

## Final Project Evaluation Report

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Your Details	
Full Name	Sofia Calvo-Rodriguez
Project Title	Greenhouse gas emissions in a Tropical Dry Forest soil
Application ID	24223-1
Grant Amount	£5000
Email Address	calvorod@ualberta.ca
Date of this Report	24/04/2019

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

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Establish a unique data set of continuous CO <sub>2</sub> , N <sub>2</sub> O and CH <sub>4</sub> fluxes from tropical dry forest soil in different land covers				We collected soil fluxes at three different land covers in the Santa Rosa National Park from April 2018 to February 2019
Study the relationship between trace gas fluxes and biotic and abiotic environmental factors controlling soil emissions from tropical dry forest soil				We collected data for soil temperature and soil moisture from April 2018 to February 2019. Also, we collected soil samples to analyse nitrate, ammonium and microbial biomass at three different land covers
Contribute to the training of youth by including undergraduate students from local communities				Undergraduate students from local communities were included in the project as field assistants. They were trained throughout the field season and were able to support field and laboratory work
Dissemination of results				Part of the results was presented to park managers through informal talks. We also presented the main results at the European Geosciences Union (EGU) held in Vienna, Austria. Scientific publications are still under preparation.

**2. Please explain any unforeseen difficulties that arose during the project and how these were tackled.**

Main difficulties came from coordinating with field assistants. Due to their commitment to other activities such as work or studies, their schedules were not as flexible to collect field data. In fact, two assistants resigned from the project after they were trained, because they got better job opportunities. Because of this problem, we could not collect data in July 2018. To counteract this problem, we

had to train a total of six assistants, more than previously planned, so we could

coordinate different field campaigns with the assistants available to go to the field and thus be able to finish the collection of data.

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

- a) Established a unique data set of continuous CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> fluxes from different land covers in tropical dry forest soils. At the start of the wet season, high emission pulses are observed for CO<sub>2</sub> and N<sub>2</sub>O at all sites, differing in strength between land covers. These high pulses last longer for the CO<sub>2</sub> (more than one month) than for N<sub>2</sub>O, for which in 1-week fluxes return to low values at all sites and remain low for the rest of the year. The different land covers were also found to be methane sinks. This information is much needed for modeling ecosystem processes and impacts of climate change and assessing forest productivity and ecosystem services of tropical dry forest.
- b) Quantify the annual sink/source strength of greenhouse gasses using manual and automatic chambers. Our data suggest that tropical dry forest can be important sources N<sub>2</sub>O and CO<sub>2</sub> at the start of the wet season and need to be better accounted for greenhouse gas emission inventories in tropical dry forest. Moreover, our data also stress the need for more spatially and extensive temporal sampling of soil variables and fluxes across different land covers in tropical dry forest to predict ecosystem-scale responses to climate change
- c) Evaluate environmental factors controlling greenhouse gas exchanges in different forest successional stages. According to our results, soil moisture and microbial biomass are the main drivers for the sink/source strength of soil greenhouse gasses in tropical dry forests

**4. Briefly describe the involvement of local communities and how they have benefitted from the project.**

We hired and trained local undergraduate students for the project, and we also had the support in the field from some park managers and park rangers. During the project, both park rangers and field assistants benefitted from each other's experience and knowledge. We benefited from park rangers and managers experience in their knowledge of the land use history of the area, and they also helped us with some minor difficulties like transportation in the area and permission for shipping samples to Germany. The field assistants benefited from the project by getting experience working in a soil ecology project in the tropics, learning the protocols for sampling and processing data of soil greenhouse gasses. At the same time, they contributed to the project with their knowledge on the local practices of farmers and foresters and also the impact these protected areas have on the local communities and their need to be taken into account and participate, for example, in more research projects.

**5. Are there any plans to continue this work?**

Currently we are looking for financing options for the continuation of the project. Moreover, at the Santa Rosa National Park, Dr. Arturo Sanchez-Azofeifa and some of

the field assistants trained will continue working in the study area using forest inventory plots for other ecological projects.

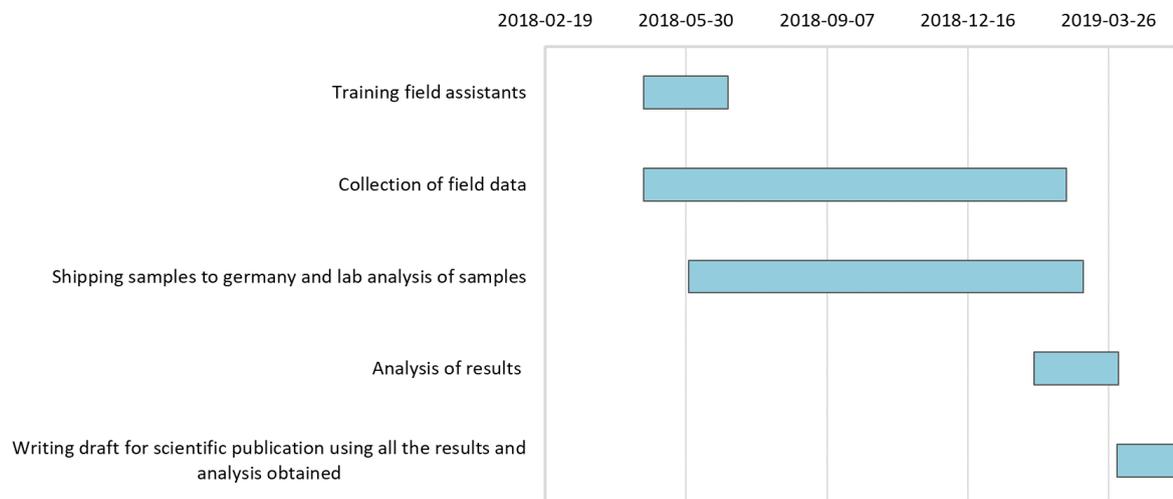
## 6. How do you plan to share the results of your work with others?

