The Natural Capital Project

Putting ecosystem services on the map

OAS, 16 June, 2009

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Ecosystem Services







- Links nature to human welfare
- Full accounting of costs and benefits
- Conservation could pay for itself?

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Appropriate scales for decisions

GLOBAL, SYNTHETIC

60% of global ES in decline (Millennium Assessment)

$33 Trillion/y (Costanza et al. 1997 Nature)

NEEDED
- region/landscape scale
- scenario based
- spatially explicit
- multiple services

LOCAL, SPECIFIC

2 forest patches: $60K/year (Ricketts et al. 2004. PNAS)

22 others (just for pollination!)

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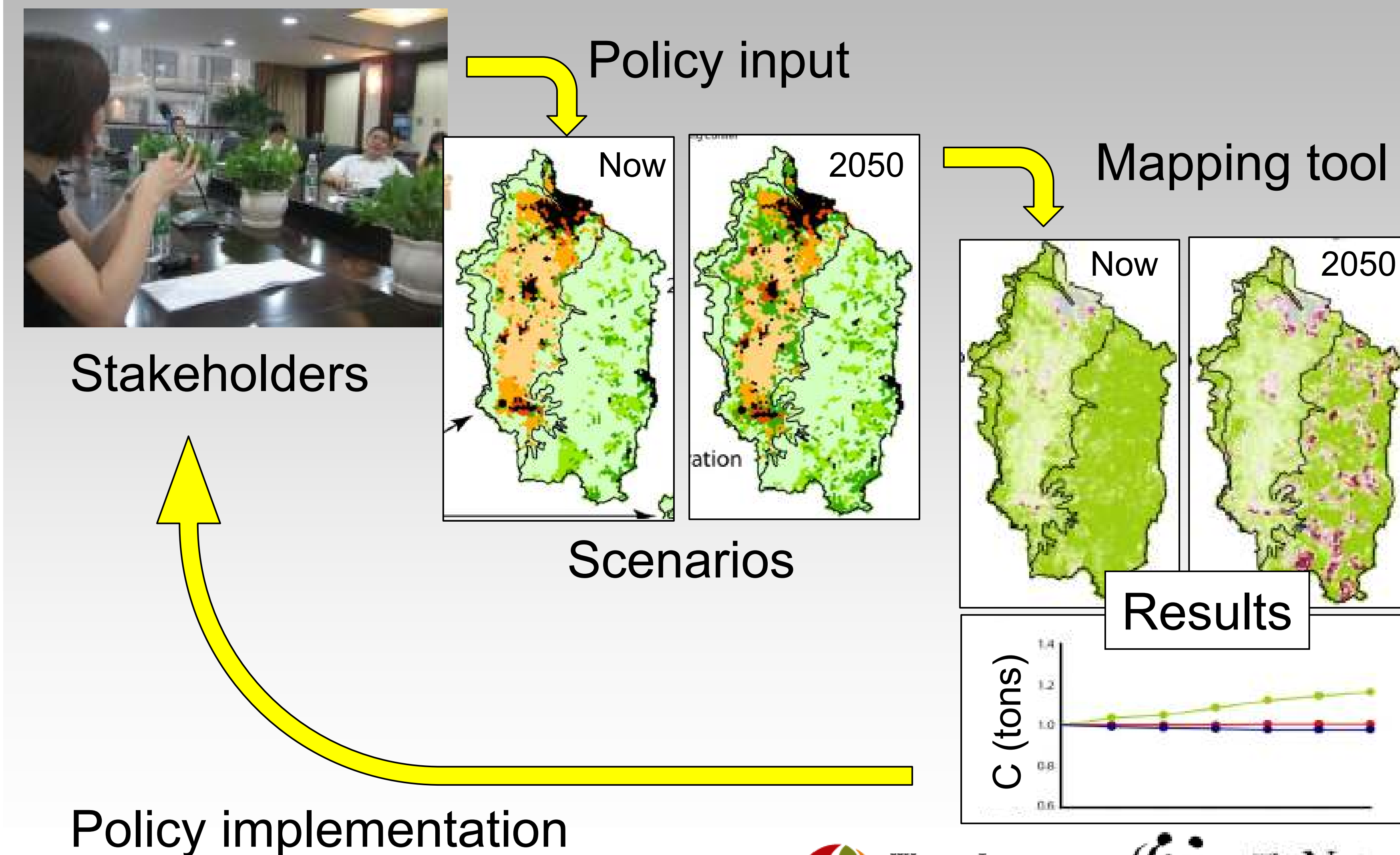
Make conservation economically attractive

- Develop science and policy tools to address ecosystem services
- Apply tools in important places
- Support policies to maintain / pay for services
- Change the way ecosystems are viewed

NatCap within decision making



Decision-maker questions

– Where are ecosystem services supplied?

– How would a proposed dam or logging project affect different ecosystem services and biodiversity?

– What landscape pattern would optimize ecosystem services now and under likely scenarios?

– Who should pay whom under a proposed PES program, and how to scale it up?

ANSWERS:
landscape-scale, multi-service assessments

Information for policies & payments

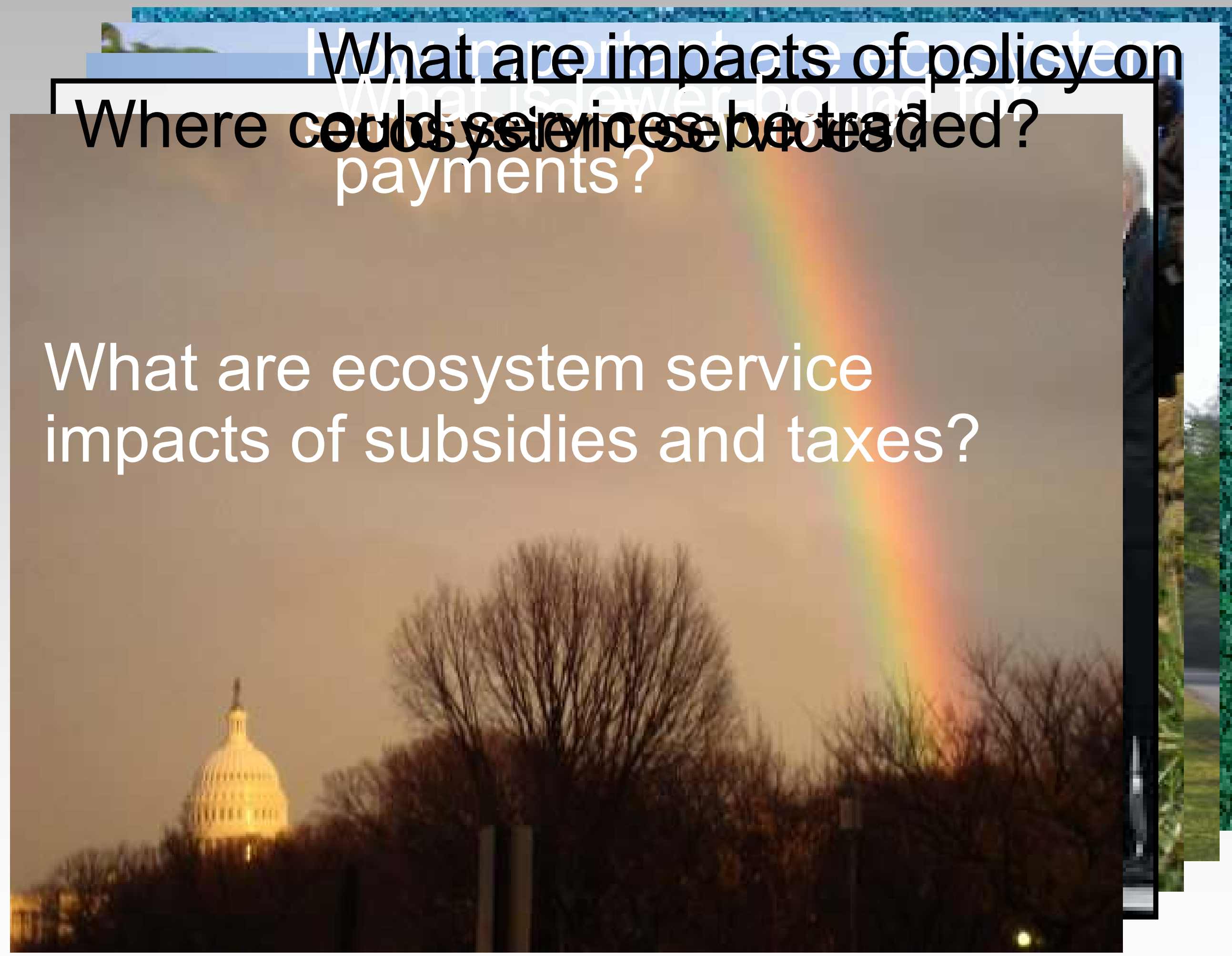
Advocacy

Regulations

Payments

Markets

Fiscal incentives



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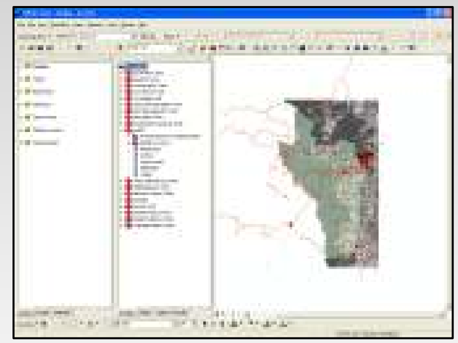
InVEST: Key features

