



# *Demonstration of InVEST: A Decision- Support Tool for Valuing Nature*

December 10, 2012



WOODS INSTITUTE  
FOR THE ENVIRONMENT  
STANFORD UNIVERSITY



The Nature Conservancy



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UNIVERSITY OF MINNESOTA  
*Driven to Discover™*

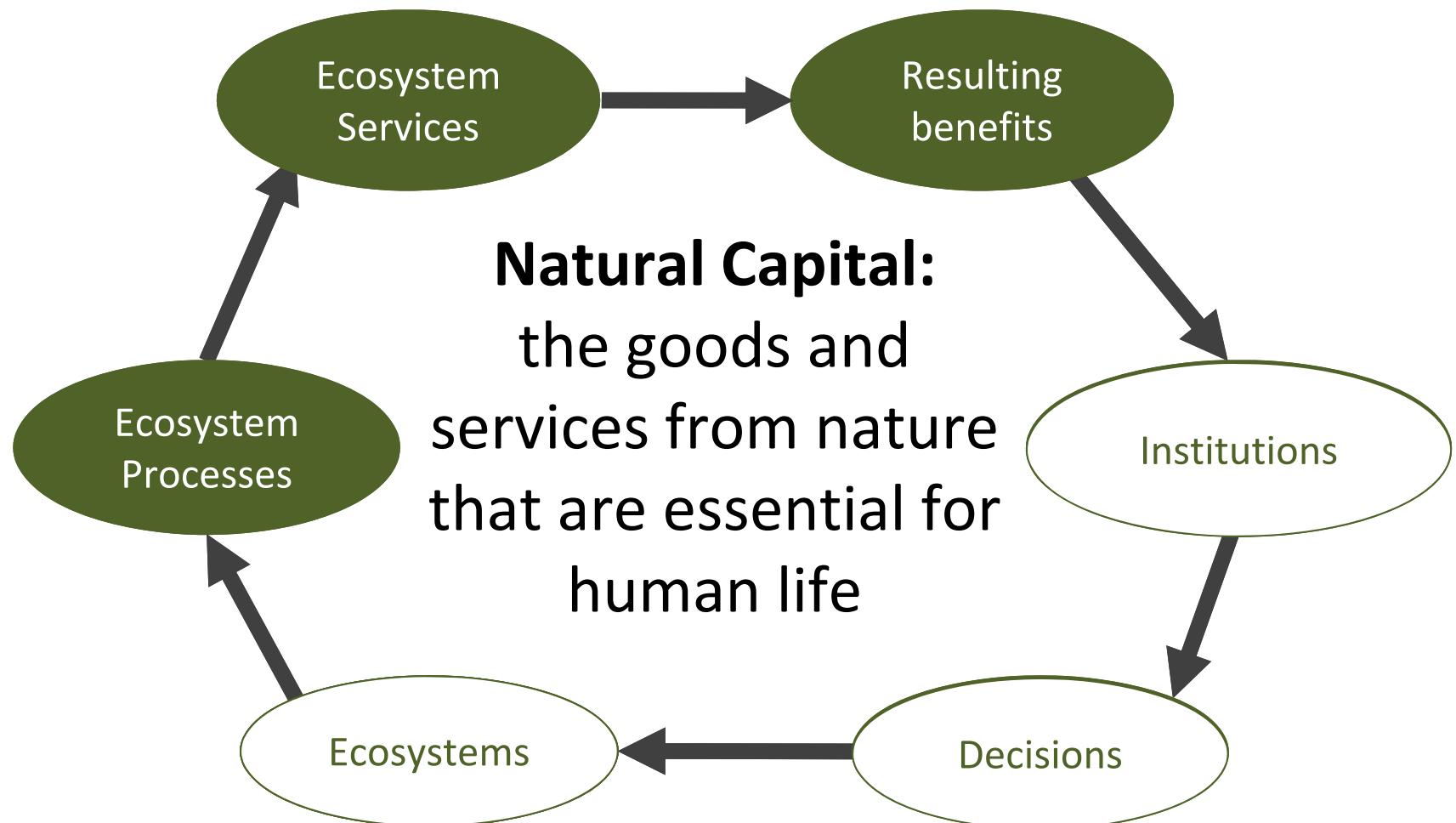
# The NatCap Team



- ecologists
- oceanographer
- fisheries scientist
- coastal engineers
- hydrologists
- computer scientists

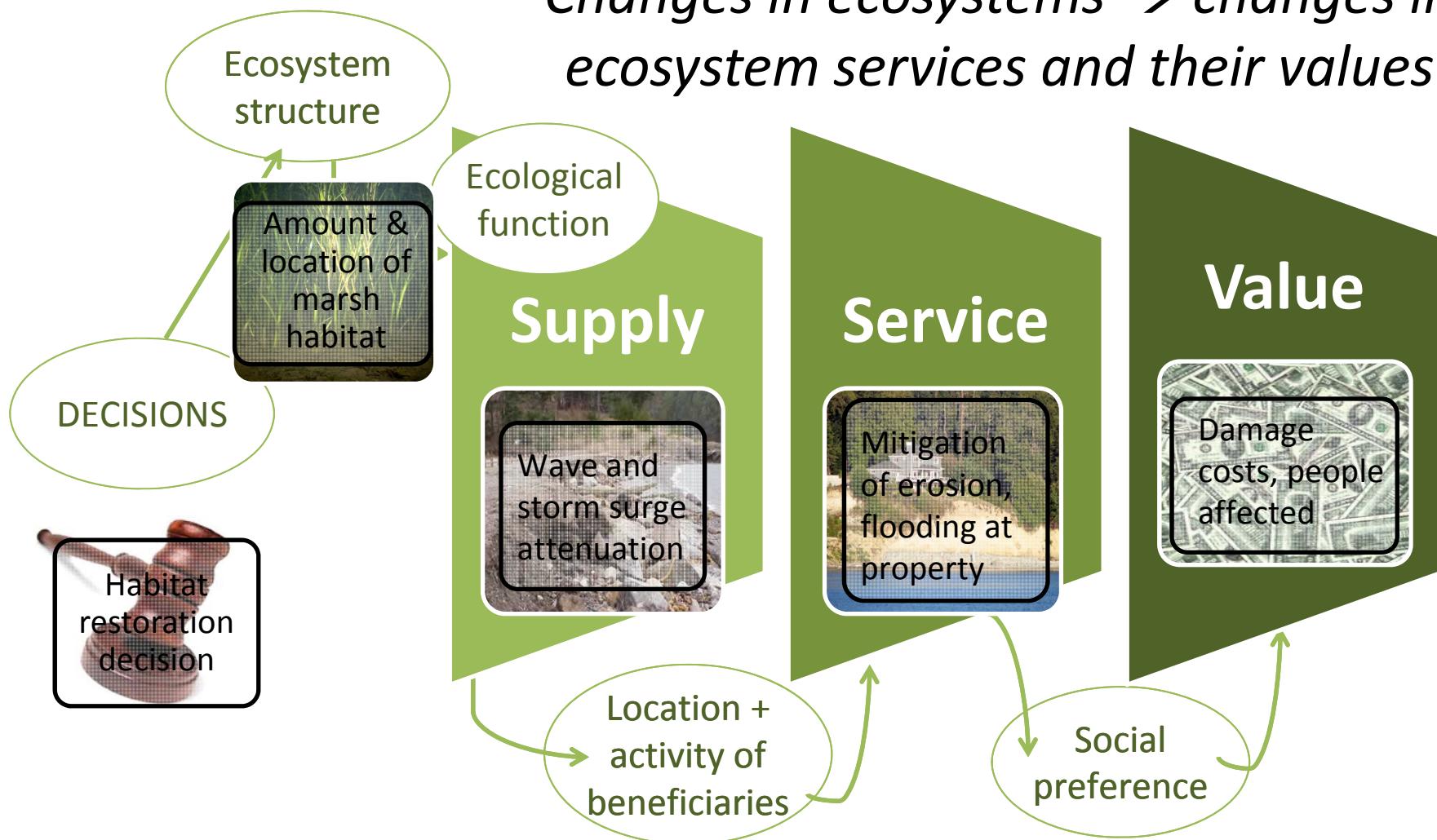
- policy and communication specialists
- economists
- geographers
- biologists

# Natural Capital in decision-making



# The Natural Capital approach

*Changes in ecosystems → changes in ecosystem services and their values*



# InVEST

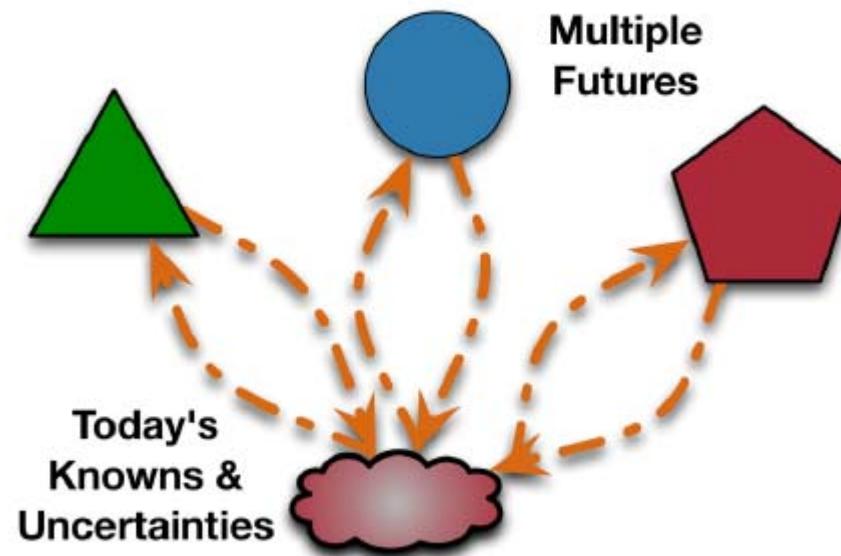


Quantify, map and value the benefits provided by  
terrestrial, freshwater and marine systems

