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Scenarios for InVEST: A Primer



For 50 years, WWF has been protecting the future of nature. The world's leading conservation organization, WWF works in 100 countries and is supported by 1.2 million members in the United States and close to 5 million globally. WWF's unique way of working combines global reach with a foundation in science, involves action at every level from local to global, and ensures the delivery of solutions that meet the needs of both people and nature.

The **Natural Capital Project** is a partnership among World Wildlife Fund, Stanford University, The Nature Conservancy, and University of Minnesota. The Natural Capital Project's vision is a world in which people and institutions incorporate the values of natural capital into decision making. The Natural Capital Project works to develop practical ecosystem services concepts and tools, apply these tools around the world to demonstrate the impact of ecosystem service approaches in decisions, and engage thought leaders to advance change in policy and practice.



Scenarios for InVEST: A Primer was developed by Emily McKenzie, Becky Chaplin-Kramer, Chris Conner, Anne Guerry, Taylor Ricketts and Amy Rosenthal.

This primer is a summary of *Developing Scenarios to Assess Ecosystem Service Tradeoffs: Guidance and Case Studies for InVEST Users*, which is available at naturalcapitalproject.org. That document includes expanded case studies and guidance on developing scenario maps, which are required inputs for InVEST.

Further Resources

For InVEST: naturalcapitalproject.org/InVEST.html

To find out more about developing scenarios for ecosystem service assessments see:

Henrichs, T., M. Zurek, et al. 2010. Chapter 5. Scenario development and analysis for forward-looking ecosystem assessments. In: *Ecosystems and human well-being: A manual for assessment practitioners*. N. Ash, H. Blanco, K. Garcia et al. Island Press, Washington D.C.

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People forget facts, but remember stories

Stories have the power to change peoples' attitudes and behavior.

Scenarios are stories about possible futures. The effective use of scenarios may help determine whether an ecosystem service assessment captures attention and leads to more sustainable decisions.

This is a primer on the most important choices and considerations to be made when developing scenarios for use in InVEST.

InVEST is a suite of ecosystem service models, developed by the Natural Capital Project, for mapping the quantity and value of ecosystem services under different scenarios. InVEST helps decision makers incorporate ecosystem services into policy and planning at different scales in terrestrial, freshwater and marine environments.

Why Use Scenarios?

Using InVEST to assess alternative scenarios can help users to

- compare the delivery of ecosystem services under plausible alternative futures
- identify the ecosystem service tradeoffs of alternative interventions and policies
- evaluate whether policies secure ecosystem services if the future changes unexpectedly
- consider new ecosystem service policy ideas
- develop consensus around a shared vision for the future
- craft and communicate compelling stories
- involve stakeholders in a powerful learning process

Developing Scenarios to Achieve Goals

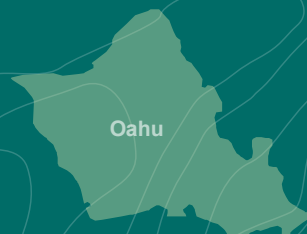
Being clear and specific about the goals for using InVEST is critical:

- What do we want to achieve? By when?
- Who will use the results? What decisions do they need to make? What are they interested in?
- Why is an InVEST analysis useful to inform this decision?
- What scenarios will enable InVEST results to address our goal and reach our audience?
 - Do we want to explore the impact of actual decisions under consideration?
 - Do we want to explore future possibilities with more exploratory scenarios?
 - Do we want to come to consensus on a shared vision for the future?

The breadth of examples shown in our case studies demonstrates how scenarios can address different decision contexts.



IN ACTION | North Shore of Oahu, Hawaii, USA



The Need

Kamehameha Schools (KS)—an educational trust serving people of Hawaiian ancestry, and the state’s largest private landowner—is pursuing an innovative approach to land management. It seeks to “derive an overall balance of economic, educational, cultural, environmental, and community values.” With Hawaii facing unprecedented pressures on its land base as a growing population intensifies demand for residential and commercial development, KS wants to make sure their land-use decisions are sustainable. They asked: What value could be gained through alternative land-use plans?

The Scenarios

KS developed seven scenarios representing plausible future land-use options on agricultural lands, such as biofuel crops or agroforestry. The scenarios were set within the context of a critical management decision facing KS: whether to allocate funds to improve the region’s aging irrigation system to sustain and enhance agricultural production or instead to pursue other options, such as selling the land for residential development.