- Biodiversity and multiple services
- Biophysical or (first estimate) economic values
- Spatially explicit (mapped)
- Tiered design: simple or complex
- Driven by management scenarios
- Free and open source

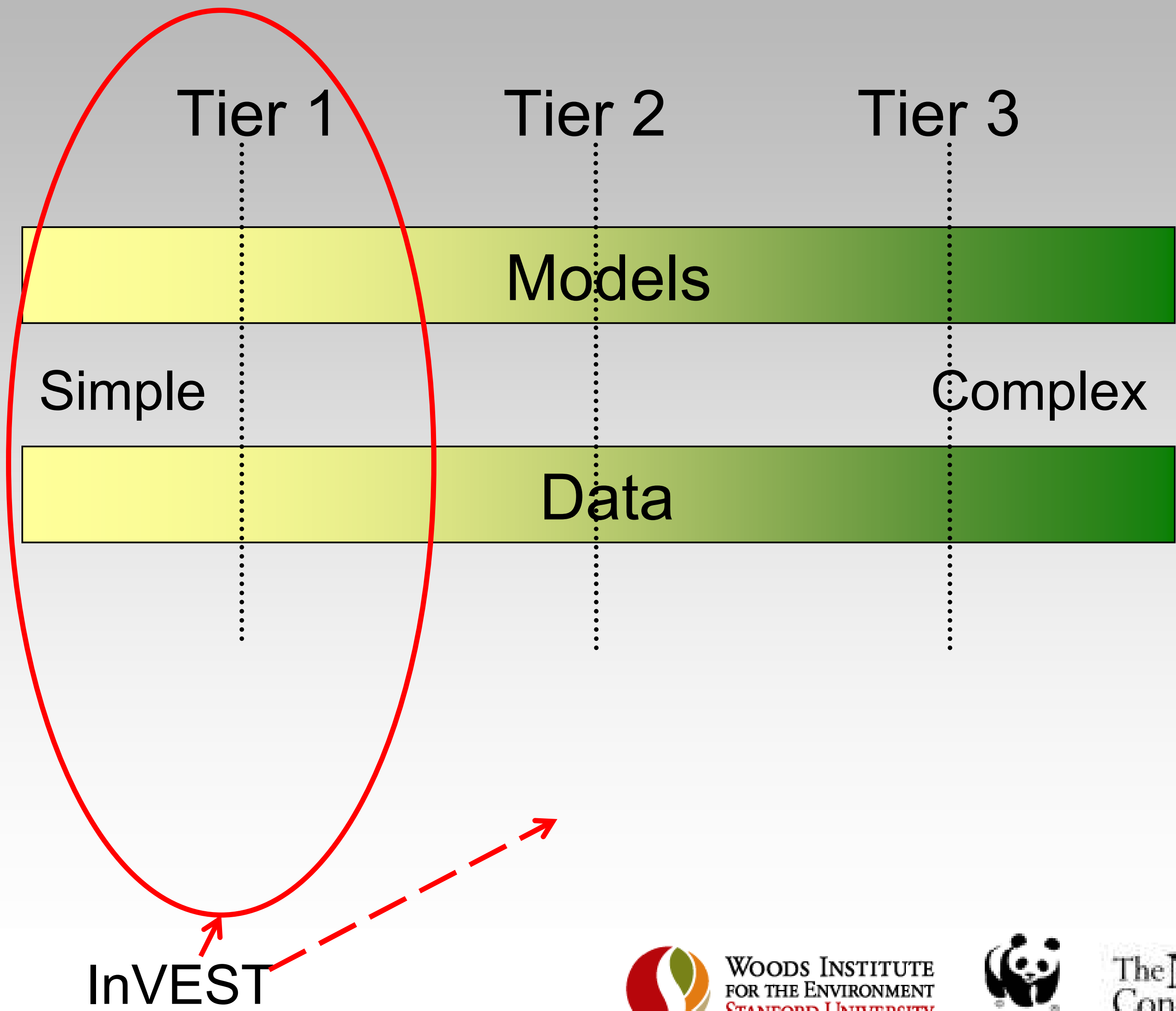
http://invest.ecoinformatics.org



InVEST: Which services?

- Biodiversity
- Ecosystem services
  - Carbon sequestration
  - Sediment retention
  - Water quality
  - Open-access harvest
  - Native pollination (for ag)
  - Commercial timber production
  - Flood control
  - Hydropower
  - Irrigation water (for ag)
  - Agricultural production
  - Recreation and tourism
  - Cultural and aesthetic values