# Scenarios

*Plausible, simplified, descriptions of the future*

InVEST requires scenarios of maps of land cover and/or coastal and marine habitats and uses



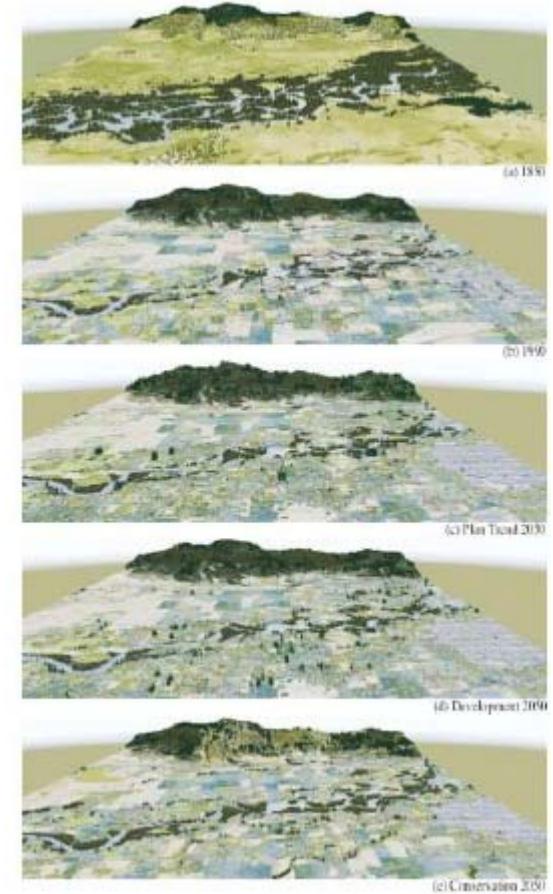
# Why use Scenarios?



Compare alternatives  
Marginal change in ES  
Future oriented

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Identify tradeoffs  
Consider new policies  
'Future-proof' policies  
Air conflicts, develop consensus  
Storytelling  
Process for iteration and learning



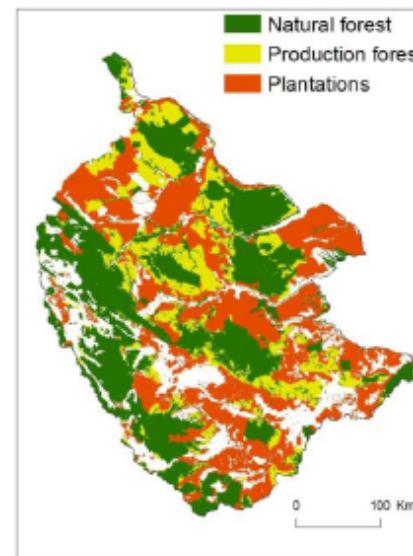
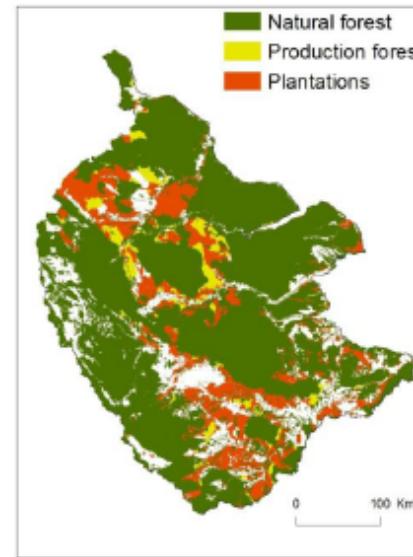
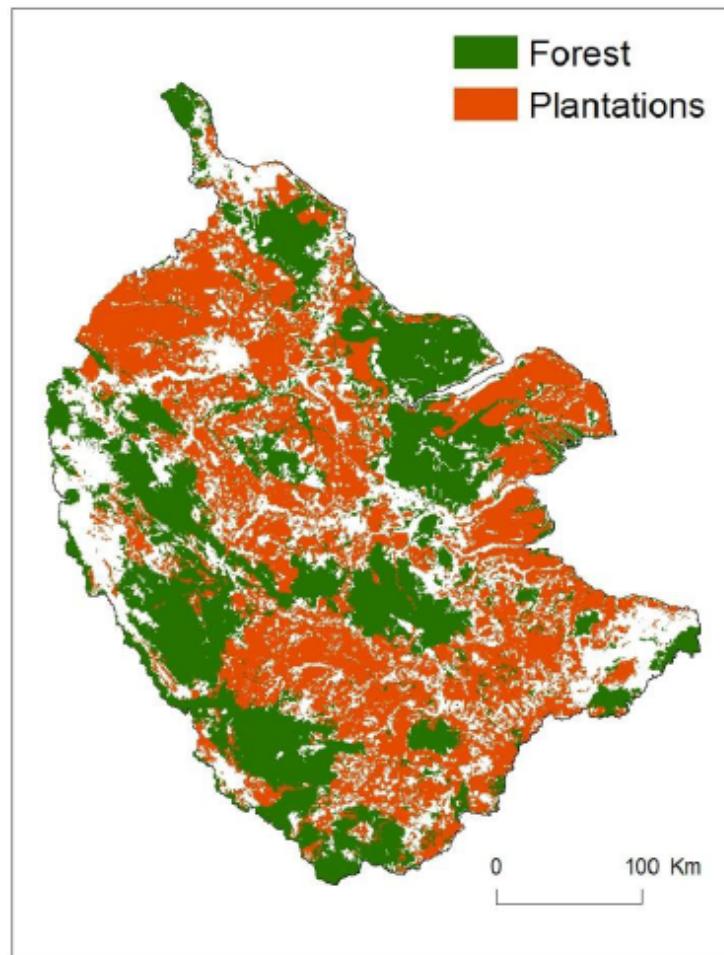
# Types of Scenarios



- **Interventions**
  - Designs for policies, plans and projects
- **Explorations**
  - Possible but unexpected futures
- **Visions**
  - Perceptions of desirable or undesirable futures
- **Projections**
  - Depictions of the expected future

# Scenarios

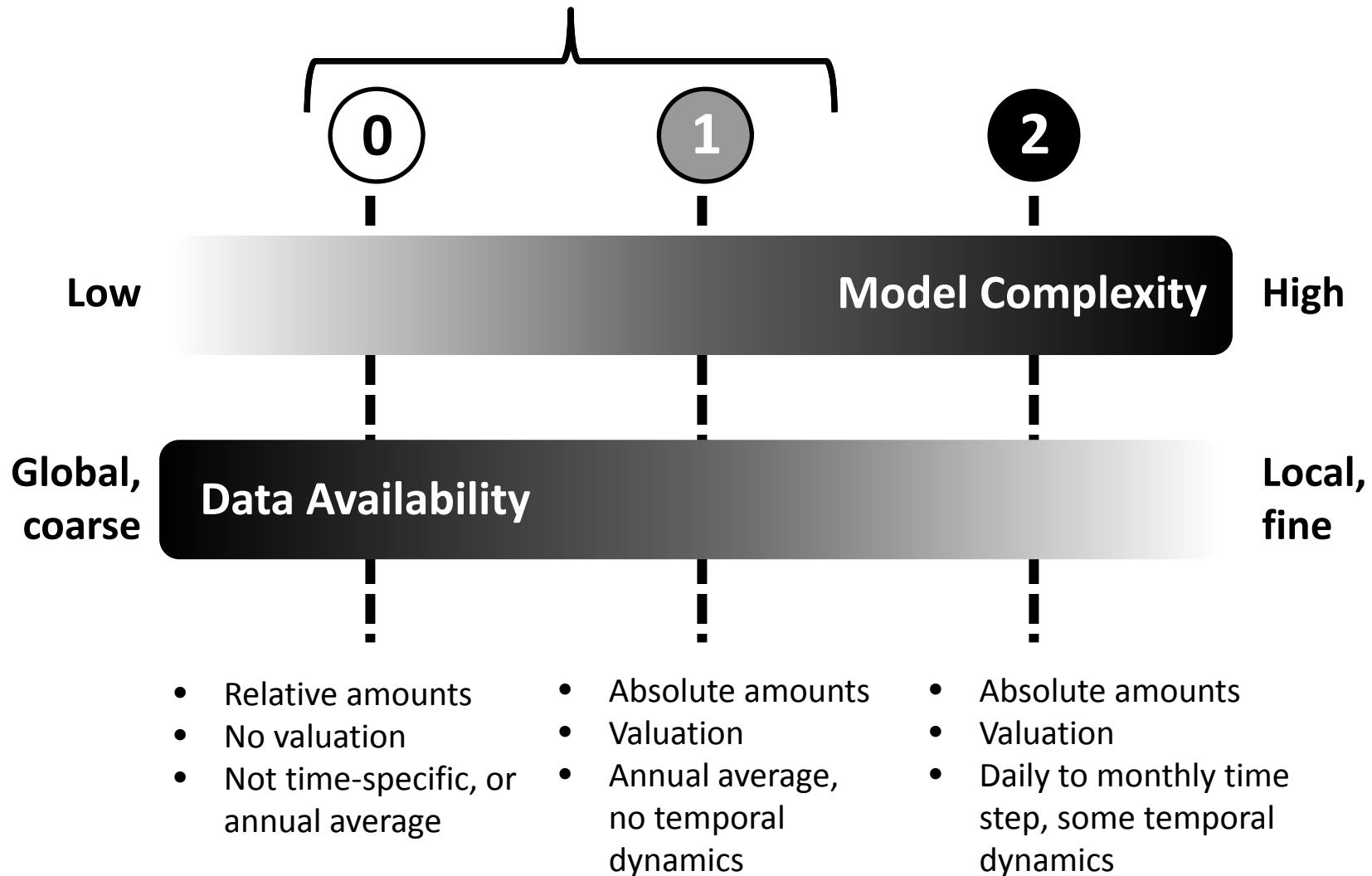
Sumatra: Developing  
sustainable spatial plans