So far we have divulged some of the results at local level through informal talks to park managers and workers. We also presented our main results of the project at the international conference of The European Geosciences Union (EGU) held in Vienna, Austria, from 7–12 April 2019. We participated in the special session BG2.11/AS4.19/SS5.12 - *Biogeochemical cycles and ecohydrology in changing tropical systems* with the talk "Soil greenhouse gas pulses from a Tropical Dry Forest". The abstract can be found in the link <https://meetingorganizer.copernicus.org/EGU2019/EGU2019-10496.pdf>.

We are also working to publish our results in a peer-reviewed journal. We will also make available our data to the academia and the scientific community through public databases and scientific journals.

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

The project was planned for 1 year. Funding from the Rufford Foundation was used for 10 months, for data collections. Last months were employed for data analysis, and dissemination of results as it was planned in the original project.



**8. Budget: Provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.**

Item	Budgeted Amount £	Actual Amount £	Difference £	Comments
Field assistants	2000	466	-1534	We paid for some of the cost of field assistants and the rest of the cost was covered by Dr. Sánchez-Azofeifa, from University of Alberta in Canada
International air fare	800	804	+4	It was necessary for myself to travel from Canada to Costa Rica to installed equipment in the field and trained field assistants
Field equipment and supplies	500		-500	Provided by collaborators from Germany
Accommodation in the park for field campaigns	1300	295	-1005	We obtained a special rate at the park for nationals so instead of the budgeted 15\$ per night we paid actually 6\$ per night to stay in the park
Food for field campaigns	1000	1172	-172	The food was acquired in the dining room at the park or it was acquired in the local supermarket
Vehicle rental	1600		-1600	Renting a car was not necessary since a car was provided by collaborators from Costa Rica
Vehicle fuel	300	213	-87	We provided the fuel for the car provided by collaborators from Costa Rica
Soil analyses at a laboratory		1387	+1387	We collected soil samples to perform analysis of ammonium, nitrate and microbial biomass in a certify laboratory for soils
Shipping samples to Germany		922	+922	We paid for some of the cost of shipping samples to Germany and the rest of the cost was covered by Dr. Ralf Kiese, from IMK-IFU in Germany
<b>Total</b>	<b>7500</b>	<b>5259</b>	<b>-2241</b>	Remaining funds to be used to carry-on the work.

All values are stated in £ sterling using a rate change (1 Costa Rican Colón equals 0,0013 Pound sterling). All original invoices can be provided in Costa Rican colones. Extra expenses (258.37£) where covered by Dr. Sánchez-Azofeifa, from University of Alberta in Canada.

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

The next step for our project is finishing the main scientific publication we are currently preparing to be submitted to the journal of Global Change Biology. This publication will be a great contribution for the current knowledge gap on soil greenhouse gasses from tropical dry forests.

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

We acknowledge the Rufford Foundation as our main source of funding at any informal seminars and talks. We also provided acknowledgments in our presentation at the international conference of The European Geosciences Union (EGU) held in Vienna, Austria, from 7–12 April 2019. We will also acknowledge the Rufford Foundation in the scientific publications that will be generated from this study as well.

## 11. Please provide a full list of all the members of your team and briefly what was their role in the project.

**M.Sc. Sofia Calvo-Rodriguez** from the University of Alberta, Canada. I was the team leader, in charge of coordination for all field work and project activities, training of assistants and managing expenses of the project.

**Dr. Arturo Sanchez-Azofeifa** from the University of Alberta, Canada. He helped supervising the project and field assistants and covering for extra expenses.

**Dr. Ralf Kiese** and **Anja Schäfler-Schmid** from the Karlsruhe Institute of Technology-Institute for Meteorology and Climate Research, Atmospheric Environmental Research (IMK- IFU) in Garmisch-Partenkirchen, Germany. They analyzed the gas samples collected in Costa Rica in the chromatography laboratory to measure CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> concentrations and fluxes from the soil.

**Dr. Julio Calvo-Alvarado** and his research team from the Costa Rica Institute of Technology, Forestry Department. They helped us analyzing soil samples collected in the field to measure bulk density and soil porosity.

Field assistants: They helped us collecting all gas samples and soil samples in the field through different data collection campaigns.

**María José Montero Javier Chávez, Einer Reyes Martínez, Gabriel Granados Madrigal Gabriel Rosales & Artiaga Arón García Arias**

## 12. Any other comments?

We are very grateful for the funding provided by Rufford, as this was our primary source of funding for the project. Without the support provided, we could not have accomplished our objectives.