Tiered Approach



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InVEST within ArcGIS

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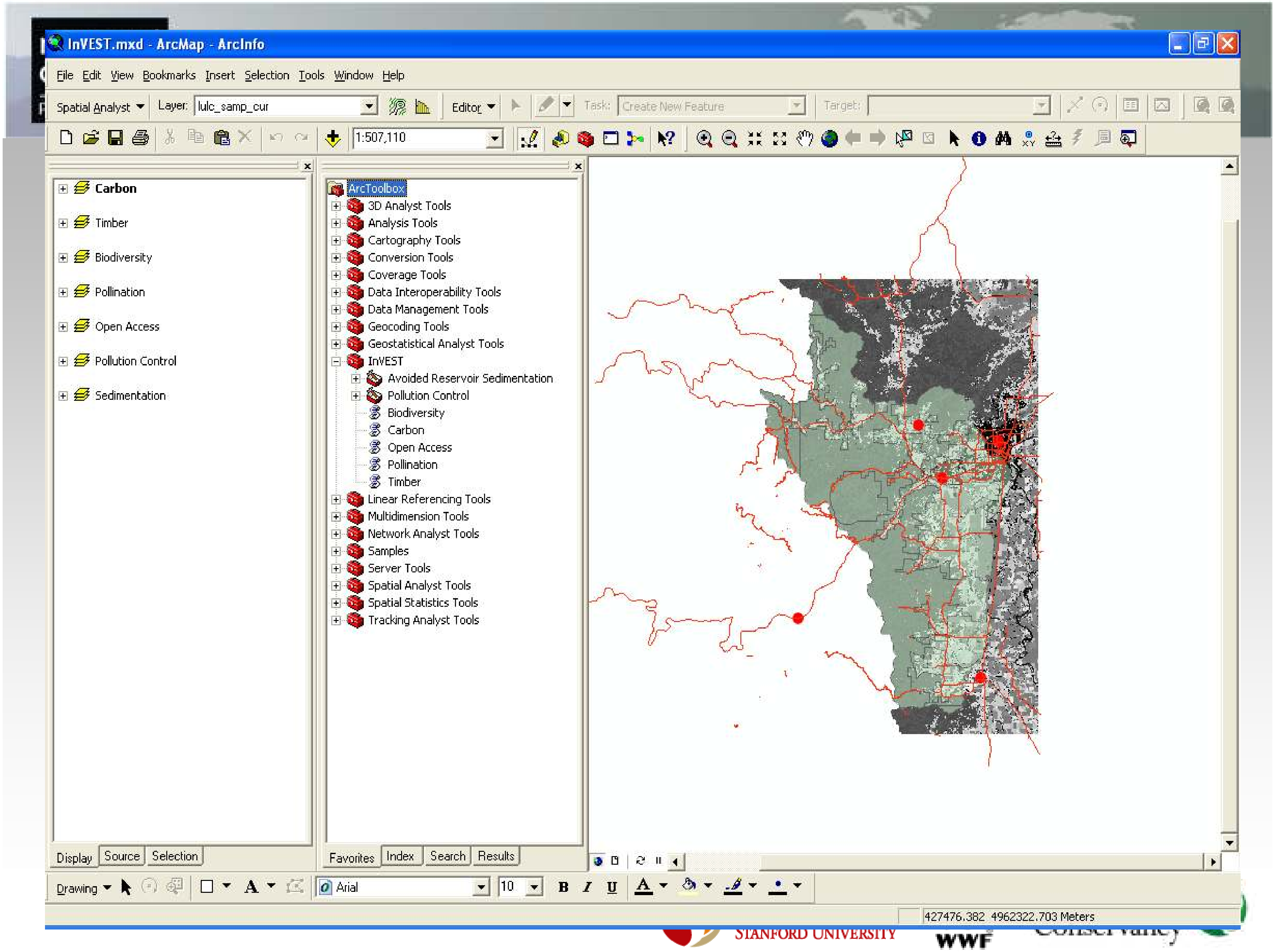
InVEST.mxd - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Tools Window Help
Spatial Analyst
Layer: lulc_samp_cur
Editor
Task: Create New Feature
Target:
1:507,110
Carbon
Timber
Biodiversity
Pollination
Open Access
Pollution Control
Sedimentation
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Coverage Tools
Data Interoperability Tools
Data Management Tools
Geocoding Tools
Geostatistical Analyst Tools
InVEST
Avoided Reservoir Sedimentation
Pollution Control
Biodiversity
Carbon
Open Access
Pollination
Timber
Linear Referencing Tools
Multidimension Tools
Network Analyst Tools
Samples
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
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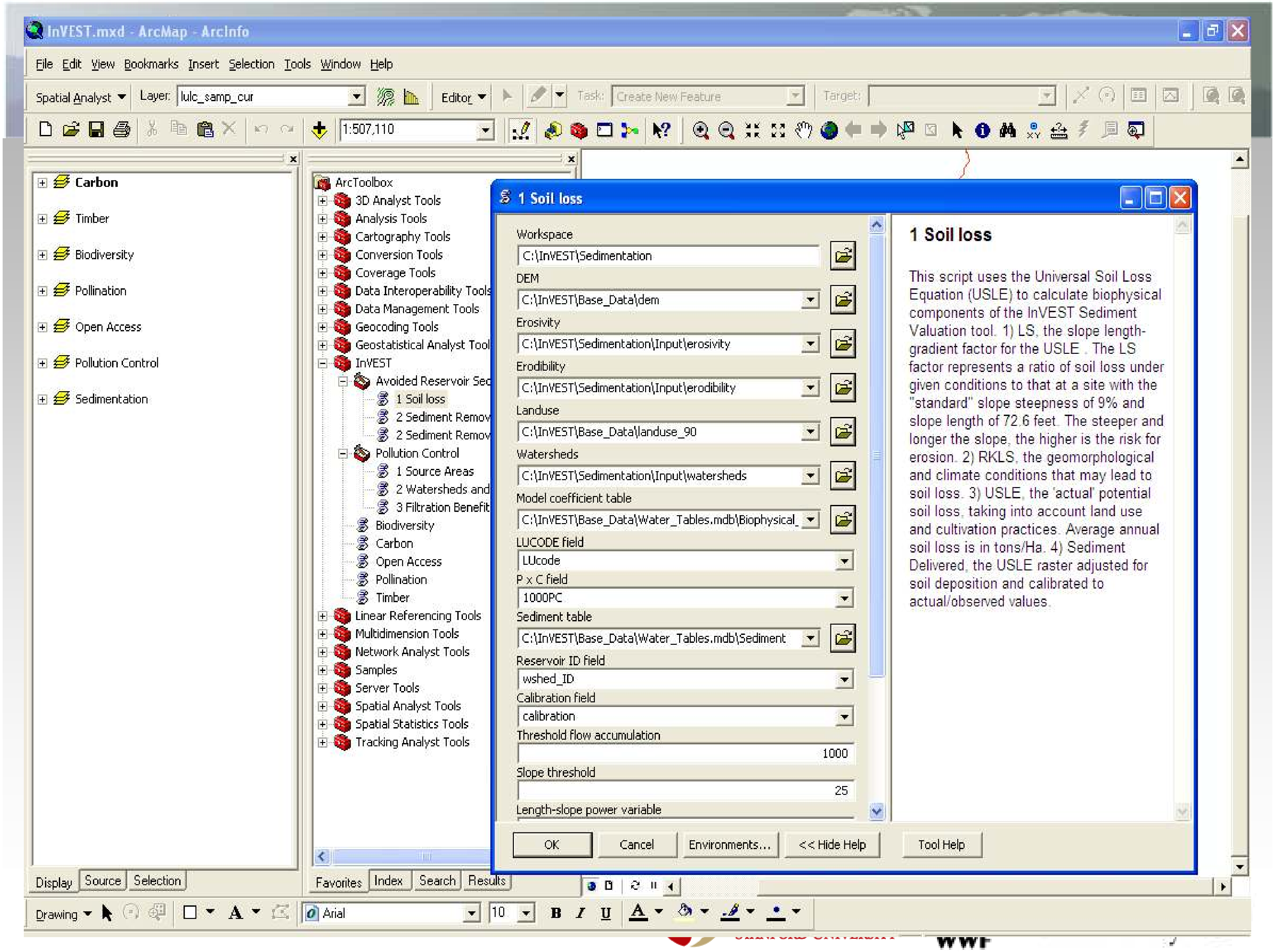
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InVEST
Avoided Reservoir Sec
1 Soil loss
2 Sediment Remov
2 Sediment Remov
Pollution Control
1 Source Areas
2 Watersheds and
3 Filtration Benefit
Biodiversity
Carbon
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Pollination
Timber
Linear Referencing Tools
Multidimension Tools
Network Analyst Tools
Samples
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools
Display Source Selection
Favorites Index Search Results
1 Soil loss
Workspace
C:\InVEST\Sedimentation
DEM
C:\InVEST\Base_Data\dem
Erosivity
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Erodibility
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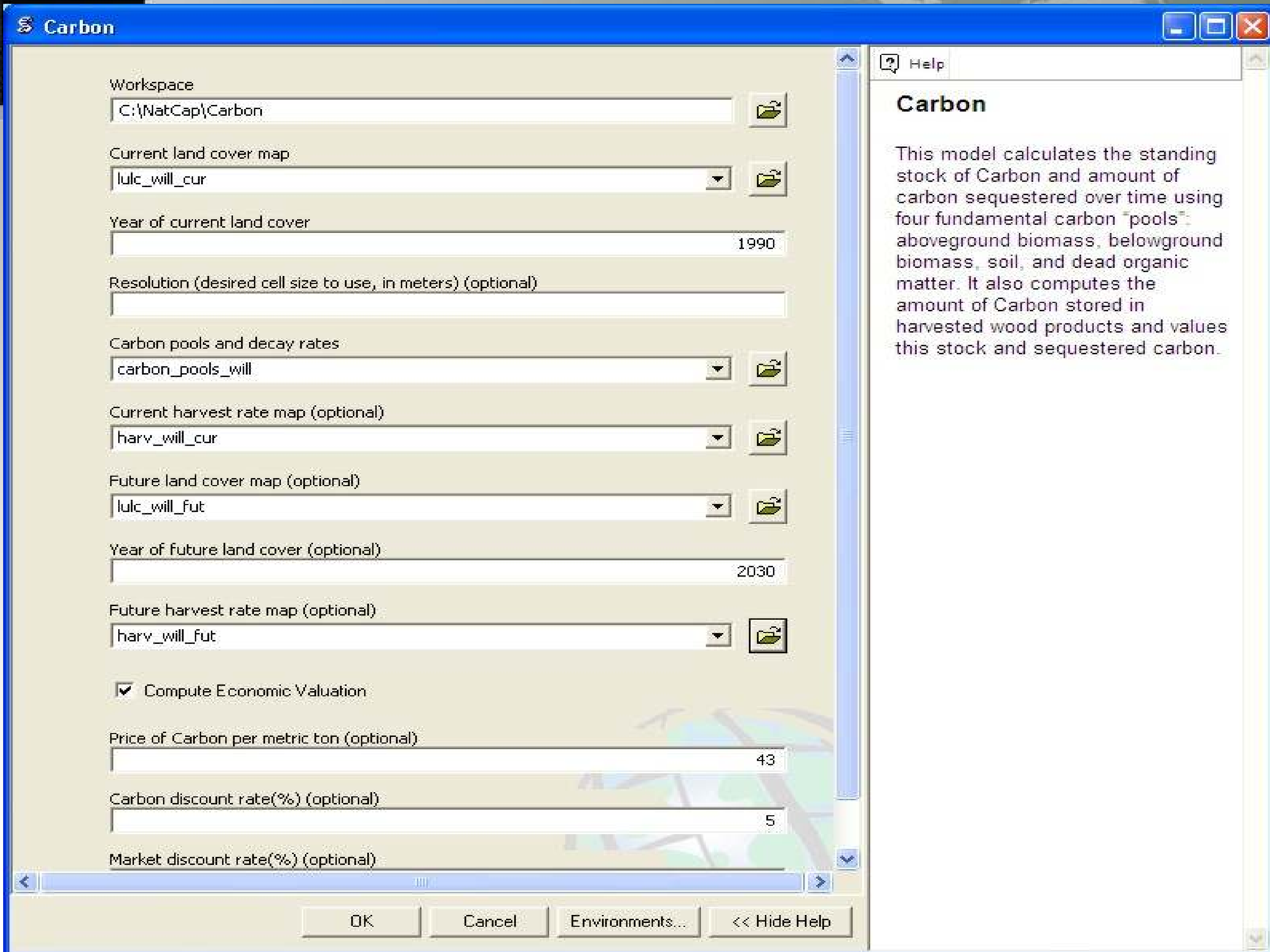
Landuse
C:\InVEST\Base_Data\landuse_90
Watersheds
C:\InVEST\Sedimentation\Input\watersheds
Model coefficient table
C:\InVEST\Base_Data\Water_Tables.mdb\Biophysical_
LUCODE field
LUcode
P x C field
1000PC
Sediment table
C:\InVEST\Base_Data\Water_Tables.mdb\Sediment
Reservoir ID field
wshed_ID
Calibration field
calibration
Threshold flow accumulation
1000
Slope threshold
25
Length-slope power variable
OK Cancel Environments... << Hide Help Tool Help
1 Soil loss
This script uses the Universal Soil Loss Equation (USLE) to calculate biophysical components of the InVEST Sediment Valuation tool. 1) LS, the slope length-gradient factor for the USLE . The LS factor represents a ratio of soil loss under given conditions to that at a site with the "standard" slope steepness of 9% and slope length of 72.6 feet. The steeper and longer the slope, the higher is the risk for erosion. 2) RKLS, the geomorphological and climate conditions that may lead to soil loss. 3) USLE, the 'actual' potential soil loss, taking into account land use and cultivation practices. Average annual soil loss is in tons/Ha. 4) Sediment Delivered, the USLE raster adjusted for soil deposition and calibrated to actual/observed values.
Drawing
Arial
10