# A Tiered Approach



## InVEST





It's free & open source!

<http://naturalcapitalproject.org>

# InVEST

- Multiple services and biodiversity
- Scenario-based analysis
- Biophysical and economic currencies
- Applicable globally with minimal data



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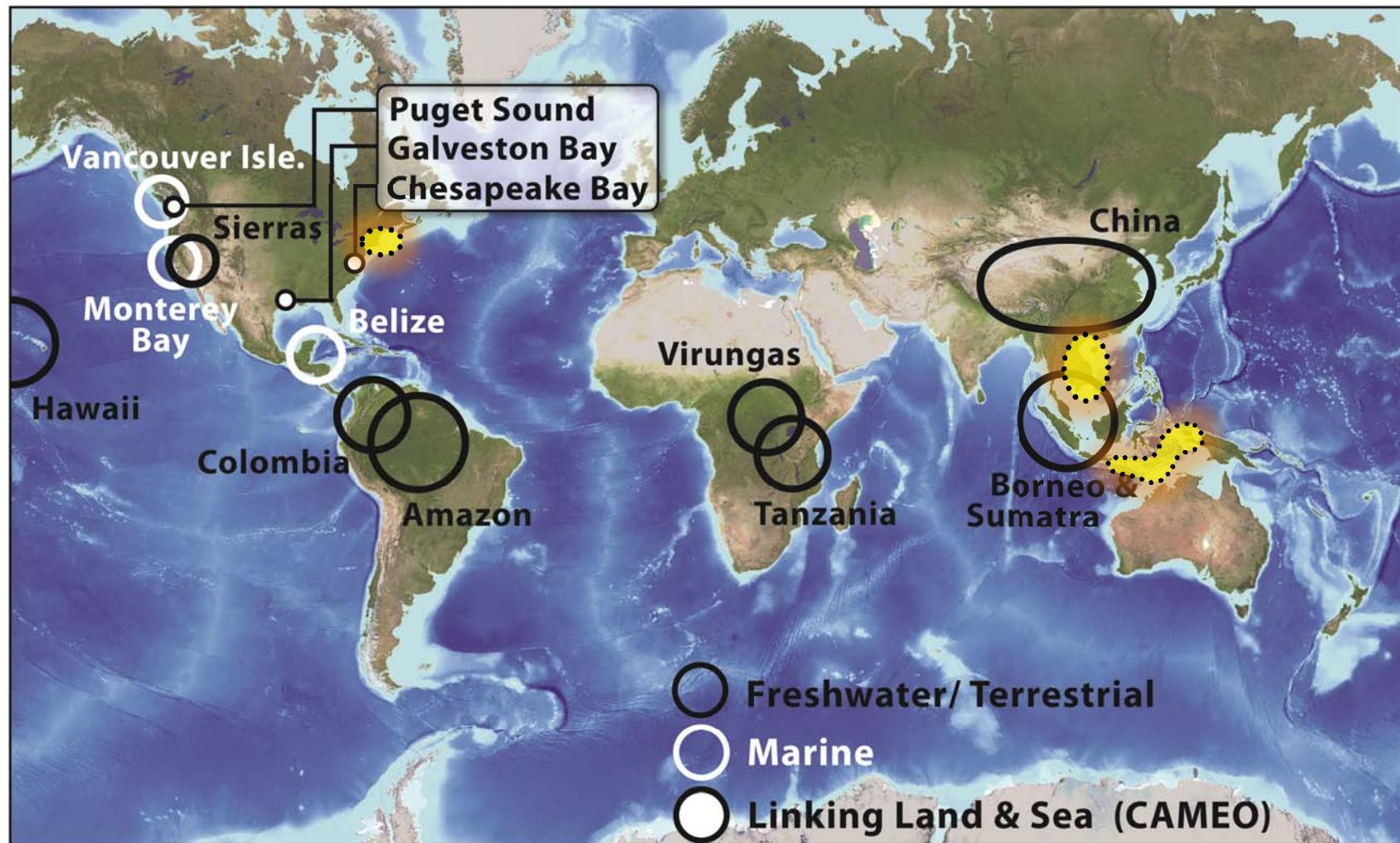
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# Where We Work

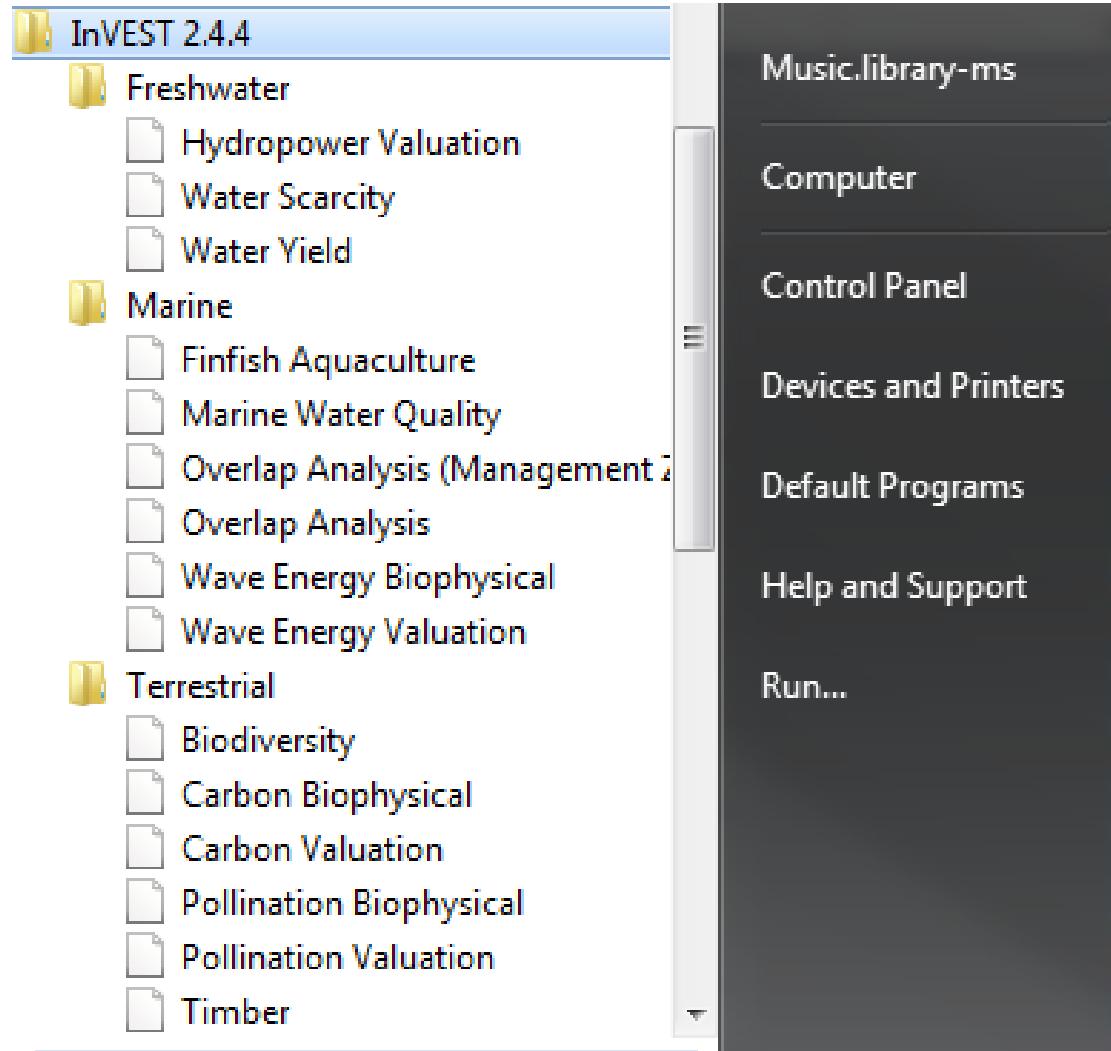


# Different Decision-Contexts



Decision Context	Geography
Spatial Planning	Tanzania, Indonesia, British Columbia, <b>Hawaii, China, Belize</b>
Ecosystem-based management (terrestrial-marine links)	USA (Puget Sound, Galveston & Chesapeake Bays)
Climate adaptation	USA (Galveston & Monterey Bays)
Payments for ecosystem services	<b>Colombia (water funds), Indonesia (REDD), Borneo, Tanzania</b>
Impact assessment, permitting, licensing	<b>Colombia (mining)</b>
Multilateral development bank investments	World Bank in Malawi
Corporate strategy	Lafarge in Michigan, USA

