Big Island Impacts: Effects of Land Use on Water Quality, Carbon Emissions, and Wildlife Habitat at Kohala Institute

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Background and Objectives

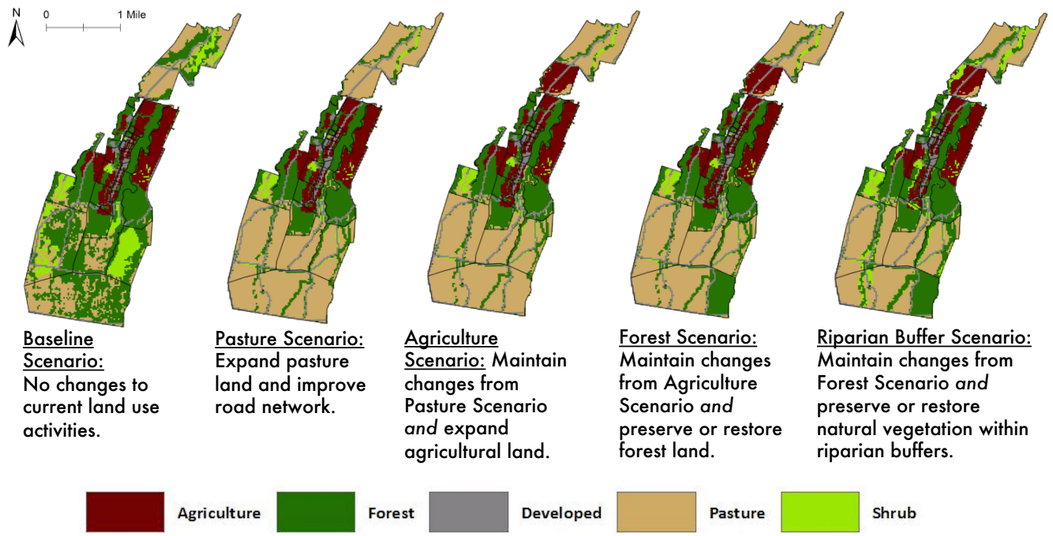
Hawaii Island supports some of the most unique ecosystems in the world, but these ecosystems have been highly altered by human activities. Kohala Institute (KI) is tasked with stewarding 2,418 acres on Hawaii Island while providing economic opportunities for the local community. However, land managers like KI often struggle with the balance between environmentally responsible land use and economic productivity. Our project gave KI the knowledge they needed to expand their land use activities in an environmentally sustainable way. We 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.

3. Recommend land uses and management practices to minimize KI's environmental impacts.

All analyses were performed on five different land use scenarios, which represent different levels of development that KI could implement on the property.



Conclusions and Mitigation Strategies

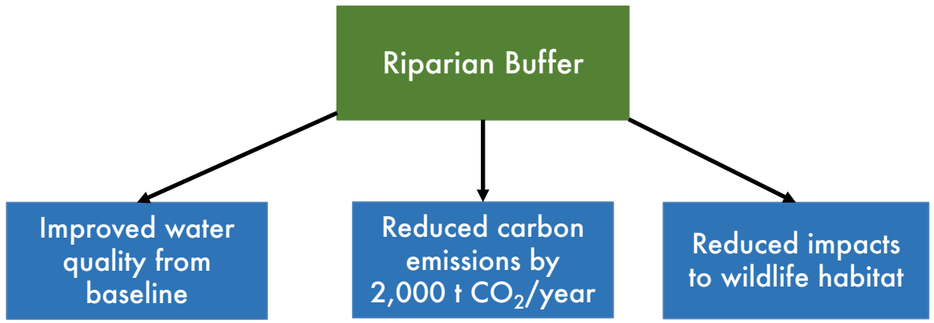
This study provided a first look into how KI's water quality, carbon footprint, and wildlife habitat could change under different land use scenarios. Three major takeaways were identified:

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.

However, given our client's goal of providing economic opportunities for the local community, strategies to reduce environmental impacts from development were also assessed. By implementing a riparian buffer, the impacts to all three environmental categories were reduced.



Additional strategies for reducing environmental impacts include cover crops, mulch, no till agriculture, reforestation, surveying for nests, and partnering with nearby conservation groups.

Acknowledgements

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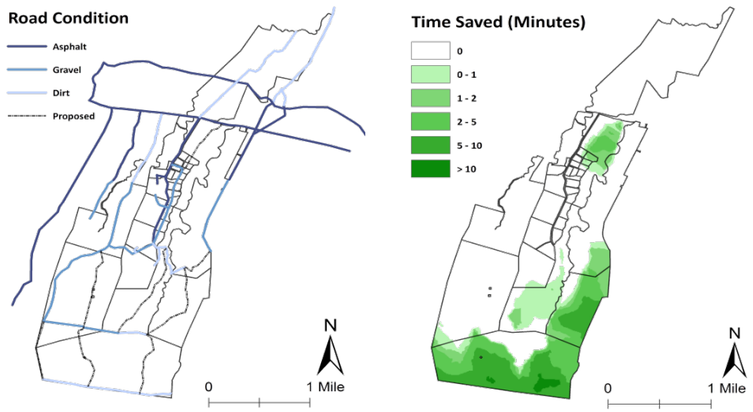
Property Access

Under present conditions, certain parts of KI's property are so inaccessible that implementing any of the land use conversions proposed in the alternative scenarios would be impossible. A travel cost analysis was performed in ArcGIS to investigate accessibility of the property, and found that the southeastern (mauka) edge was the least accessible.