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Attributes of lulc_samp_cur

Rowid	VALUE *	COUNT	DESCRIPTION	LULC_GROUP
40	79	6447	79_Row crop	Ag
41	80	14318	80_Grass	Ag
42	81	386	81_Burned grass	Ag
43	82	22685	82_Field crop	Ag
44	83	47470	83_Hayfield	Ag
45	84	3652	84_Late field crop	Ag
46	85	96698	85_Pasture	Ag
47	86	17226	86_Natural grassland	Unkn
48	87	98374	87_Natural shrub	Unkn
49	88	9610	88_Bare/fallow	Ag
50	89	7073	89_Flooded/marsh	Water
51	90	15323	90_Irrigated perennial	Ag
52	91	3562	91_Turfgrass	Ag
53	92	14262	92_Orchard	Ag
54	93	16250	93_Christmas trees	Forest
55	95	594	95_Conifer Woodlot	Forest

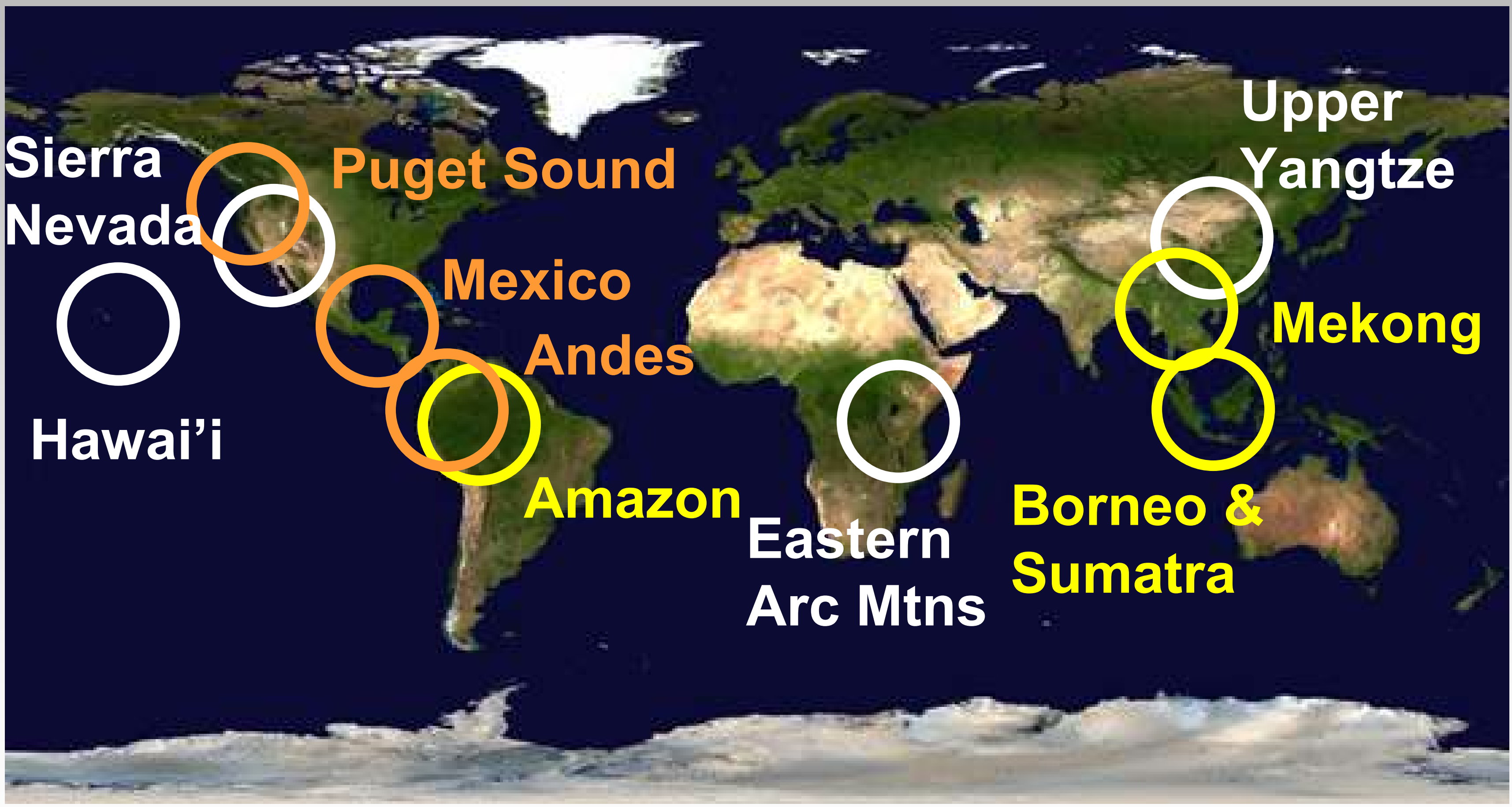
Record: 1 Show: All Selected Records (0 out of 56 Selected) Options

Attributes of Sediment

ID *	wshed_ID *	rem_cost	time_period	discount_rate	calibration
2	0	24	10	5	1
3	1	30	20	5	1
4	2	42	30	5	1