# InVEST w/ and w/o ArcGIS



## InVEST 3.0

- Launch through 'Start' menu
- Independent of ArcGIS
- Faster
- More user-friendly

# Terrestrial / FW Models



Tier 0: **Biodiversity** (Habitat quality and loss)

**Crop pollination**



Tier 1: **Managed timber production**

**Carbon sequestration & storage**



**Sediment retention**

**Water purification:** nutrient retention



**Water yield** for hydropower production



# FW and Terrestrial inputs

## Spatial data

Land use/  
Land cover



Soil type



Topography



Cities



Infrastructure

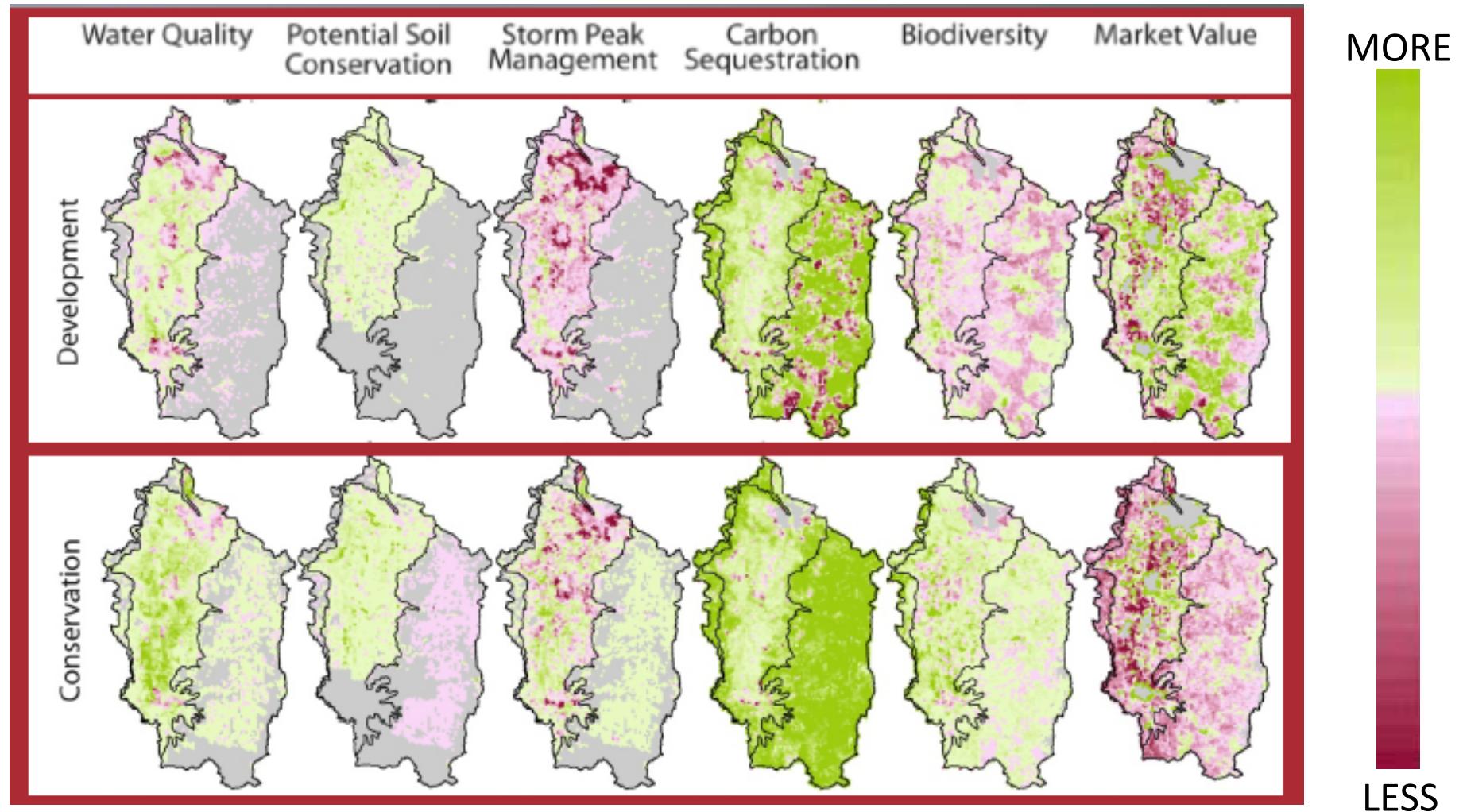


## Associated data

Examples:

- Carbon pools by land use/land cover and soil
- Habitat suitability by land use/land cover
- Market value of timber or carbon

# Outputs: Quantifying & Mapping



1) Relative or absolute measures

2) Biophysical amount or value

# Sediment Retention: example



**Sediment erosion can:**



- Increase reservoir dredging costs
- Increase water treatment costs
- Decrease agricultural productivity



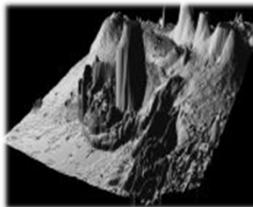
# Sediment example: Biophysical inputs



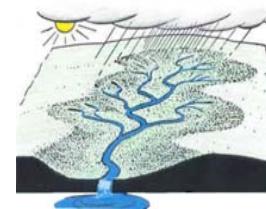
**Land use/Land cover**  
+ associated factors affecting  
soil loss and retention



