Wildlife-friendly Farming: Economic and Geospatial Analysis of Sustainable Farming Incentives in Southern Costa Rica

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I. Objective:
This project will support the work of Osa Conservation by contributing to their efforts to improve habitat connectivity and promote ecosystem stewardship. It will do so by encouraging farmers to adopt economically viable and sustainable agricultural practices on the Osa Peninsula of Costa Rica.
We will accomplish this by:

- Identifying and comparing benefits of applicable crop certifications through economic analysis
- Projecting suitable crop distributions with regard to climate change in order to increase climate resilience
- Mapping viable added value crops (black pepper, blackberries, and vanilla) that farmers can implement into their current operations to diversify their income while creating wildlife-friendly farms.

II. Significance:
The Costa Rican government considers the newly established Amistosa biological corridor, which connects the Osa Peninsula to the Talamanca mountains, to be one of the top four conservation priorities in the country ("About the Osa", 2017). However, spatial analysis completed this past year through a NASA DEVELOP partnership shows ongoing loss of forest, rapid encroachment from large-scale agriculture, and degradation of primary forests. Certain crops and growing practices, such as large-scale monoculture pineapple farms, impede species' movement between habitats. Models predict a greatly increased loss of connectivity in this region over the next 30 years if "business as usual" practices continue (Zahawi et al., 2015).

To date, little has been done to create an ecologically functional corridor. While there is a high degree of interest from many stakeholders based on preliminary surveys, government resources and capacity to move forward remain limited ("Conservation Challenges", 2017). Osa Conservation believes that much is to be gained from working directly with area landowners to develop economically viable strategies which promise agricultural sustainability and climate resilience. Such collaboration offers the best path towards preventing habitat degradation and restoring the forest connectivity that is vital to the survival of the local ecosystems.

Wildlife-friendly, sustainable agricultural practices allow for continued wildlife movement and critical linkages between protected areas in the Osa Peninsula and La Amistad National Park. Developing a model

for applying available economic incentives for such practices will support Osa Conservation's efforts to recruit and train local farmers.

III. Background:
Southern Costa Rica hosts two of the most important sites for conservation in Central America: the Osa Peninsula and La Amistad National Park.

The Osa Peninsula houses an estimated 2.5% of the planet's biodiversity and was referred to as "The most biologically intense place on Earth" by National Geographic ("About the Osa", 2017). The small (1,800 km^2) but highly diverse peninsula is home to approximately half of the country's 500,000 species in its rainforests, coastal landscapes, and tropical waters. La Amistad National Park, the largest remaining intact forest in Central America, includes much of the Talamanca mountain range. The Talamancas encompass important ecosystems ranging from premontane forest to alpine paramo.

Along with the high levels of endemism found in the Osa Peninsula and La Amistad, the area between them represents a critical biological corridor. In 2019, this area became officially designated as the Amistosa Corridor, aiming to provide a link for species to migrate between the two regions

In 1996, Costa Rica's Forest Law 7575 established the framework for a Payment for Ecosystems Services Program. This law also prohibited extraction from national reserves or state property and created the National Forest Finance Fund (FONAFIFO) to promote agroforestry and reforestation (Rodrick, 2010). Deforestation rates have subsequently decreased since its having been enacted. Despite policies like this, weak enforcement and limited government capacity to act on and implement environmental measures put the biodiversity in the region at risk (Ding et al., 2017). Practices such as industrial monoculture for crops like palm oil, pineapple, and teak drive deforestation in the Amistosa Corridor. Deforestation and the spread of agriculture continue to fragment the remaining habitat. This poses a particular threat to species that require large territories for survival such as the jaguar.

Increasing urgency to align on-the-ground conservation efforts with the projected impacts of climate change further complicates the issue described above. Much of the flora and fauna that comprise the biodiversity in the region have limited temperature tolerances, making them particularly vulnerable to climate change. Studies in the last year show that less than 38% of tropical forests globally retain enough connectivity to allow species to migrate with shifting climate (Senior et al., 2019). Consequently, the greatest conservation impact will come from actively restoring the connectivity of forests across elevational gradients (Senior et al., 2019).