Record: 1 Show: All Selected Records (0 out of 3 Selected) Options

InVEST sites



- test InVEST with field partners and experts
- ensure useful, relevant

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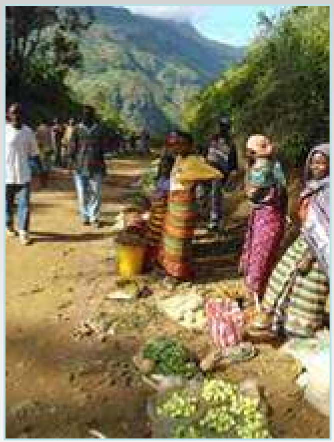
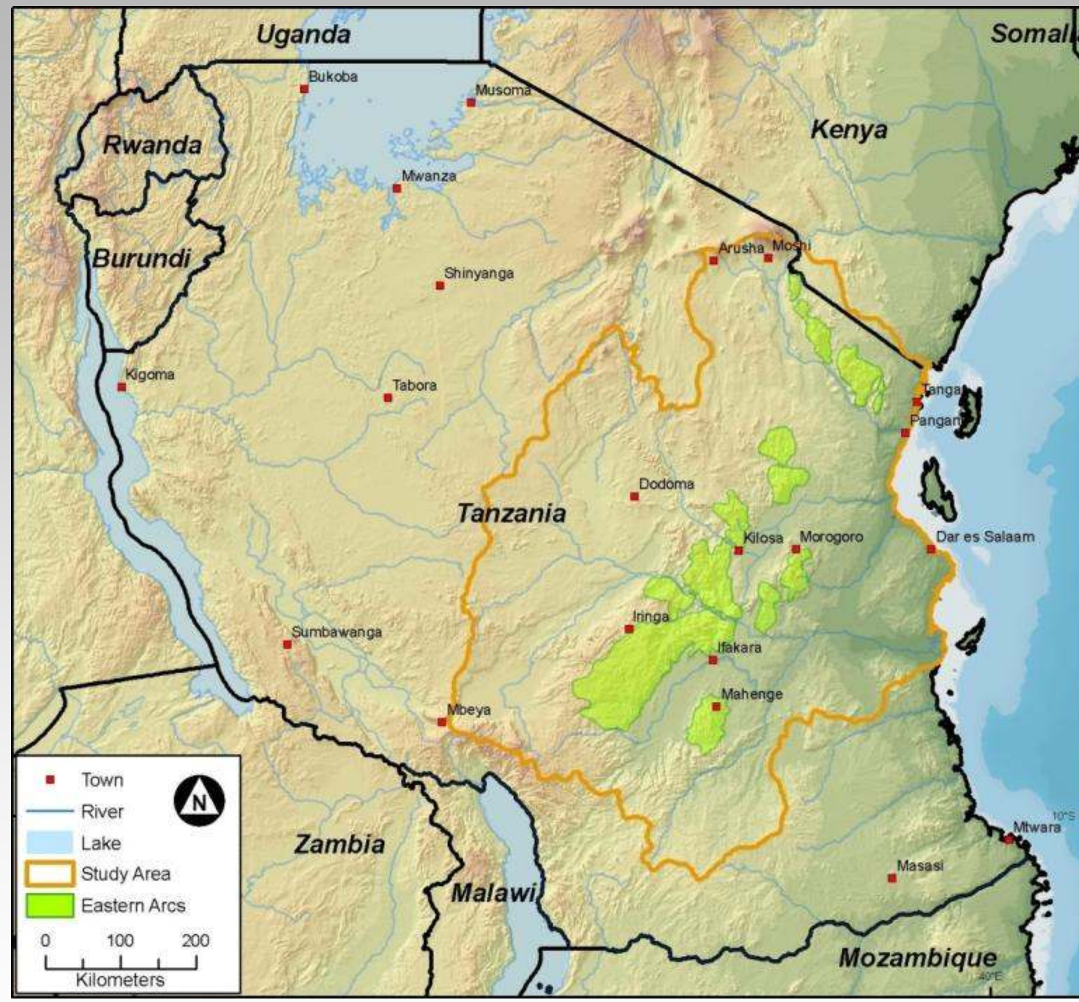
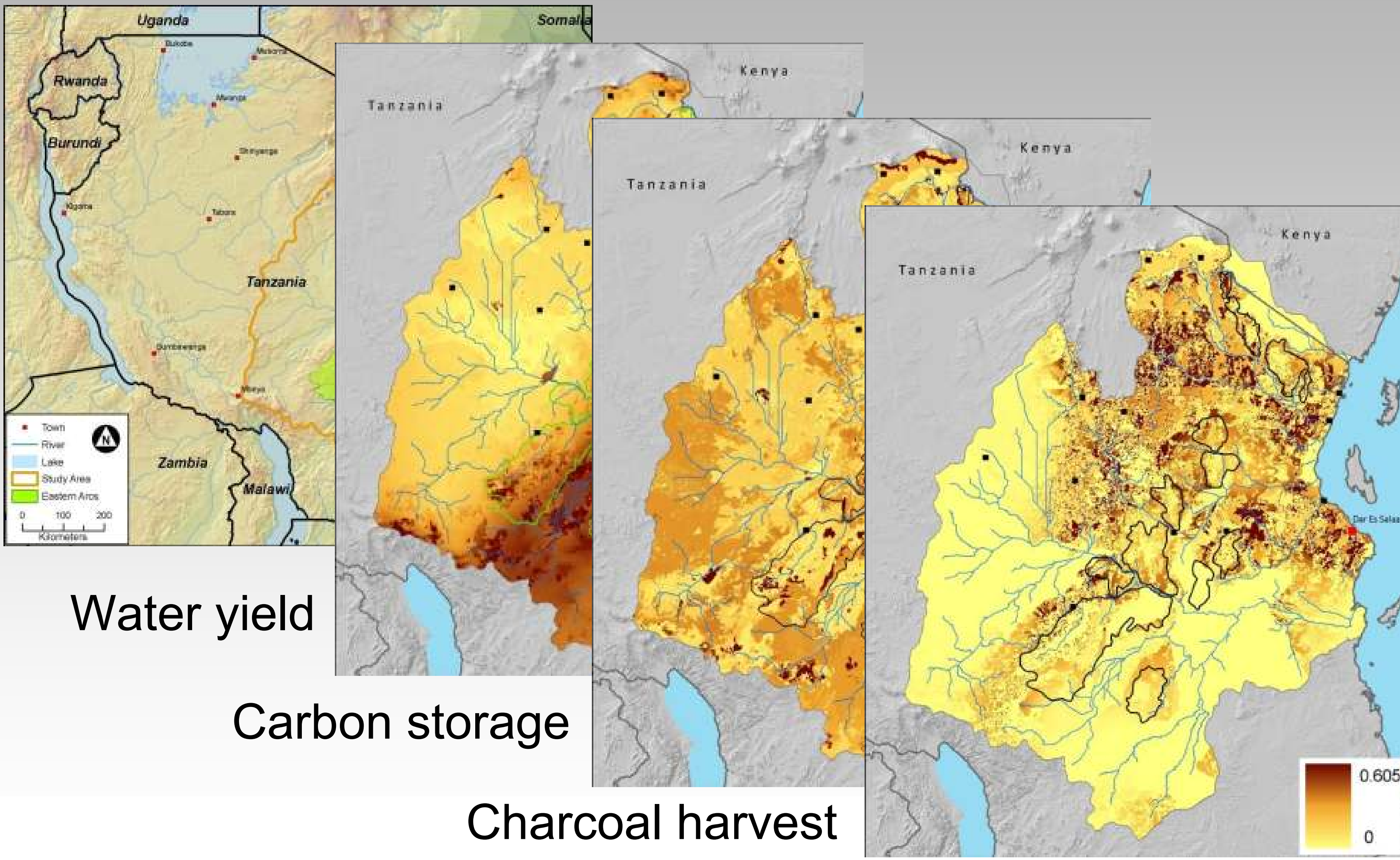
Example: “Valuing the Arc”