**Streams**



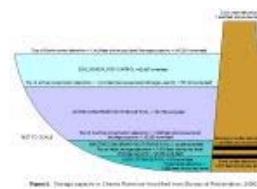
**Slope**



**Watersheds**



**Rainfall erosivity**

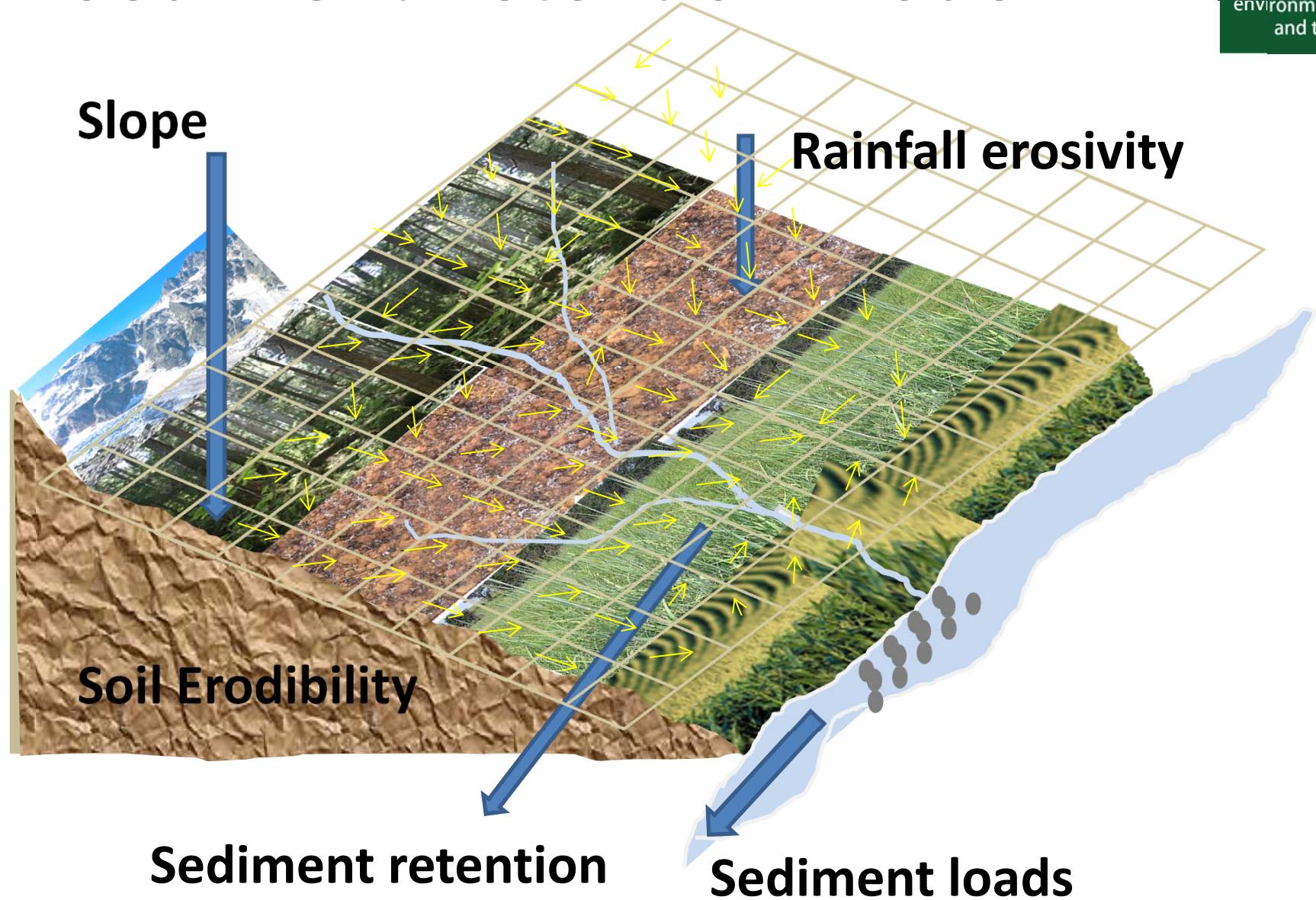


**Sediment thresholds**  
(of reservoirs or water  
quality requirements)



**Soil erodibility**

# Sediment Retention model



# Sediment – supply, service, value



## Supply

Potential available



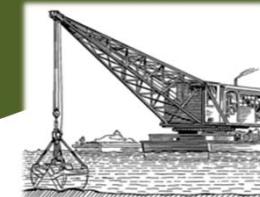
## Service

Delivered  
to people



## Value

Economic  
& social  
impacts



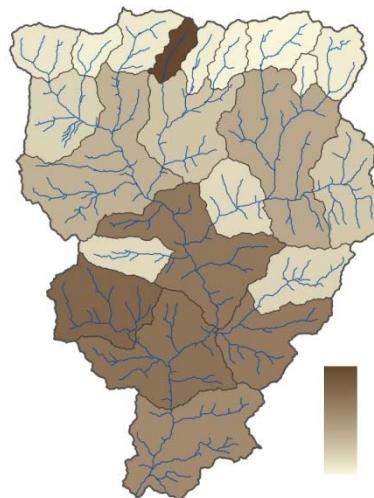
**Sediment  
retained**

**Avoided  
sedimentation**

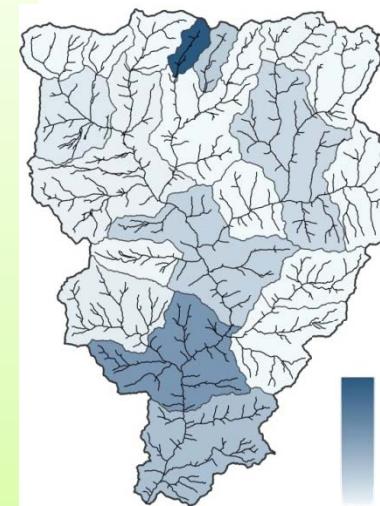
**Avoided dredging  
or  
treatment costs**

# Sediment example: Output

AVOIDED SEDIMENTATION  
PER SUBWATERSHED



AVOIDED TREATMENT COST  
PER SUBWATERSHED



- Where are the sediment sources?
- Where is sediment retained?
- How much is retained?

- What is the value of this retention?
- How does this differ between scenarios?



# Targeting Investments in Resource Conservation with RIOS (Resource Investment Optimization System)

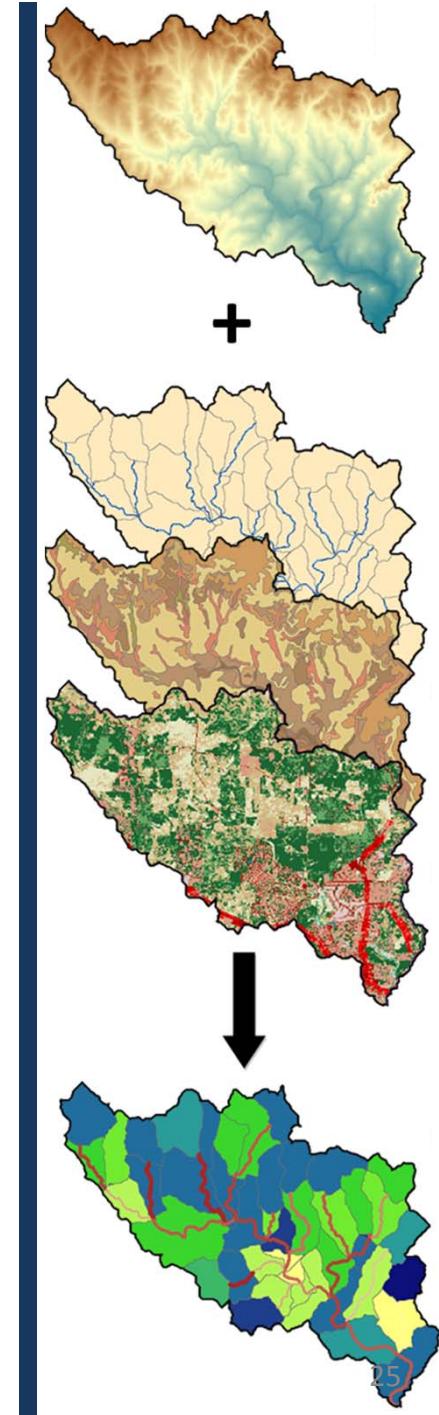
Adrian Vogl (avogl@stanford.edu)

Heather Tallis, Stacie Wolny, Rich Sharp, James Douglass, Doug Denu,  
Silvia Benitez, Fernando Veiga, Juan Sebastian Lozano, Paulo Petry,  
Jorge Leon, Joao Guimaraes, Eddie Game

Can we do a better job of targeting investments  
in watershed services by using a science-based  
approach with biophysical and social data?

# Science-based approaches

- Use biophysical data with models to target where services are highest
- Scenario analyses of vulnerability or sensitivity to interventions
- Specific to context and available data



# Resource Investment Optimization System

- An approach **general** enough to work everywhere in Latin America
- Easy with **available** data
- Give **standard outputs**



# Resource Investment Optimization System



## **InVEST approach:**

- How do the amount, distribution and value of ecosystem services differ between scenarios?
- Scenarios often a starting point

## **RIOS approach:**

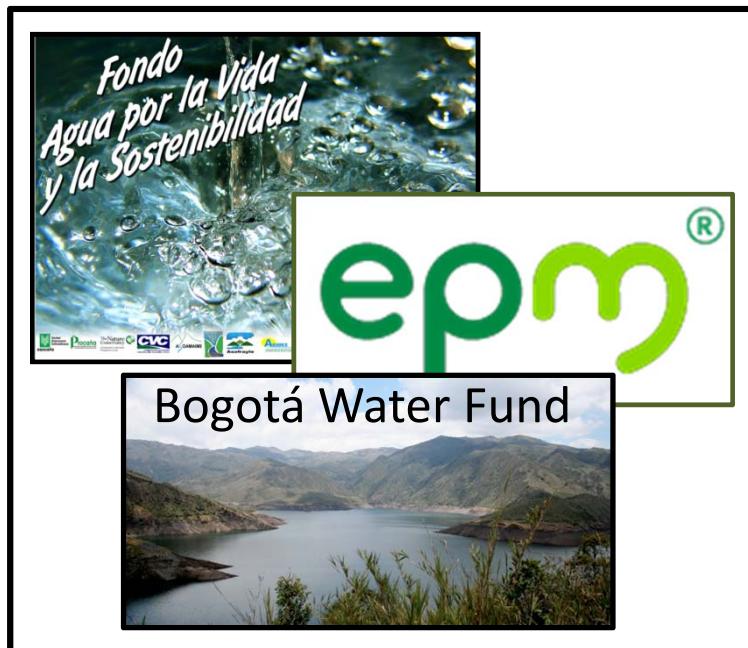
- What changes to the current landscape would maximize benefits of ecosystem services?
- Scenarios (portfolios) are an end point

### **RIOS models planned (2013 launch):**

- Erosion control
- Nitrogen & phosphorous regulation
- Groundwater recharge
- Flood mitigation
- Dry season base flow
- Biodiversity

