The Big Island of Hawaii supports some of the most unique ecosystems in the world, but these ecosystems have been highly altered by human activities. Kohala Institute (KI) is tasked with stewarding 2,418 acres on Hawaii Island while providing economic opportunities for the local community. However, land managers like KI often struggle with the balance between environmentally responsible land use and economic productivity. This project provided KI with the knowledge needed to minimize their environmental impacts when determining future land uses as their organization continues to grow.

**Background**

The purpose of the Big Island Impacts project was to give KI the knowledge necessary to expand their land use activities in an environmentally sustainable way. The project had three primary objectives:

1. Describe KI’s current land uses and land characteristics, assess property accessibility, and identify alternative future land uses.
2. Analyze the effects on KI’s water quality, carbon footprint, and wildlife habitat under five land use scenarios over a 20-year planning horizon.
3. Recommend land uses and management practices to minimize KI’s environmental impacts.

**Project Objectives**

The Big Island Impacts: Effects of Current and Potential Future Land Use

on Water Quality, Carbon Emissions, and Wildlife Habitat at Kohala Institute

**Conceptual Framework**

All analyses were performed on five different land use scenarios. These land use scenarios represent different levels of development that KI could implement on their property as they continue to expand their operations.

**Methods and Results**

**Water Quality**

A water quality analysis using the Nonpoint Source Pollution and Erosion Comparison Tool (NSPECT) calculated total annual runoff, phosphorus, nitrogen, and sediment loadings, and found that row cropping and orchards had the highest loadings per acre. These can be minimized with the addition of riparian buffers in areas that are prone to water quality degradation, which will help mitigate existing water quality issues in the Wainao Gulch on KI’s property.

**Carbon Emissions**

Four sources of carbon emissions and one carbon sink were identified at KI: land use conversion, purchased electricity, cattle, and erosion; and sequestration from the growth of woody biomass. In the baseline scenario, cattle are the largest source of greenhouse gas emissions, emitting over 370 t CO₂ per year. Conversion of forest to pasture becomes the largest source of emissions in all four alternative scenarios, emitting an average of over 4,000 t CO₂/year, or the equivalent to burning over 4 million pounds of coal.

**Wildlife Habitat**

Three species were selected for review based on their endangerment to the region, current level of endangerment, and likelihood to be present at KI: the Hawaiian hawk (Buteo solitarius), Hawaiian hoary bat (Lasiurus semotus), and Hawaiian goose (Branta sandvicensis). Habitat for these species at KI was classified as highly suitable, somewhat suitable, or not suitable, and calculated by acre.

**Lessons Learned**

This study provided a first look into how KI’s water quality, carbon footprint, and wildlife habitat could change under different land use scenarios. Three major takeaways were identified:

1. Agriculture caused the most negative water quality impacts;
2. Land use conversion contributed the most to carbon emissions; and
3. Land use conversion from natural to anthropogenic land cover types decreased habitat availability for wildlife species of concern.

**Mitigation Strategies**

After the environmental impacts had been studied under all scenarios, several strategies to reduce environmental impacts were recommended.

**Recommendations**

This project represents the first water quality, carbon footprint, and wildlife habitat assessment ever conducted for KI. Further data collection is essential before another more comprehensive analysis can be performed. We recommend implementing water quality monitoring, field data collection for carbon content, and wildlife surveys in the future. An economic analysis of the costs and benefits of potential management actions should also be performed.

**Acknowledgements**

For more information about the Big Island Impacts group project, visit us on the web at: [http://www.BigIslandImpacts.Weebly.com](http://www.BigIslandImpacts.Weebly.com). Image credits (from left to right): Kohala Institute; Ilan MacAdam-Somer; Pinterest.

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