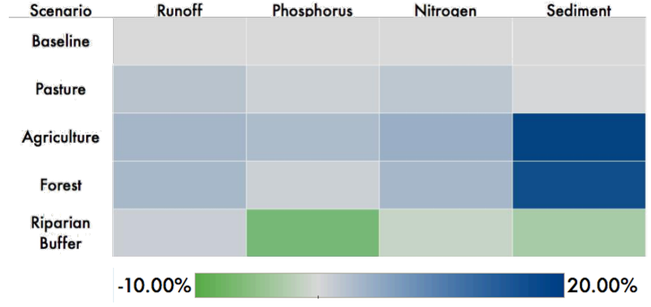
Access to this region could be enhanced by >10 minutes of travel time or over 50% with the addition of new and improved roads.



Accessibility. Current property access (left) could be substantially improved with a revitalized road network (right).

Water Quality

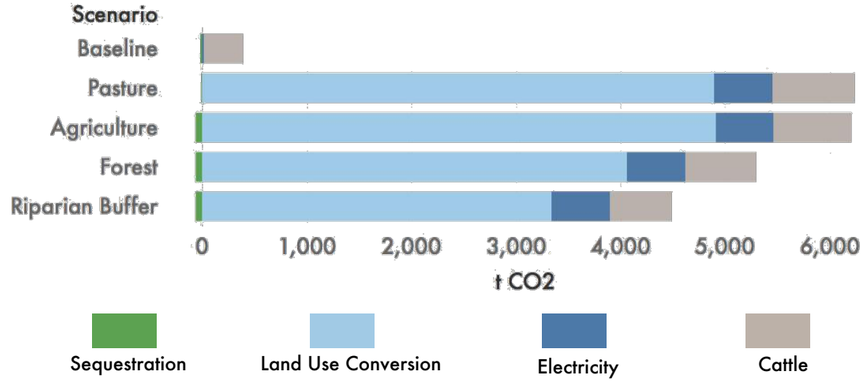
A water quality analysis using the Nonpoint Source Pollution and Erosion Comparison Tool (NSPECT) calculated total annual runoff, phosphorus, nitrogen, and sediment loadings, and found that row cropping and orchards had the highest loadings per acre. These can be minimized with the addition of riparian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



Water Quality. Total runoff, phosphorus, nitrogen, and sediment loadings varied relative to the Baseline Scenario.

Carbon Emissions

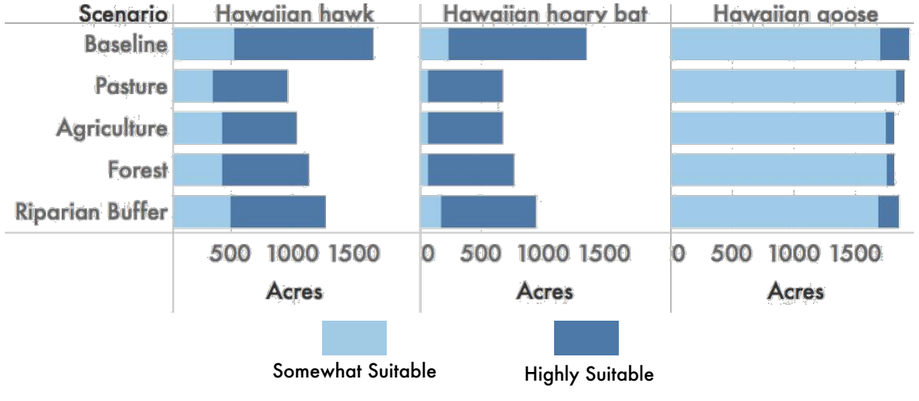
Four sources of carbon emissions were identified at KI: land use conversion, electricity, cattle, and erosion. One carbon sink, sequestration from the growth of plants, was also discovered. In the Baseline Scenario, cattle are the largest source of emissions, producing over 370 t CO_2 per year. Conversion of forest to pasture becomes the largest source of emissions in all four alternative scenarios, with an average of over 4,000 t CO_2/year.



Carbon Emissions. Annual CO_2 emissions and sequestration(t CO_2) by source and land use scenario.

Wildlife Habitat

Three species were selected for review based on their endemism to the region, endangerment status, and possible presence at KI: the Hawaiian hawk, Hawaiian hoary bat, and Hawaiian goose. Habitat for these species was classified as highly, somewhat, or not suitable, and calculated by acre. Habitat for all three species of concern decreased under all alternative scenarios.



Wildlife Habitat. Wildlife habitat availability by species under each land use scenario.