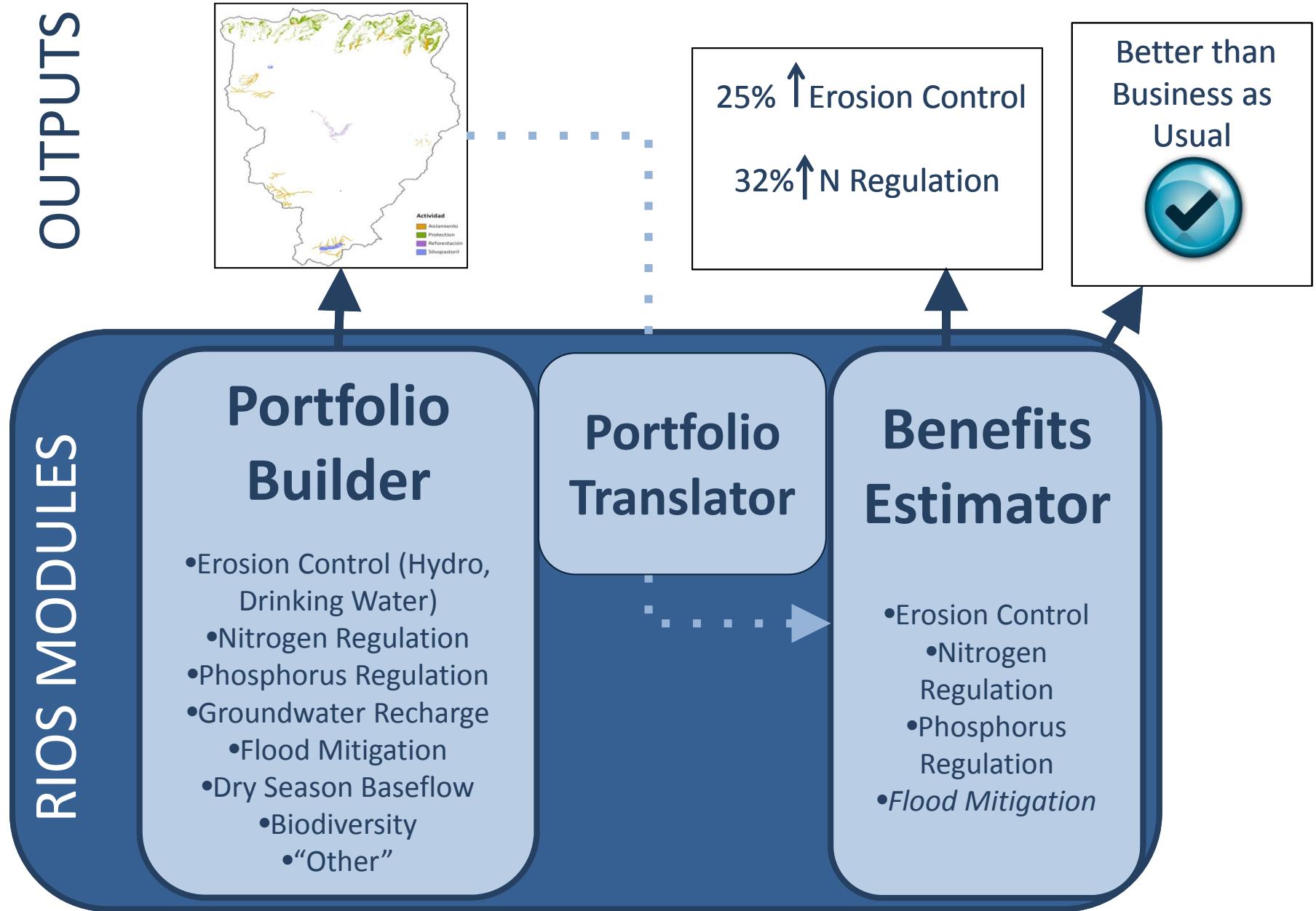
# Can We Do Better? YES!

## Deep Dive Sites

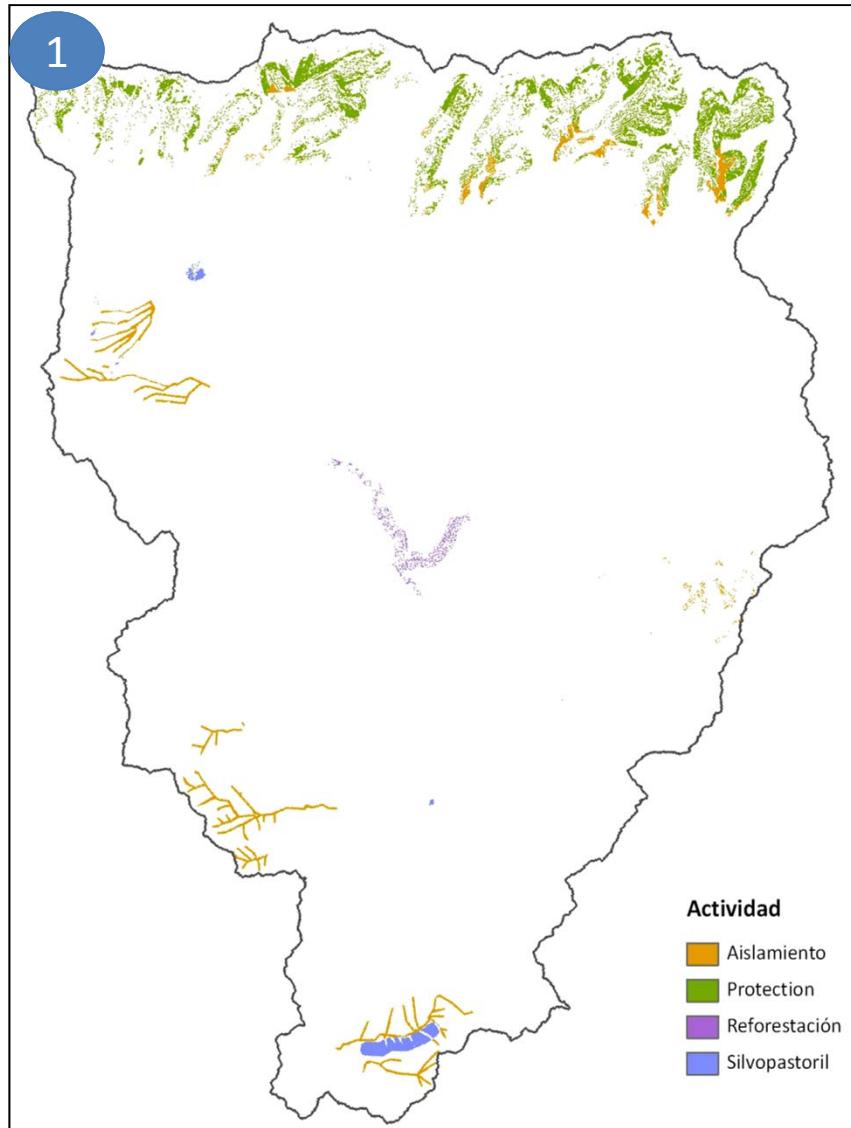


**30% to 600%**  
better estimated  
returns than  
business as usual

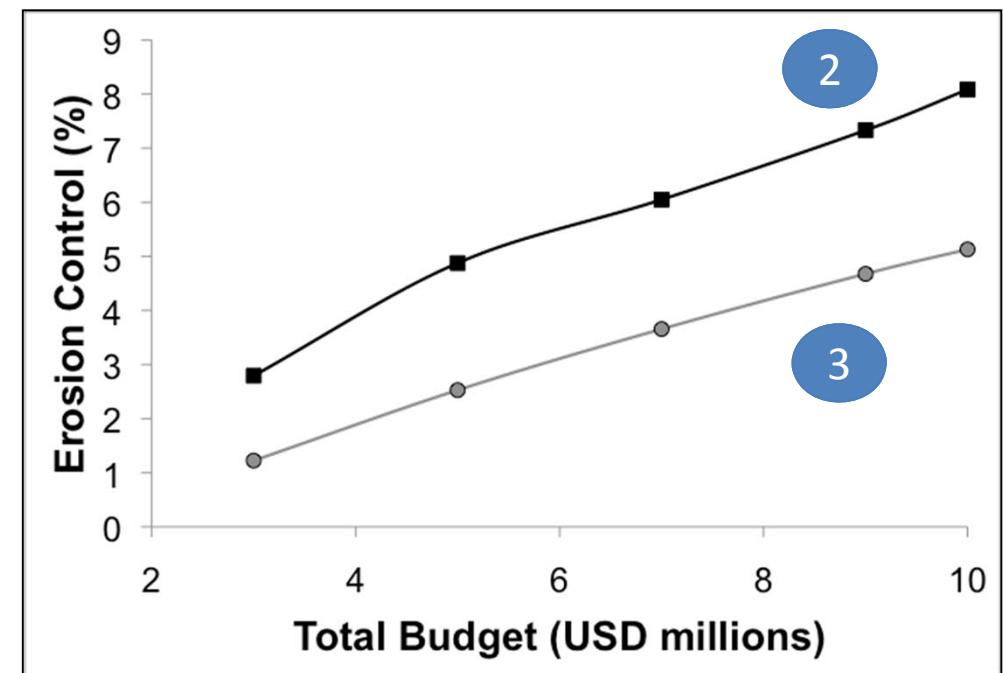
# RIOS Structure



# RIOS Outputs



- 1 Investment Portfolio  
(Multi-objective, ranking & diagnostic screen)
- 2 Estimated Return on Investment  
(Estimate Returns)
- 3 Estimated Value of Science  
(Business case for approach)