Osa Conservation has been working to promote conservation of the region's biodiversity. Its projects include fostering ecosystem stewardship, enhancing scientific understanding, providing education and training, and creating sustainable economic opportunities. This project proposed will provide the necessary data and tools to create economically viable opportunities for farmers to pursue sustainable growing practices that allow for movement of wildlife through farms and between protected areas.

IV. Available Data and Supporting Materials:
This project will use NASA satellite imagery from LANDSAT satellites and digital elevation models from its ASTER sensors on Terra and Aqua satellites in addition to *in situ* data and models provided by Osa Conservation to create crop type maps.

An existing climate change projection methodology for predicting coffee crop distribution will be applied to cacao and palm crop distribution within the Amistosa Corridor.

This project will also combine existing land use and land cover classification data with analysis of high-resolution Planet Lab satellite imagery to identify suitable locations for added value crops.

V. Possible Approaches:
A combination of literature review, geospatial analysis, and application of economic frameworks will be used to achieve the objectives of supporting economically viable and sustainable agriculture and fostering climate resilience in the Amistosa Corridor.

- Analysis to compare economic benefits and required qualifications of incentive programs for sustainable crops.
    - A literature review of current certifications for wildlife and climate friendly agriculture, including Climate-Adaptive Agriculture through the Ministry of Agriculture and Cattle Raising, Jaguar-Friendly Coffee, Blue Flag Sustainability for Cacao, and Sustainable Palm Oil.
- Mapping of current and future distributions of crops based on suitable habitat.
    - Suitable locations for introducing added-value crops such as blackberries and vanilla.
    - Projected impacts of climate change on distribution of current staple crops in the area: coffee, cacao, and palm.

VI. Deliverables:
In addition to the required deliverables, this project will provide:

- Table comparing economic incentives per crop, including the requirements and economic.
- Climate resiliency maps of projected future crop distribution.
- Suitability map for possible introduction of value-added crops.

VII. Internships:
Osa Conservation will offer room and board at their biological station in the Costa Rican rainforest to two to four interns, as well as mentorship throughout the duration of their stay. Being a grassroots non-profit, they are unable to provide full funding for an internship but are willing to provide mentorship and other support for the students.

VIII. References:

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CONSERVING COSTA RICA'S NATURAL TREASURE

TO: Group Project Committee
Bren School of Environmental Science and Management
University of California, Santa Barbara

DATE: January 24, 2020

RE: Wildlife-friendly farming: Economic and geospatial analysis of sustainable farming incentives in southern Costa Rica

Dear Group Project Committee,

We are writing to express our support for the group project *Wildlife-friendly farming: Economic and geospatial analysis of sustainable farming incentives in southern Costa Rica.* Osa Conservation's mission is to conserve the globally significant terrestrial and marine biological diversity of the Osa Peninsula of Costa Rica by implementing ecosystem stewardship, enhancing scientific understanding, providing education and training, and creating sustainable economic opportunities. We believe this project will help advance our efforts in sustaining southern Costa Rica's abundant biodiversity and fostering climate change resilience.

With constant deforestation due to large-scale agriculture and rapid climate change, it is now more important than ever for local farmers to know about and adapt to sustainability certification schemes. We will accomplish this by creating economic analysis to compare benefits of crop certifications, use prior methodology to project suitable crop distributions in regards to climate change, and also project viable added value crops farmers can implement into their current croplands to diversify their income while creating wildlife-friendly farms.

By working with Bren students, we will be able to more effectively achieve our project goal of educating local farming communities about the benefits of sustainable farming. We have worked with Marie Bouffard over the past 2 years through NASA DEVELOP, and will look forward to continue working with her and other Bren students to create high quality products that contribute to our organization's decision making process to support the conservation of this incredible region.

As part of our support, we are prepared to offer room, board and Wifi at our biological station deep in the Costa Rican rainforest, as well as mentorship for interns for the duration of their stay at the Osa Conservation while working on the group project specifically. Being a grassroots non-profit, we are unable to provide full funding for an internship, but we are very willing to provide mentorship and support for the students. Through working with Osa Conservation, the Bren students on this project will develop many interdisciplinary hard and soft skills, allowing them to grow as future environmental leaders.

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If you have any further questions, feel free to contact me at hilarybrumberg@osaconservation.org or +506-8331-3699

Sincerely,

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