Current ecosystem services

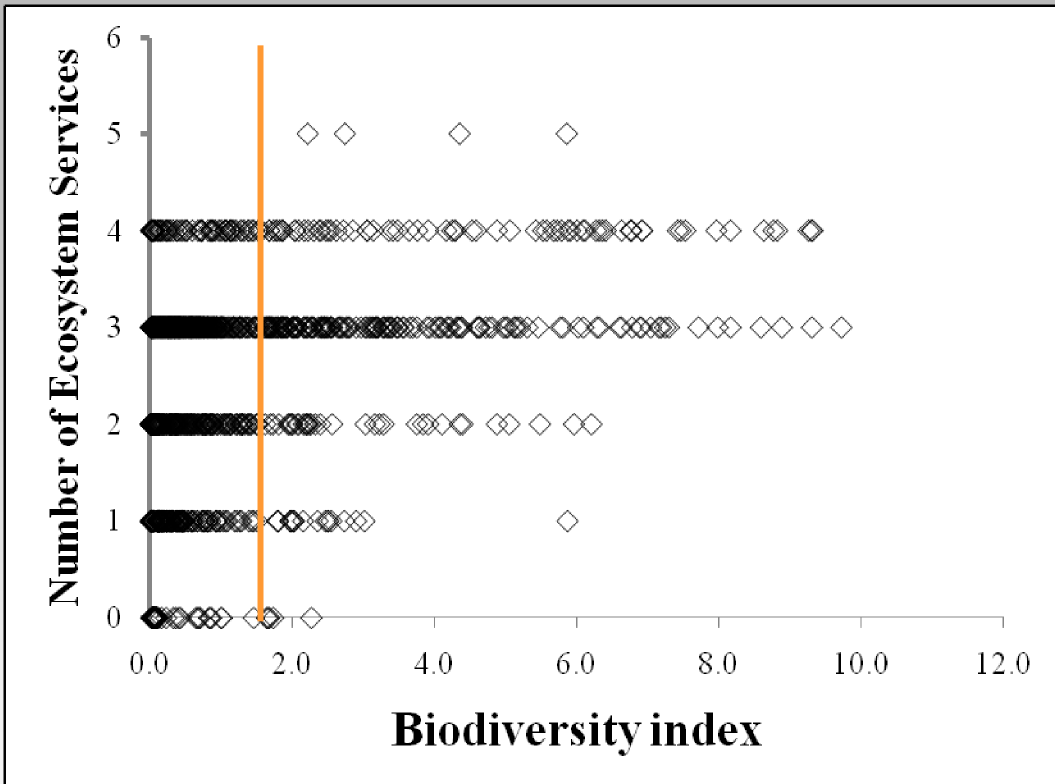


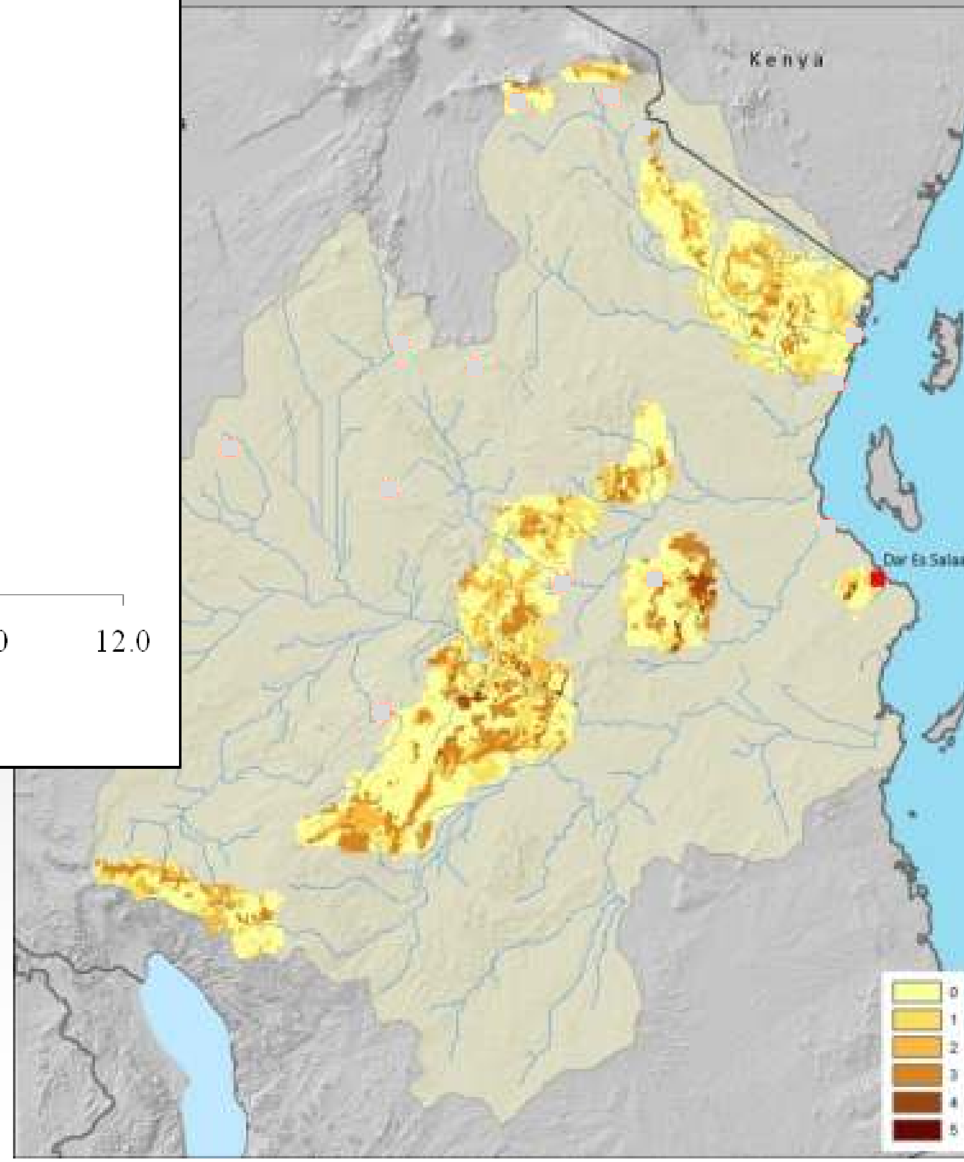
Water yield

Carbon storage

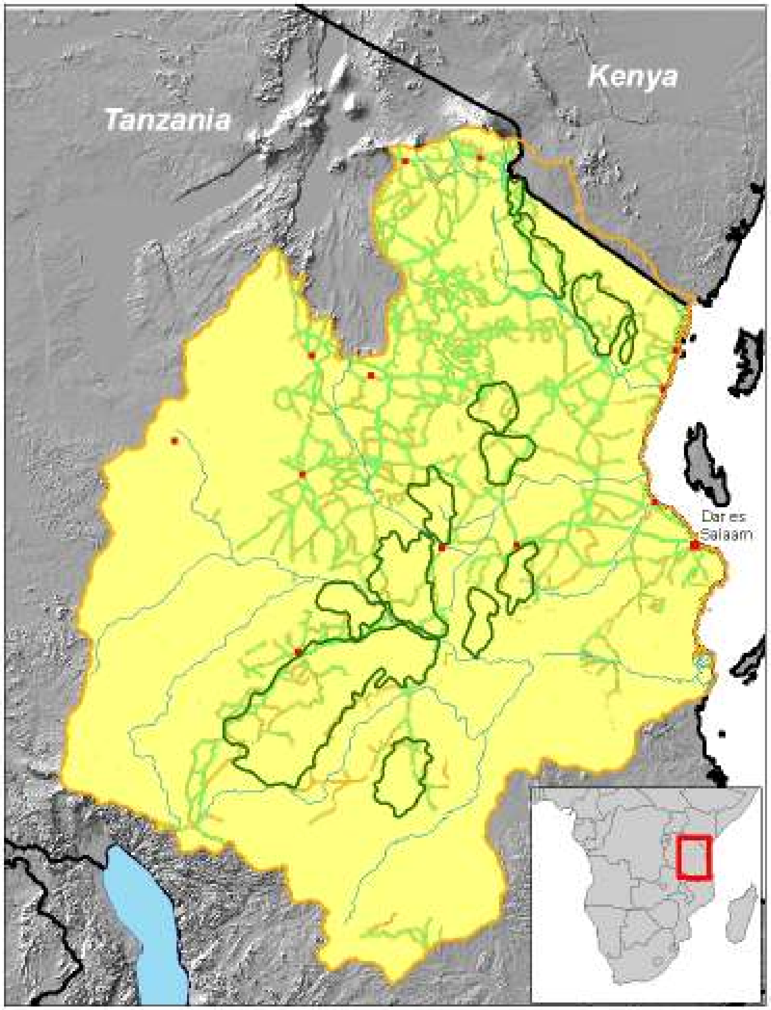
Charcoal harvest

Compare to biodiversity

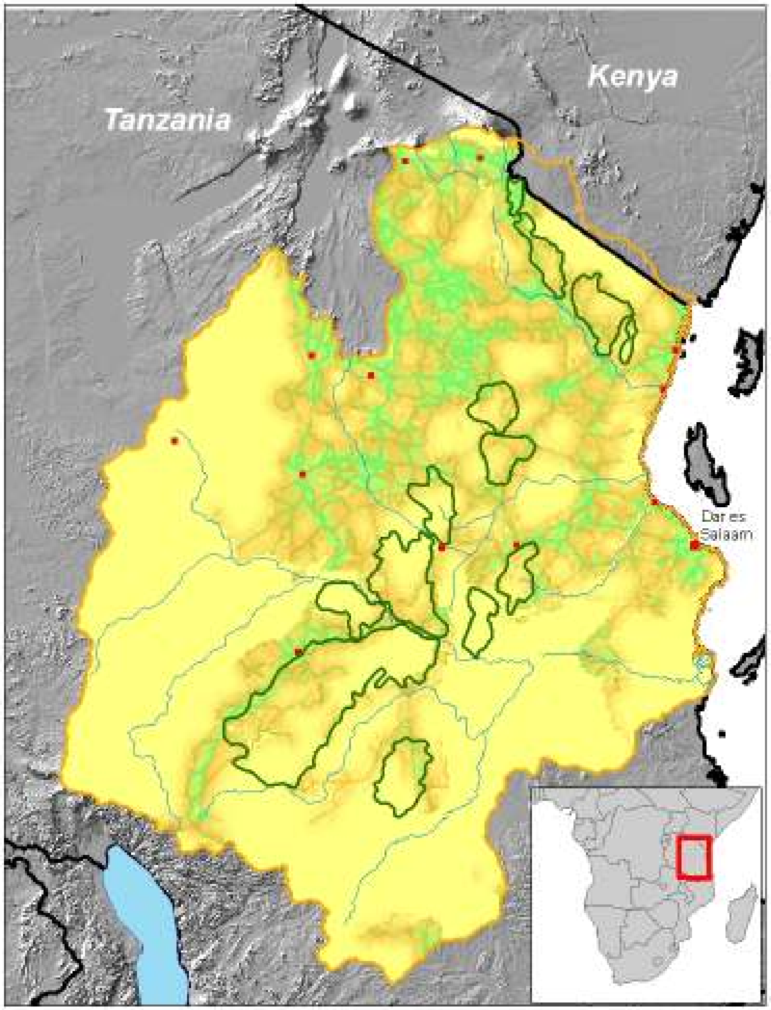




Assumptions matter!