The Result

The scenarios enabled KS to assess the best use of the largely abandoned agricultural lands to meet the needs of the local community and the broader public, while also generating positive financial returns. An examination of the tradeoffs among the scenario alternatives—what would be lost and gained—prioritized a land-use plan involving diversified agriculture and forestry.

Staff from Kamehameha Schools and the Natural Capital Project discuss a map of the North Shore of Oahu. Scenarios were developed through collaborative, iterative discussions between scientists and stakeholders.

© Josh Goldstein

How Scenarios Are Used in InVEST

InVEST requires scenarios to be depicted as maps of land cover and/or coastal and marine habitats and uses. These maps feed into the biophysical and economic models in InVEST to produce maps of ecosystem services for each scenario.

Example	Evaluating scenarios with InVEST enables users to...
National and local governments are creating an integrated spatial plan with stakeholder input.	Learn about the ecosystem service impacts of <i>alternative spatial plans that reflect the preferences of stakeholders</i> in order to create an integrated spatial plan that balances the goals of multiple groups.
A multilateral development bank is deciding whether to fund a major road development.	Assess the impacts of <i>land-cover changes likely to result from alternative designs for the new road</i> on ecosystem services that are important to poor communities.
A local community is concerned about upstream deforestation that is affecting their water supply.	Assess the ecosystem service impacts of <i>alternative possible future deforestation</i> to communicate concerns to upstream land managers.
A planning authority needs to make a marine spatial plan that will effectively sustain habitats and ecosystem services while allowing multiple human activities and generating revenue.	Assess the impacts on marine habitats and ecosystem services of <i>alternative levels and locations of desired development</i> —such as offshore oil and gas, fisheries and aquaculture.
A water utility and a beverage company want to ensure that the payments they provide to upstream land managers to ensure a clean, regular supply of water are cost-effective.	Assess the impacts of <i>alternative targeting criteria for payments</i> on hydrological services to scope the feasibility and design of a water fund.



IN ACTION | The Heart of Borneo in Kalimantan, Indonesia

The Need

The governments of Malaysia, Indonesia and Brunei are working in Borneo to showcase how to develop a “green economy,” where policies reflect the value of natural capital. They asked: What ecosystem services could be maintained or enhanced under a green economy? How could a green economy be implemented and financed? In which areas can we most cost-effectively target interventions that restore, sustain and enhance ecosystem services?

The Scenarios

Two future scenarios were developed representing business-as-usual and a green economy. The team used the IDRISI Land Change Modeler—a quantitative scenario generation modeling tool developed by Clark Labs—to predict land-cover change based on a range of variables including past change observed between 2000 and 2009. Some further manual adjustments were made to the scenarios to make them more distinct and to reflect important changes in land-cover and management practices, such as palm oil and logging concessions.

The Result

These two scenarios enabled policy makers to see the impacts on ecosystem services of two contrasting futures. This provided a scientific basis for discussions among decision makers of the financial and policy mechanisms and commitments required to make the vision of a green future a reality, and for investments by multilateral and bilateral donors to help put these policies into practice.

Two women navigate a boat along Tepai River in Kutai Barat District, East Kalimantan.

© WWF-Indonesia

What Makes an Effective Scenario?

Certain characteristics can make scenarios more effective. It may not be possible to achieve all characteristics simultaneously, and some characteristics will only matter in certain contexts. Consider which of these characteristics your scenarios need to have:

Relevant

Do the scenarios align with the problems and questions of interest to stakeholders and decision makers?

Legitimate

Does the scenario development process include diverse stakeholder views and beliefs?

Plausible

Do the scenarios tell coherent stories that could conceivably happen?

Understandable

Are the scenarios understandable and accessible to the target audience?

Distinct

Are the scenarios sufficiently dissimilar to show contrasting ecosystem service impacts?

Participatory

Are stakeholders involved meaningfully in the process of developing scenarios and assessing their ecosystem service impacts?

Scientifically credible

Have scenario storylines and maps been developed using scientifically robust, credible methods?

Comprehensive

Do the scenarios consider relevant drivers of change, including both those beyond and within the control of decision makers?

