboldt Institute social media (Facebook and Instagram) • Paper on plant community composition submitted for publication.
2. Assess biodiversity and carbon and nutrient cycling in DTF and associated economic value.	• Quantification of the delivery of regulatory ES of C and nutrient N, P, K cycling and variability. • Explore relation between biodiversity and regulatory ES.	• Quantification of regulatory ES, value and variability. • Understanding of relationship between biodiversity and ES provision.	• Methodological protocols for ES measurement developed. • Values of regulatory ES estimated on per unit area basis. • Paper comparing ES values across gradients in four regions submitted for publication. • Pictures taken from the field expeditions to TDF advertised and published through Humboldt Institute social media (Facebook and Instagram).

[16] www.sibcolombia.net
[17] https://www.flickr.com/groups/2287605@N22/

Activity	Description	Outputs	Results
3. Landscape-level quantification of ES.	• Develop a map of the current distribution and successional stages of TDF in two 10,000 ha areas. • Quantify regulatory ES in the two areas. • Estimate ES loss of ES for two areas based on original TDF extension. • Perform landscape level assessment of plant diversity, and carbon and nutrient cycling.	• Quantification of carbon stocks and cycling, and nutrient cycling and their economic value at landscape level. • Estimate loss of regulatory ES based on original extension of TDF.	• Maps developed for local land-use planning, which will be published through the Humboldt Institute webpage (www.humboldt.org.co). • Landscape-level protocols to quantify TDF ES developed and disseminated. • Value of regulatory ES for current situation and loss estimated. • Regional workshop conducted. • Strategies for conserving TDF on private land developed. • Paper on a landscape assessment of TDF ES submitted for publication.

IV. Indicative Budget (US$)

Activity	Description	IDB Funding	Humboldt Institute Counterpart Funding	Total Funding
1. Assess TDF plant diversity	• Plot establishment and plant inventory.	$244,134	$44,533	$288,667
2. Asses biodiversity and carbon and nutrient cycling in DTF and associated economic value.	• Field measurements of carbon and nutrient cycling. • Estimation of economic value.	$149,634	$35,033	$184,667
3. Quantify landscape-level ES.	• Per unit area values scaled-up to landscape level.	$155,634	$29,033	$184,667
TOTAL		**$549,402**	**$108,599**	**$658,001**

V. Executing Agency and Execution Structure

5.1 The Executing Agency for the operation will be **Alexander von Humboldt Biological Resources Research Institute** (*Instituto de Investigación de Recursos Biológicos Alexander von Humboldt*) sometimes referred to as IAVH. The IAVH is an independent non-regulatory research institute of the Executive Branch of the Government of Colombia charged with conducting scientific research on the biodiversity of the country including hydrobiology and genetic research. The Institute is internationally recognized for its research activities in biodiversity and has launched a program of research on TDF. In addition, the IAVH hosts the national biodiversity information system (SiB Colombia; www.sibcolombia.net), through which Colombian biodiversity data are made available to the public, and counts with a solid communications team that is constantly publicizing the Institute's scientific results through the Institute webpage (www.humboldt.org.co) and social media (Instagram and Facebook). The IAVH will be responsible for administering the TC, including supervision, reporting, monitoring and evaluation, and communications.

VI. Project Risks and Issues

6.1 Extreme weather events pose threats for plots established in the field. To mitigate potential damage and loss of field plots, multiple plots in each environmental and successional gradient will be established.

6.2 Establishing collaboration agreements with numerous institutions may slow project execution, particularly in the case of public institutions. Given that IAVH has already established agreements with several institutions that will be involved in the project, this risk has been reduced.

VII. Environmental and Social Classification

7.1 It is not anticipated that the activities to be financed in this TC will have negative direct or indirect social or environmental effects. According to the Bank's Safeguards Screening Toolkit, this operation is classified with "C": (i) no environmental or social risks; and (ii) direct contribution to solve an environmental issue.