The Natural Capital Project, Kamehameha Schools, and InVEST: Integrating Ecosystem Services into Land-Use Planning in Hawai`i

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Summary

A quantitative ecosystem services assessment helped Kamehameha Schools (KS), the largest private landowner in Hawai`i, to design and implement a plan that fulfils its mission to balance environmental, economic, cultural, educational, and community values. With the Natural Capital Project, KS used InVEST software to evaluate the impacts on ecosystem services of alternative planning scenarios on its iconic 10,500 hectare landholding on the North Shore of O`ahu. The scenarios included returning agricultural lands to 1) sugarcane as a biofuel feedstock, 2) diversified agriculture and forestry, or 3) residential development. The quantified services were carbon storage and water quality, as well as financial return from the land. Cultural services were incorporated qualitatively. The results informed KS' decision to rehabilitate irrigation infrastructure and make other investments required to pursue diversified agriculture and forestry. In 2008, KS won an award from the American Planning Association Hawai`i Chapter for the quality of their overall land-use planning and community engagement process.

What is the problem?

Mirroring global trends, Hawai`i is facing unprecedented pressures on its land base as a growing population intensifies demand for residential and commercial development, while concurrently there are rising concerns related to food security, fossil fuel reliance, climate change mitigation and adaptation, and other factors integral to the well-being of the state's residents and visitors. Recognizing these challenges, landowners, communities, and leaders are pursuing new strategies to incorporate the values of natural capital into land-use and policy decisions.

One such leader, Kamehameha Schools (KS), is an educational trust serving people of Hawaiian ancestry and is also the state's largest private landowner, owning approximately 8% of Hawai`i's land base. In managing its lands, in 2000 KS adopted an innovative approach to land management that seeks to "derive an overall balance of economic, educational, cultural, environmental, and community returns" (Kamehameha Schools 2000).

From 2006 to 2008, KS undertook an extensive land-use planning process in partnership with local communities for one of its major land holdings on the North Shore region of the island of O`ahu. KS' lands in this region (approximately 10,500 hectares) have a rich historical legacy of use for agricultural production, aquaculture cultivation, and habitat for biodiversity. Until recently, the agricultural lands (approximately 2,200 hectares) were in continuous sugarcane production for over one hundred years, but in 1996 the Waialua Sugar Company surrendered its lease of lands and infrastructure that showed the effects of years of deferred maintenance. Since then, agricultural use has been restored on only a third of the former sugar plantation lands. The remainder is no longer in production and is being overtaken by the rapid advance of invasive plants. A key challenge for KS and the communities was to determine what should be done with the remaining agricultural lands to meet KS' and the communities' mission to balance environmental, economic, cultural, educational, and community values, and to contribute to statewide policy initiatives for sustainable development.

What was done to solve it? Which ecosystem services were considered and how?

KS worked with the Natural Capital Project to use InVEST software (Tallis et al. 2010) to evaluate the impacts of alternative futures for the agricultural lands on carbon storage (to mitigate climate change forces), water quality (to meet current and future needs), and financial return (to support KS' educational activities). Drawing upon input from the communities, the research team developed three spatially-explicit and contrasting scenarios: (1) biofuel feedstock – returning the agricultural lands to sugarcane to produce an energy feedstock; (2) diversified agriculture and forestry – using the lower irrigated fields for diversified agriculture, establishing vegetation buffers to reduce field runoff, and undertaking native forestry plantings on the remaining higher elevation fields; (3) residential development – selling the lands for a residential housing development. While neither KS nor the communities are disposed to pursue the latter scenario, it represents a development pattern that has played out repeatedly on former plantation lands across the state.

All three scenarios were projected to generate positive income streams for the agricultural lands that exceed the current negative returns. The residential development scenario, not surprisingly, was projected to generate the greatest economic net present value for KS. This income boost, however, is linked with reductions in carbon stock and water quality relative to current conditions. Reductions in carbon stock and water quality are even more pronounced for the biofuel feedstock scenario. In both cases, losses in carbon stock are driven by clearing invasive woody vegetation on abandoned fields. In contrast, the diversified agriculture and forestry scenario is projected to improve carbon stock and water quality relative to the current landscape and also generate positive income. While the residential development scenario would yield the largest financial return, the diversified agriculture and forestry scenario has the greatest potential to optimize balanced, positive returns across the modeled ecosystem services, thereby most effectively contributing to KS' multi-value approach to land management.