Iterative

Are the scenarios refined over time to incorporate stakeholder feedback, as well as emerging knowledge, trends and issues?

Surprising

Do the scenarios challenge assumptions and broaden perspectives about unexpected developments?



IN ACTION | Eastern Arc Mountains, Tanzania



The Need

A major research project called “Valuing the Arc” set out to develop new insights into the contribution that ecosystem services make to the well-being of rural communities in the region. They asked: What is the value of ecosystem services? How might that value change in the future? Where are projects for forest carbon and payments for watershed services feasible?

The Scenarios

The team developed scenarios to contrast how different policy trajectories could impact the quantity, value and location of ecosystem services in Tanzania over 15 years. The scenarios were grounded in policy and practical realities and developed with extensive input from Tanzanian stakeholders. The scenarios represented business as usual (*kama kawaida* in Swahili) and an optimistic future where progress is made toward sustainable development goals (*matazamio*). Scenarios created a framework for exploring how drivers—such as policy shifts, climate change and population growth—might change in the future.

The Result

Researchers broke new ground by developing a process to move from narrative scenario storylines to quantitative, spatially explicit scenario maps, with stakeholder participation at every step. The scenarios showed policy makers what might happen to Tanzanian forests in the future, and the implications for multiple ecosystem services. The difference between the future carbon storage in the *kama kawaida* scenario and that in the *matazamio* scenario showed the additional carbon “saved.” This identified areas that could be candidates for payment under REDD+ and voluntary carbon projects.

Villagers near the Uluguru Mountains in Tanzania tend tree saplings for reforestation projects.

© Neil Burgess

Examples of Goals and Methods for Scenarios

User Goals	Scenario Storyline	Common Methods	Possible Decision Context
Identify effective and equitable interventions that meet policy goals	Designs for real policies, plans and projects	<ul style="list-style-type: none"> • Desk study of policy, project and planning documents • Literature review of similar interventions in similar contexts • Workshops and/or interviews with decision makers and stakeholders • Statistical or simulation modeling 	Strategic Environmental Assessment to compare options for a new infrastructure development
Test how policies cope with unexpected future circumstances	Possible but unexpected futures	<ul style="list-style-type: none"> • Stakeholder workshops that explore drivers of change and possible surprises • Literature review on drivers of change • Statistical or simulation modeling 	Government review to assess resilience of existing policies with possible climate change
Determine how to reach a desired future and resolve stakeholder conflicts	Stakeholders' concepts of desirable or undesirable futures	<ul style="list-style-type: none"> • Workshops where stakeholders share and/or develop common vision of future • Interactive websites to share ideal or undesirable futures • Interviews or surveys with stakeholders or stakeholder groups • Landscapes or seascapes optimized to meet specific goals 	Community planning based on a shared vision for local land-use and coastal management
Compare other scenarios against a standard that represents current policies and identify likely risks or opportunities	Depictions of the expected future (i.e., business as usual) with no new interventions	<ul style="list-style-type: none"> • Predictions or forecasts, based on statistical analysis of historical trends • Stakeholder workshops • Desk study of existing policy or planning documents • Statistical or simulation modeling 	Identifying baseline to determine whether Reduced Emissions and Forest Degradation (REDD) project will provide additional benefits



IN ACTION | West Coast of Vancouver Island, Canada



The Need

The West Coast Aquatic Management Board (WCA) is tasked with creating a marine spatial plan for the most populated region on the west coast of Vancouver Island, British Columbia. The plan must balance the interests and activities of multiple stakeholders including First Nations and industries such as commercial fishing, shipping and forestry. They asked: Which regions are suitable for different activities? How would alternative spatial plans affect a range of ecosystem services? What marine-use conflicts are likely to arise from alternative spatial plans? How could such conflicts be avoided or minimized?

The Scenarios

WCA created a large number of spatially explicit scenarios—each representing alternative configurations and intensities of activities on the coast and in the ocean at a range of spatial scales (from single First Nations' territories to whole sounds). To facilitate the collaborative scenario development process, the team used the Natural Capital Project's online mapping tool, InSEAM, to enable multiple people to draw on maps in real-time. Natural Capital used these initial zoning maps to identify questions of particular concern, such as conflicts among stakeholders.