Firewood - 5km access



Firewood - 40km access

Future scenarios

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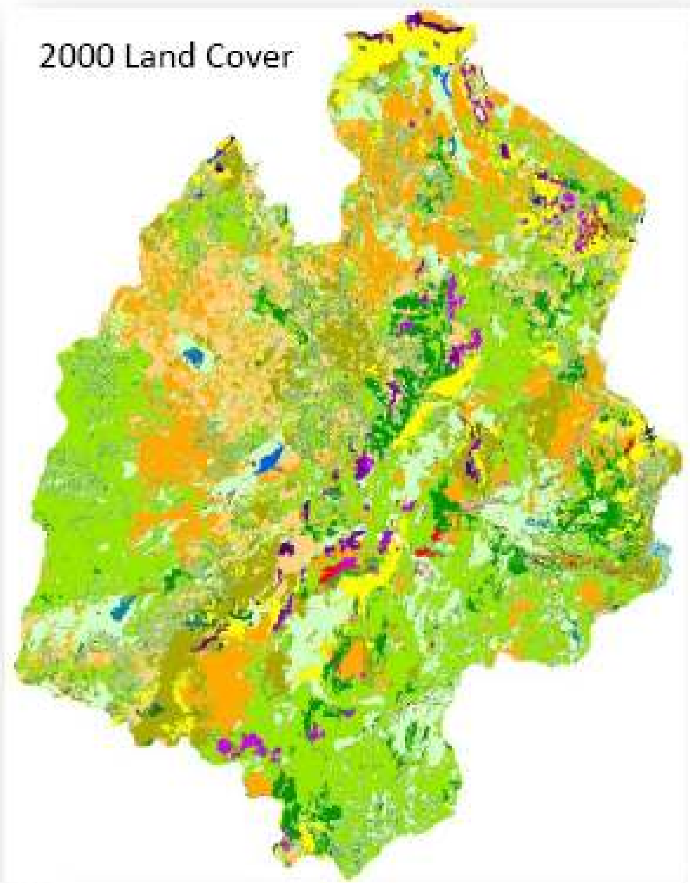
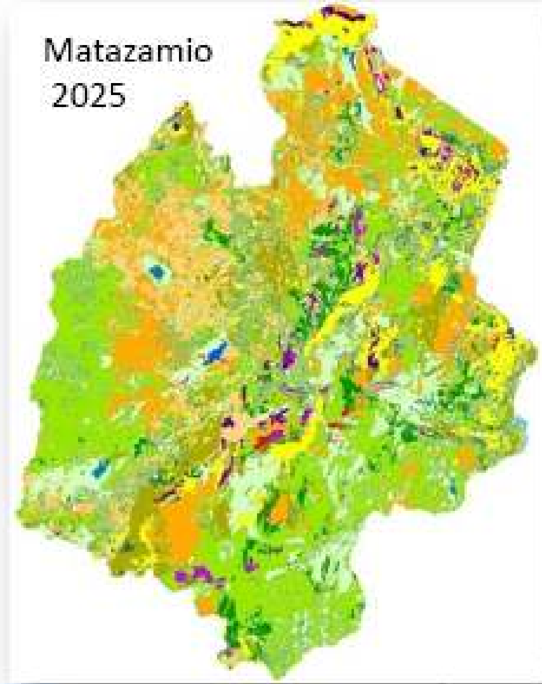
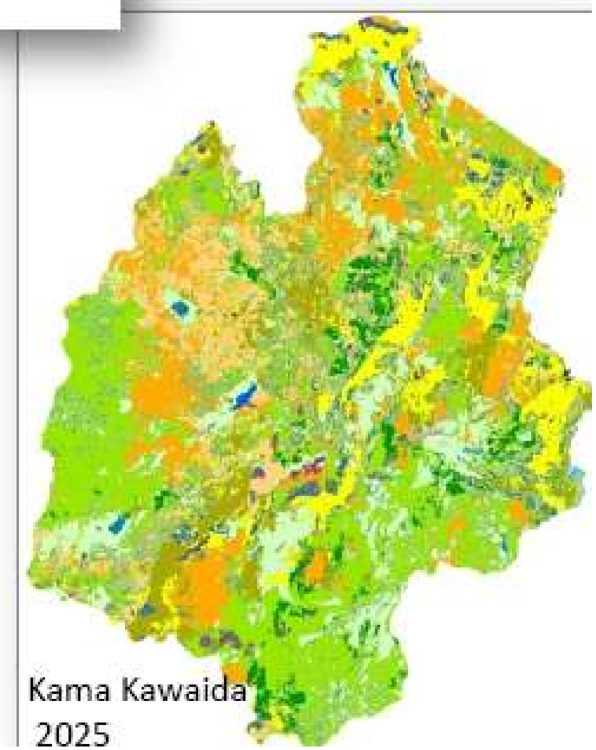
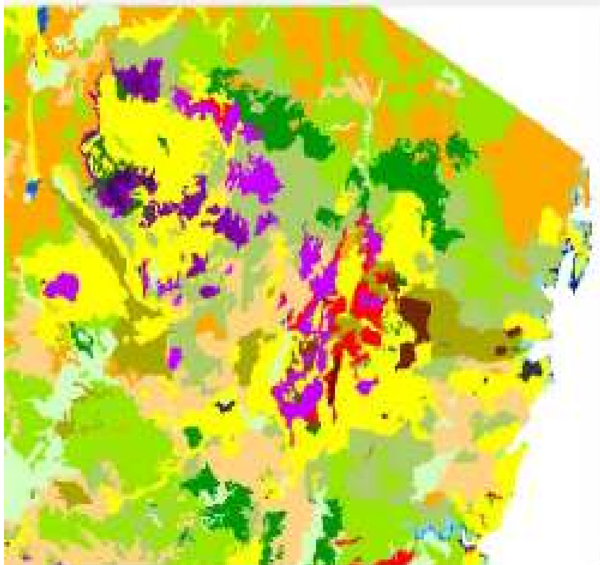




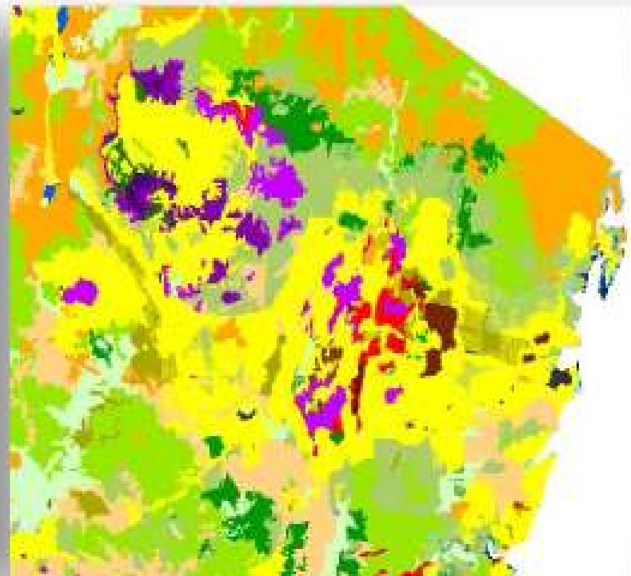


Detailed examples of scenarios of change

Land cover 2000



Matazamio 2025



Kama Kawaida 2025

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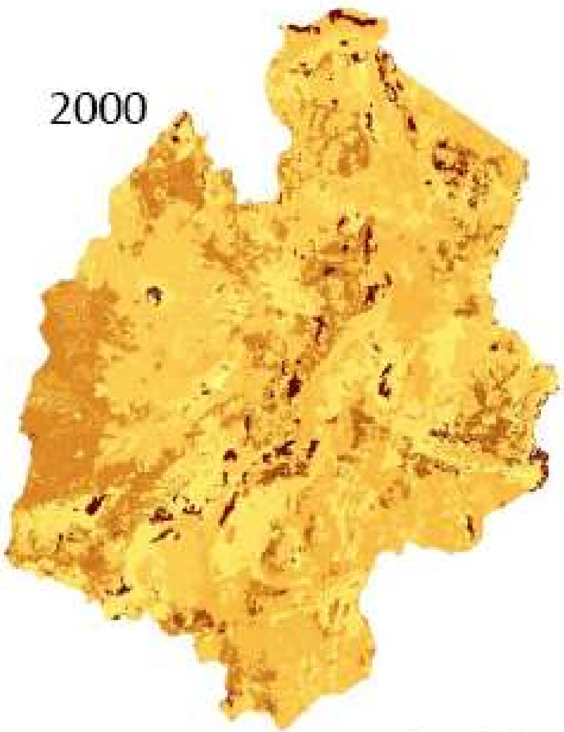
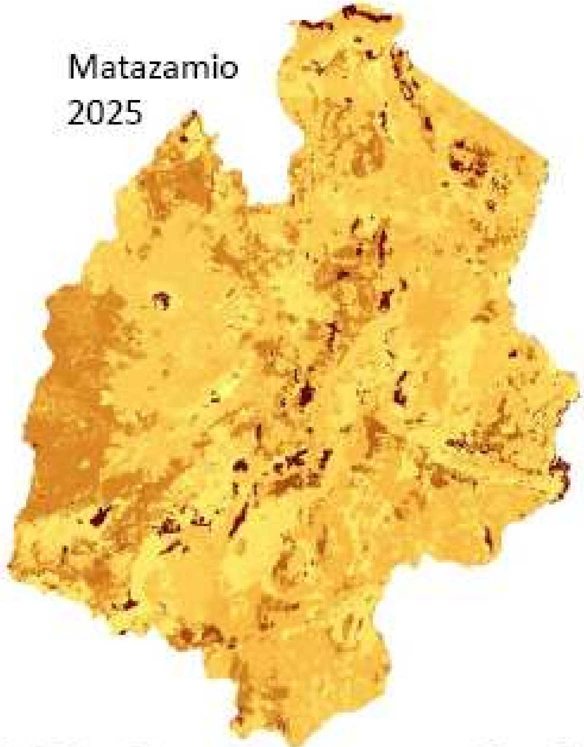
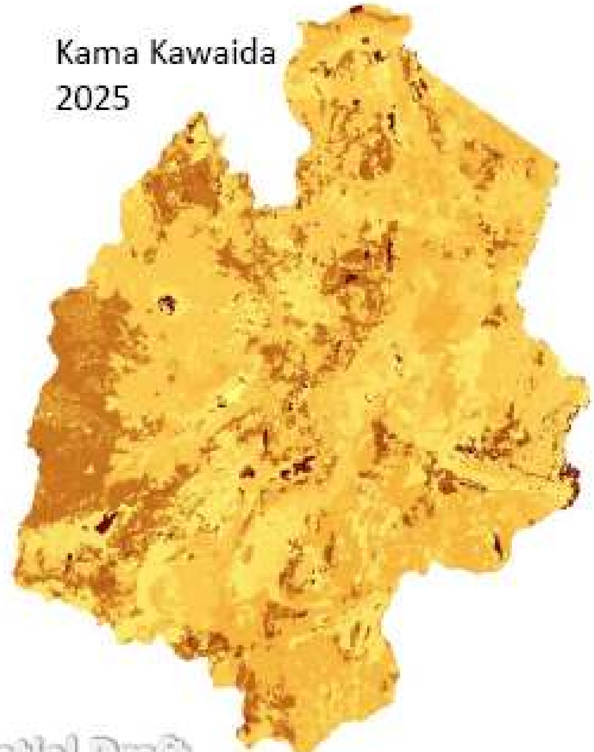
2000



Matazamio
2025



Kama Kawaida
2025



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2.86^{9} t/C
2,864,239,183 t/C

