I Pa□a Hou i Kalou: Visualizing the Restoration Suitability of Loko Wai and Lo□i Kalo at Waiale□e, O□ahu

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Introduction

Coastal wetlands are ecologically and culturally important, though commonly threatened by human activity (Bruland, 2008). Understanding the historic context and current condition of a wetland is beneficial to assessing the restoration suitability of the site. Here, I assess the suitability of restoring the historic wetland agro-ecosystem of Kalou, a present-day marsh in Waiale'e, O'ahu. To do so, I set out to answer the following questions:
1. What was the 19th Century extent of wetland agriculture at Kalou?
2. What is the current extent of the wetland at Kalou?
3. To what extent could wetland agriculture be restored at Kalou?

Figure 1. An aerial view of Kalou Fishpond and marsh (former lo'i kalo) from March 2019 (McDonald, 2019a).

Methods

Archival Data Extraction

Figure 3. A 1902 map of Waiale'e showing native land claims awarded via the Kuleana Act of 1850. I extracted land use information from the original documents corresponding to each individual land claim in Waiale'e (Emerson, Lowell, and Wall, 1902).

UAV Survey

Figure 4. In order to determine the current extent of Kalou accurately and efficiently, I enlisted a colleague to conduct an unmanned aerial vehicle (UAV) survey of Kalou. This is the resulting ortho-rectified composite image (McDonald, 2019b).

Field Surveys

Figure 5. Field techniques including water sampling and qualitative observation were used to augment archival and geospatial methods. Here, Buddy Keala (left), a Hawaiian fishpond specialist, tests water quality at Kalou marsh. Richard Fisher (right), a University of Hawai'i employee and lifelong Waiale'e resident, has also provided invaluable insight to the historic conditions of Kalou.

Suitability Analysis

To determine the historic wetland extent of Kalou, I used ArcMap to geo-reference Emerson, Lowell and Wall, 1902, and hand-digitize the historic wetland extent deliniated on the map (Figure 6). Similarly, to determine the current state of Kalou, I hand-digitized the present wetland extent and general land-cover types from McDonald, 2019b (Figure 7). Finally, I combined the two aforementioned maps to assess the suitability of restoring the traditional wetland agro-ecosystem of Kalou (Figure 8).

Results

Figure 6. Extent of historic taro lands and current wetlands at Waiale'e.

Figure 7. An illustration of general land cover types at Waiale'e based on Mcdonald, 2019b.

Figure 8. Suitability for restoration of wetland agriculture at Waiale'e.

Discussion and Conclusion

Assumptions
For the purposes of this study, I assumed that:
1. historically-documented agricultural production is a proxy for historic agricultural suitability.
2. current structures and/or incompatible land uses are the only major factors precluding restoration.
3. other factors, such as pollution, if present, would affect the wetland homogeneously.
4. all vegetative land cover types can be restored, though they vary in required effort.
Limitations
This study bears a few other notable limitations.
1. Map features were digitized by hand.
2. Relatively few suitability criteria were considered.
3. Criteria weights were not empirically determined.
Conclusion
This study demonstrates high potential for agro-ecological restoration of Kalou. It shows how diverse methods can be used to:
1. visualize historic geography and assess current state of Hawaiian agro-ecosystems.
2. determine restoration potential of these sites.
In addition to addressing limitations, future work could incorporate:
1. projected changes to temperature, rainfall, solar radiation, and sea level.
2. more Hawaiian archival resources including newspapers, land records, and maps.

Background

Three types of wetland agricultural systems are historically documented at Kalou (Kikuchi, 1973):
1. Loko Wai - freshwater fishpond
2. Loʻi Kalo - wetland taro cultivation
3. Loko Iʻa Kalo - hybrid loʻi kalo + loko wai

Figure 2. Schematics of a loko wai (left) and loko iʻa kalo and/or loʻi kalo (right) (Kikuchi, 1973).

Works Cited

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Figures and claims not otherwise cited were produced by the author.

Works Cited

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