# Current Marine Models

**Recreation**



**Aquaculture (finfish, shellfish)**



**Fisheries**



**Coastal Protection**



**Renewable Energy (wave and wind)**



**Aesthetic Quality**



**Water Quality**



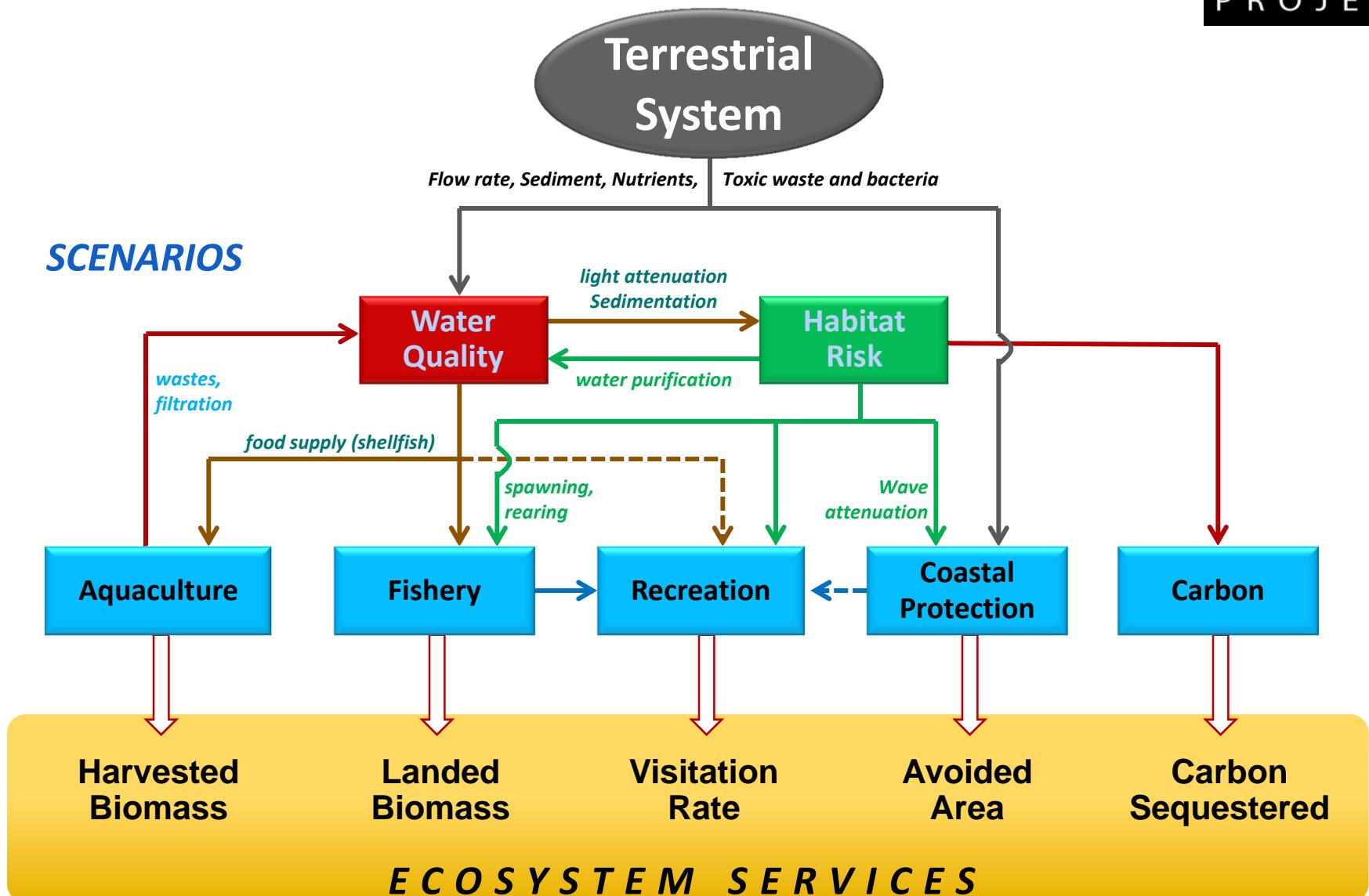
**Habitat Risk Assessment**



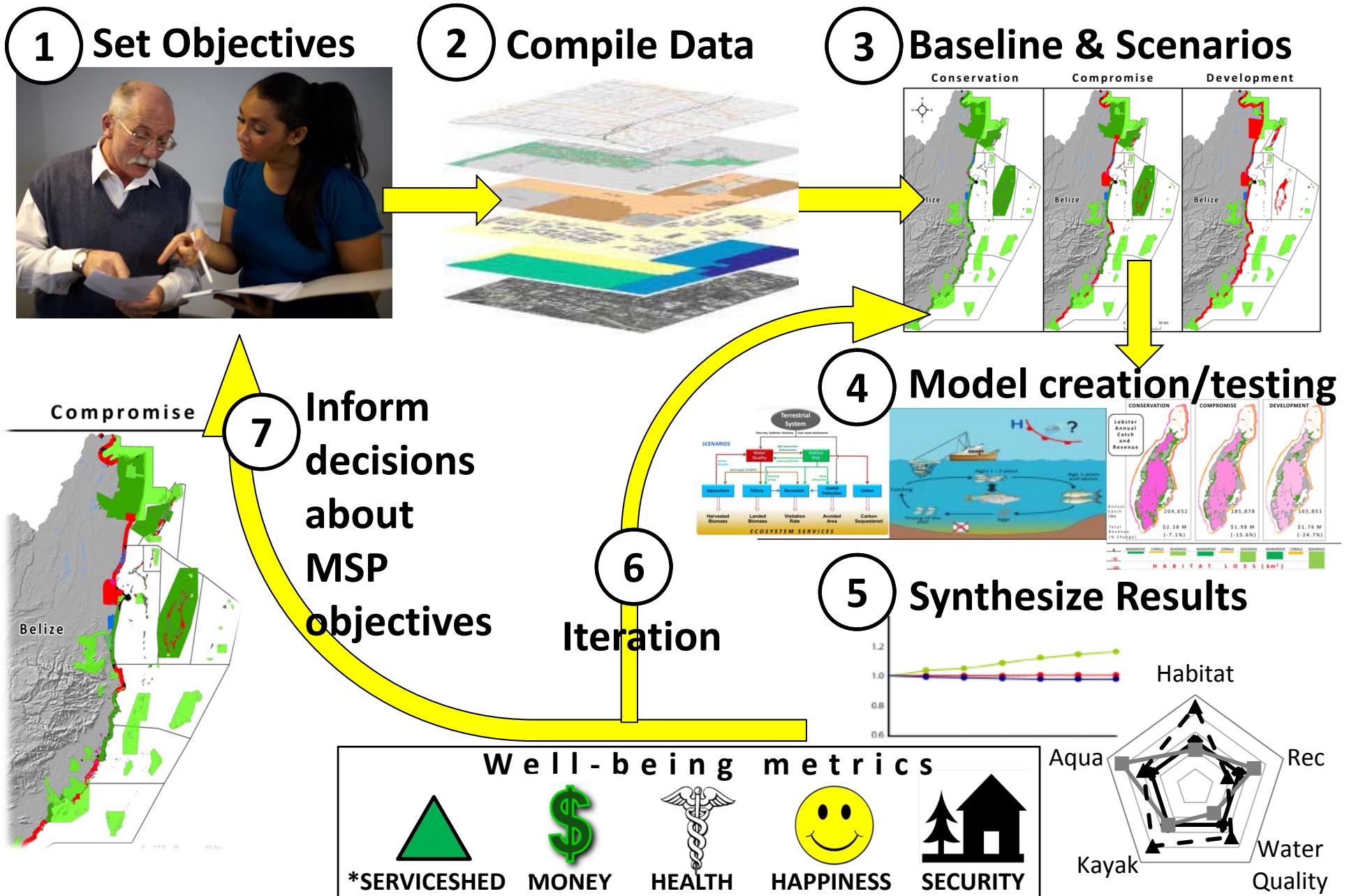
**Carbon Sequestration**



# InVEST Marine Linking Diagram



# Steps for ES Assessment

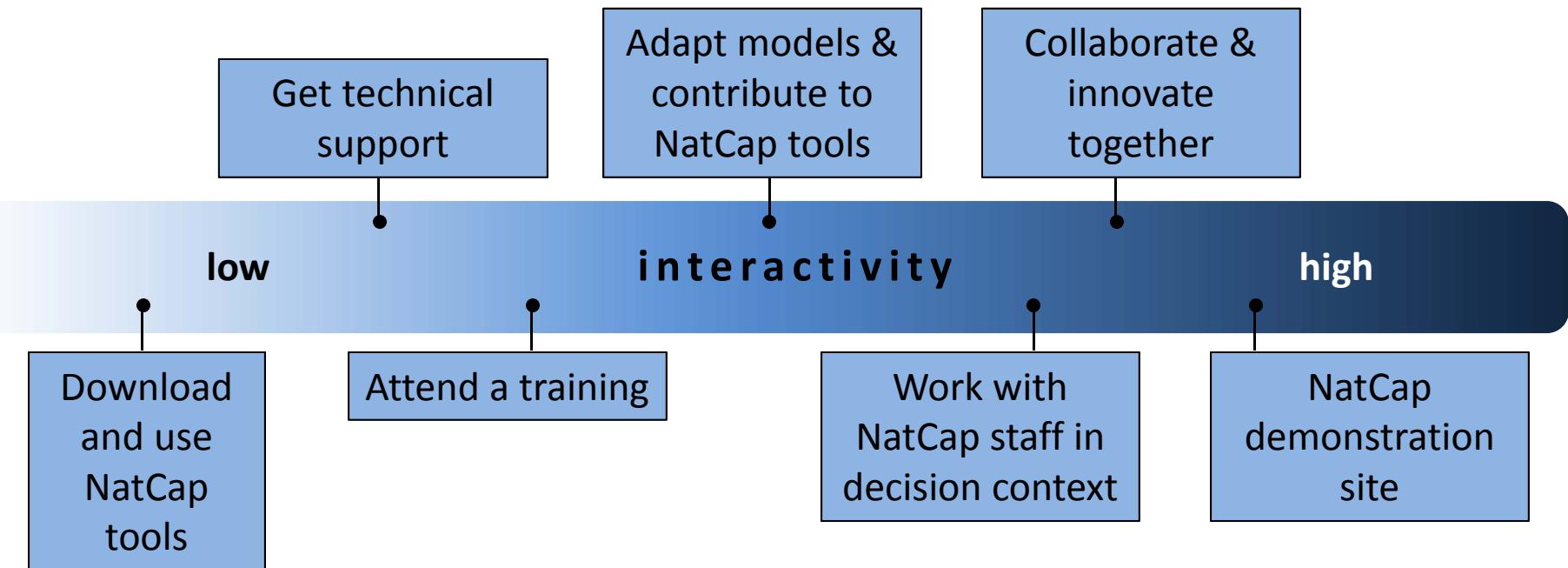


# Take Home Points



1. NatCap interdisciplinary team and approach
2. Many tools available
  - InVEST and RIOS are two examples
3. Our ecosystem framework can help bring together a variety of stakeholders within a decision context, access useful scientific tools, influence decisions

# Spectrum of Engagement



# Clarify expectations



## (-) You will not be an expert in our approach or GIS in six hours

Not possible to learn GIS or spatial modeling in one day

## (+) We can give you an overview of our approach, tools and experience

There are certain groups that have been able to run with it...