LOSS

-3.26^{7} t/C
or **-1.14%** of 2000 value

LOSS

-18.27^{7} t/C
or **- 6.38%** of 2000 value

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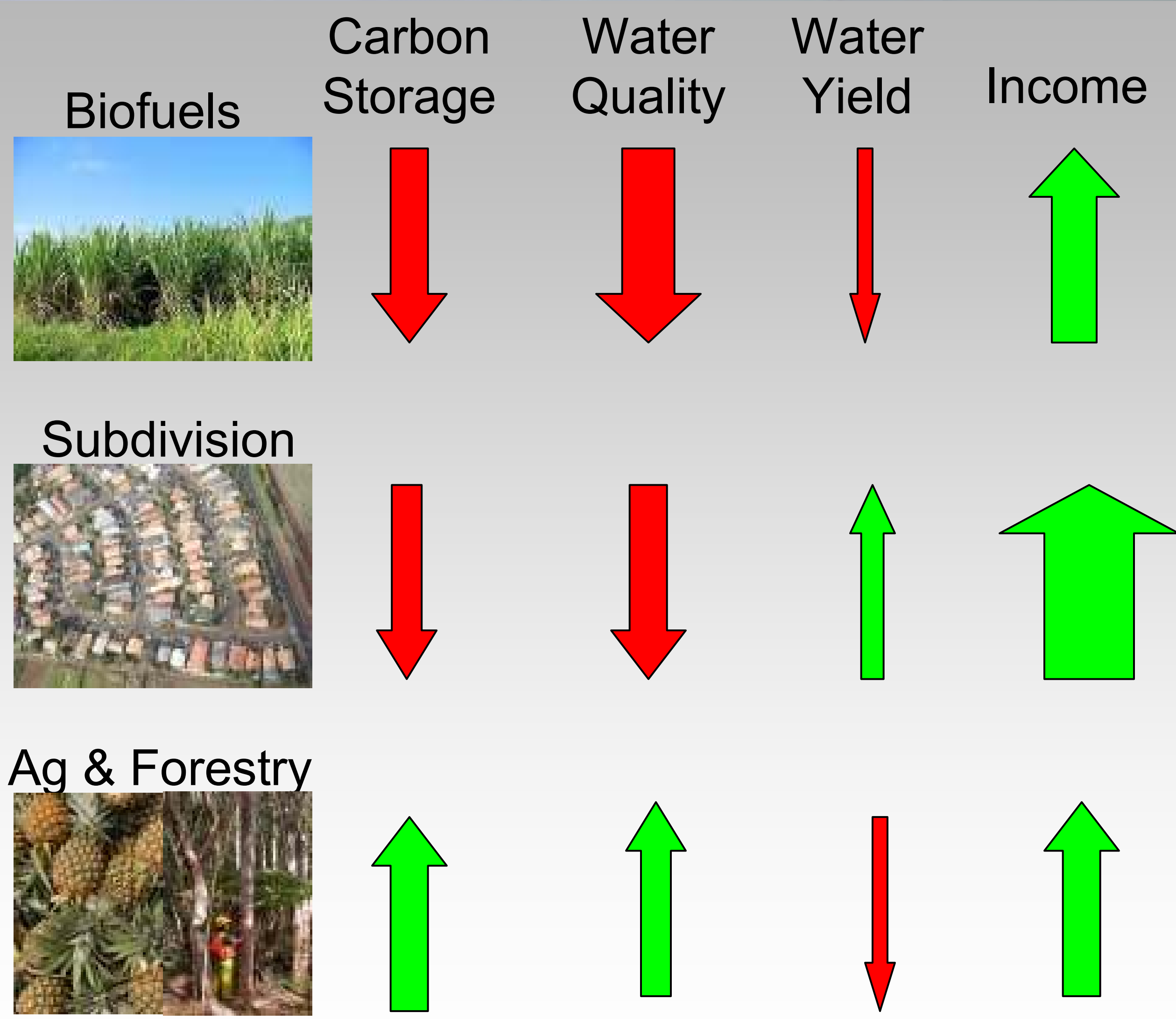
Land-use planning in Hawaii



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Another example: Colombia

- Government grants licenses for industrial and extractive sectors
- Permit conditions now based on ecosystem service impacts
- System of compensation for unavoidable impacts

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California

Change in 4 services over climate change scenarios:

- Forage production
- Carbon sequestration
- Recreational skiing
- Salmon fisheries

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What do policy-makers still want?

- Distributional information
- Measures of uncertainty
- Opportunity costs
- Trade-off analysis
- Temporal dynamics
- Valuation (or not…)

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What do practitioners want?

- Available data
- Builds local capacity
- Visually appealing

- Quick and cheap and easy
- Not always relying on external consultants

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Lessons – what leads to success?

- Long-term stakeholder engagement
- Framing analyses as stories through scenarios
- Finding political openings
- Effective communication

Scoping opportunities: Screening Criteria

- Will it deliver service & conservation?
- Are conditions supportive?

Criteria	Project A	Project B
1		
2		
3		
4		
5		
…		

Strong opportunity

High risk

Information gap

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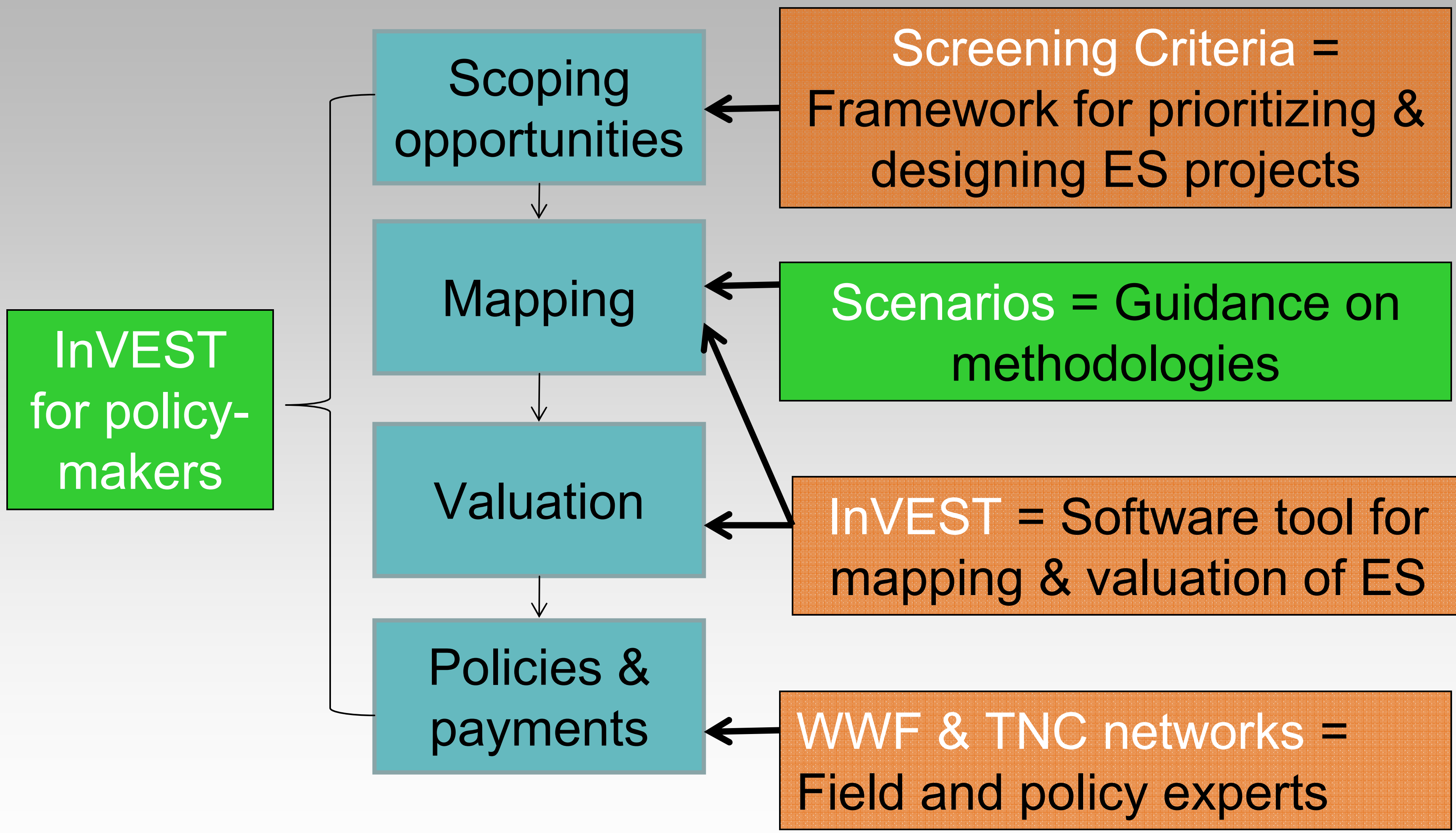
What's next? Policy & finance tools



What's next? Marine ecosystem services

Thanks…

NatCap

Kai Chan
Chris Colvin
Gretchen Daily
Helen Fox
Peter Kareiva
Chuck Katz
Erik Lonsdorf
Bruce McKenney
Guillermo Mendoza
Belinda Morris
Robin Naidoo
Erik Nelson
Nasser Olwero
Steve Polasky
Jim Regetz
M. Sanjayan
Rebecca Shaw
Heather Tallis
Christine Tam
Buzz Thompson
Michael Wright

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Andrew Balmford
Neil Burgess
Rhys Green
Shadrack Mwakalila
Mathieu Rouget
Ruth Swetnam
Kerry Turner
Sue White
…

Support

NSF-NCEAS
Leverhulme Trust
Packard Foundation
MacArthur Foundation
Moore Foundation
Roger and Vicki Sant
Peter and Helen Bing
…