Cultural values are important to the North Shore communities and to KS' approach to land management. While cultural ecosystem services were not assessed quantitatively in this analysis, the scenarios present some clear and contrasting implications. For instance, native forests play a supportive role in the water cycle and provide resources to promote Hawaiian

cultural practices. On the other hand, many residents prize the North Shore's rural character and are vocal advocates for maintaining active agricultural lands. These lands provide jobs and income to local residents, as well as contributing to a sense of place and connection with previous generations. Such benefits would be captured best by the diversified agriculture and forestry scenarios, rather than the biofuel feedstock or residential development scenarios.

What was achieved?

An examination of the trade-offs among the three alternatives – what would be lost and gained – prioritized a land use plan involving diversified agriculture and forestry. Informed by the strengths and drawbacks of each alternative, KS is working with the communities to implement a mixed land-use plan to deliver the desired balance of ecosystem services, while also having potential to contribute to statewide policy initiatives. In this context, biofuel feedstock may be incorporated along with diversified agriculture and forestry, and possibly other compatible uses. In doing so, KS and the communities will be aware of the benefits and trade-offs inherent in their decision, enabling them to mitigate negative impacts where necessary. In 2008, Kamehameha Schools received an award from the American Planning Association Hawai`i Chapter for the quality of this land-use planning and community engagement process. Similar land-use planning initiatives that attempt to achieve a balance of environmental, economic, and other social goals are now underway, both elsewhere in Hawai`i and globally.
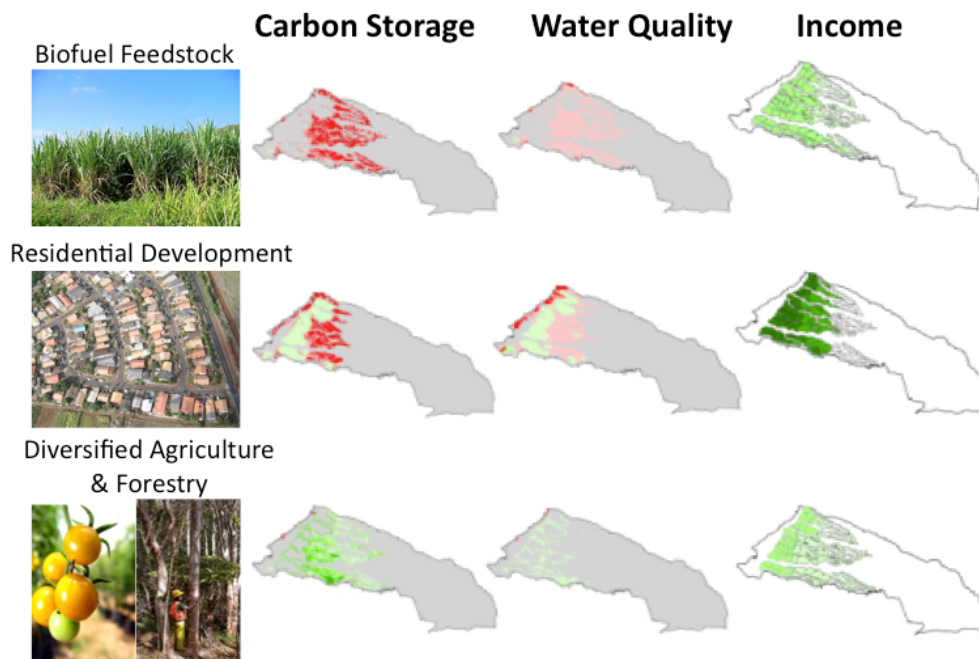

Figure: Modeling results for the North Shore study region for each of the three planning scenarios. The maps for carbon storage and water quality show enhancements (green color) or reductions (red color) in ecosystem service provision for the scenario relative to the current landscape; gray color denotes no change. The income maps show projected land rental rates (biofuel feedstock and diversified agriculture & forestry scenarios) or sale price (residential development), with darker green colors representing greater values.

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