# Successful Groups

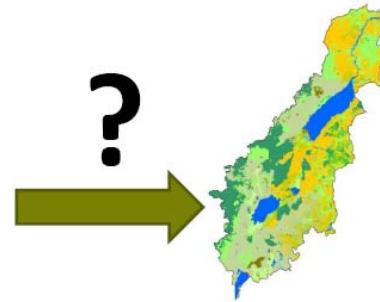
Group Name	Background
<b>Peru</b> J.C. Riveros (WWF Conservation Director)	<b>spatial analysis background;</b> team of spatial analysts.
<b>Colombia</b> Cesar Suarez , WWF	 <b>Very proficient in spatial analysis, strong team.</b> Cesar and J.C. are data and science leaders in the region.
<b>Carribean</b> (Emil Cherington – CATALAC)	 Former GIS analyst in Belize, now at CATALAC in Panama
<b>Viet Nam</b> (Institute of Strategy and Policy on Natural Resources and Environment)	 Policy arm of Ministry of Natural Resources and the Environment in Viet Nam

***Good GIS capacity...industry leader...strong and diverse team***

# NatCap Scenario Generator

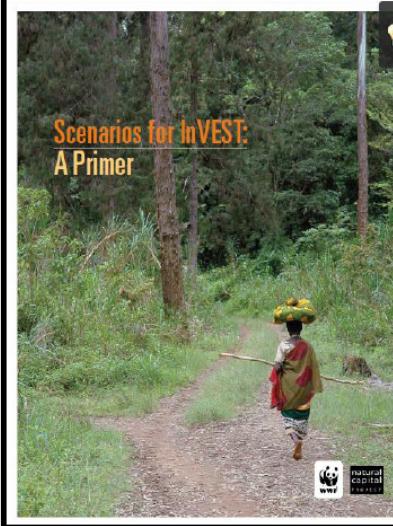
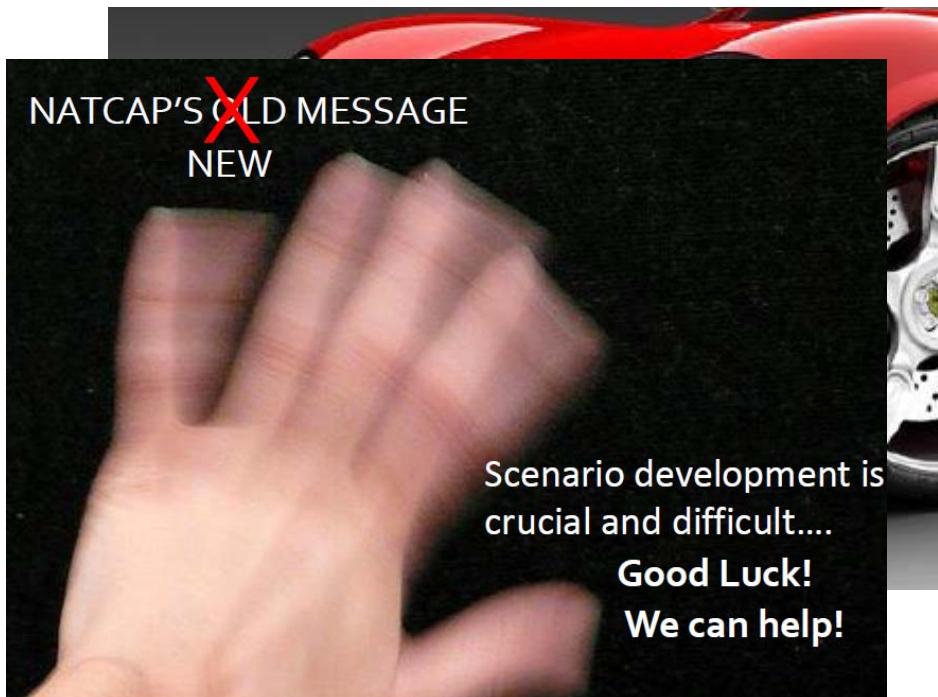
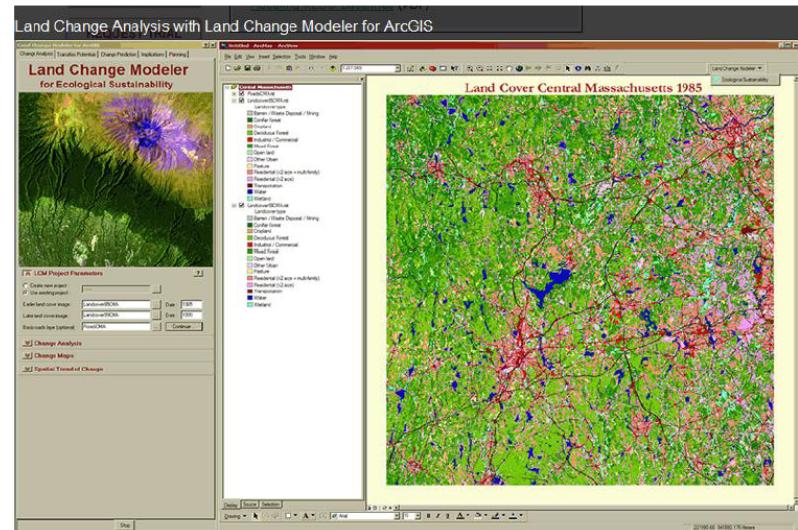
Simple, rule-based software  
Add rules to translate storylines to maps  
Only requires one land-cover map

Landcover Types	Change	Rules
Broadleaved tree plantation	increase	along roads, in poor soils, on hilltops, difficult to cultivate areas, in and around cfrs & lfrs,
Coniferous plantation	increase	along roads, in poor soils, on hilltops, difficult to cultivate areas, in and around cfrs & lfrs,
Tropical high forest	increase	in and around cfrs and lfrs, not in nps
Degraded forest	decrease	in and around cfrs and lfrs, not in nps
Woodland	increase	outside pas



# InSEAM (InVEST Scenario Modeler)

InVEST link to IDRISI Land Change Modeler



Primer

Guide and Case Studies



## Models

- Aesthetic Quality
- Biodiversity
- Carbon
- Coastal Protection
- Coastal Vulnerability
- Crop Pollination
- Habitat Risk Assessment
- Managed Timber Production
- Marine Fish Aquaculture
- Marine Water Quality
- Reservoir Hydropower Production
- Overlap Analysis
- Sediment Retention
- Water Purification
- Wave Energy

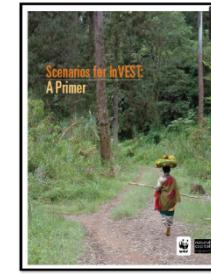
## Resources

- [Download InVEST](#)
- [Users Guide](#)
- [Training Videos](#)
- [InVEST Trainings](#)

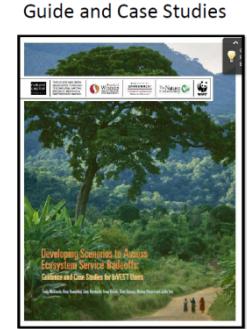
# Website and other Resources

## Free content

- scenario tools and guidance
- scientific guide & users manual
- demonstrations sub-pages
- support forum & training videos



Primer



Guide and Case Studies

## InVEST-U (coming soon!)

- online training
  - teach how to use InVEST
- without attending a training



**Timber**  
[Users Guide](#)  
[Training Video](#)  
  
Model Outputs  
Amount of Timber

### Managed Timber Production Model

The Managed Timber Production Model analyzes the net present value of legal timber harvests over user-defined time intervals. Based on timber harvest prices, extraction and management costs and a discount rate, the model estimates the economic value of the timber production process. This information serves timber companies, governments and communities in determining ways to sustain timber supply while maximizing the economic benefits of its removal.



**Learn More**  
[InVEST User's Guide chapter on the Managed Timber Production Model](#).  
[Training video](#) on the Managed Timber Production Model presented by Shan Ma, an economist at the Natural Capital Project.





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PROJECT



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