The Result

WCA is using InVEST to understand the ecosystem service tradeoffs of these different scenarios. This enables them to articulate connections between human activities often considered in isolation, to align diverse stakeholders around common goals, and to use science to resolve conflicts. Ecosystem service results for scenarios have informed early versions of the marine spatial plan and will inform the creation of the final plan in 2012.

Fishers along the West Coast of Vancouver Island.

© Joey Bernhardt

Creating Scenario Maps for Use in InVEST

In terrestrial and freshwater InVEST models, scenario drivers are represented by

- Land cover or land use (e.g., agriculture)
- A change in management practices (e.g., crop type)
- Other assumptions (e.g., how far people are willing to travel to harvest a forest product)

In marine InVEST models, scenario drivers are represented by

- Human uses of the coast and ocean (e.g., fishing)
- Coastal and near-shore habitat distribution
- Coastal development
- Land cover or land use (e.g. outputs from terrestrial InVEST models)

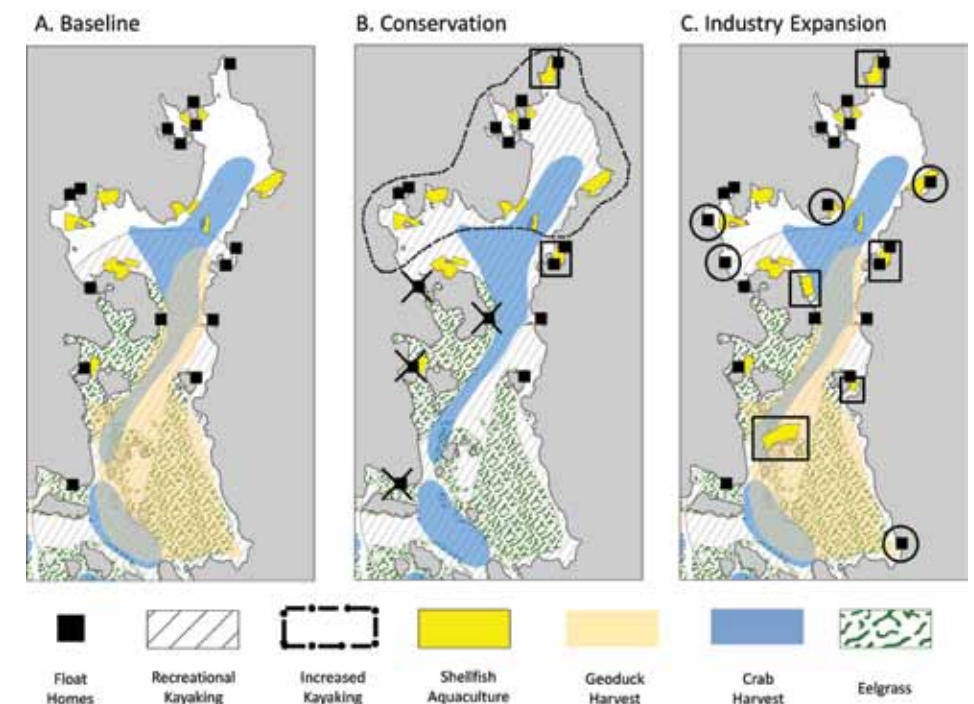
There are several approaches for converting scenario storylines into maps:

- Work with stakeholders to draw a map for each scenario using paper, digital or online mapping tools.
- Use past experience and statistical methods to predict where change is most likely to occur on the landscape or seascape.
- Use rules based on social, economic or biophysical principles that define which areas are likely to be most suitable for particular uses or activities.

Three alternative management scenarios for Lemmens Inlet, B.C. identified by West Coast Aquatic.

- A) No changes to current uses or zones.
- B) Zoning rules restrict float homes and aquaculture in areas near eelgrass beds. Kayaking routes expand into previously unused areas. Geoduck harvest is prohibited.
- C) New float home leases and oyster tenures are added. Wild geoduck harvest is allowed.

Source: Guerry et al. (2012) International Journal of Biodiversity Science, Ecosystem Services & Management



Conclusion

Scenarios help make InVEST a powerful tool for assessing ecosystem service tradeoffs by enabling comparison of the change in services under alternative possible futures. To learn more, please visit naturalcapitalproject.org and download *Developing Scenarios to Assess Ecosystem Service Tradeoffs: Guidance and Case Studies for InVEST Users*.