PRIORITIZING INVESTMENTS IN WATERSHED SERVICES IN HIMACHAL PRADESH:

Overview of Modeling Approach

Adrian Vogl
Natural Capital Project

21 May, 2014

INVESTING IN WATERSHED SERVICES FOR HYDROPOWER

- World Bank partnered with the Natural Capital Project to provide technical assistance on ecosystems modeling and valuation.
- Goals
  - Demonstrate a method that can complement and improve the targeting of investments in watershed management by incorporating watershed-scale services
  - Demonstrate how targeted management can improve ecosystem services
  - Develop a framework for valuing forest management for hydropower production

THE NATURAL CAPITAL PROJECT PARTNERSHIP

natural capital PROJECT

Stanford WOODS INSTITUTE for the ENVIRONMENT

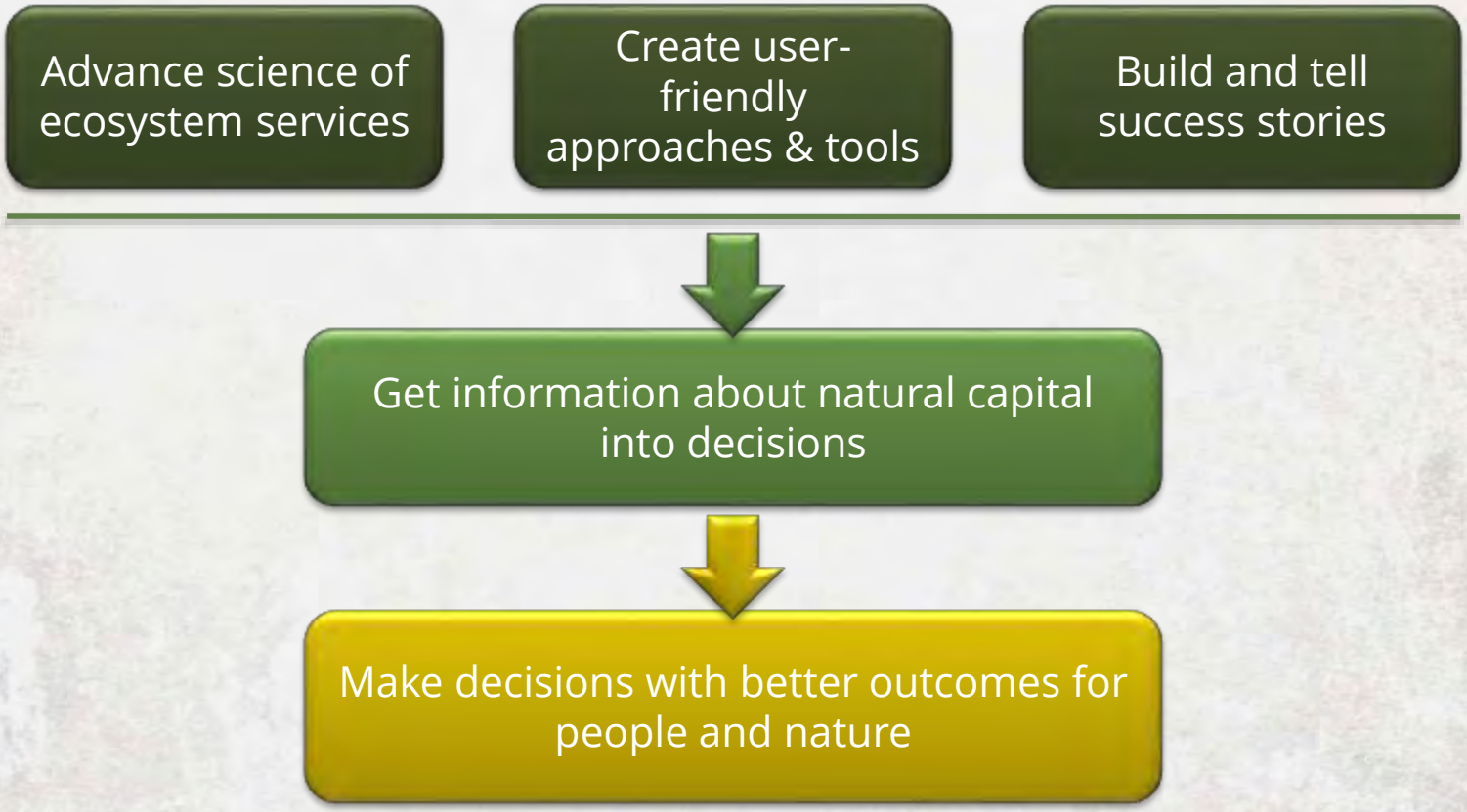
WWF

The Nature Conservancy

INSTITUTE ON THE ENVIRONMENT
UNIVERSITY OF MINNESOTA
Driven to Discover℠



OUR GOALS


Advance science of ecosystem services
Create user-friendly approaches & tools
Build and tell success stories
Get information about natural capital into decisions
Make decisions with better outcomes for people and nature

THE NATURAL CAPITAL APPROACH

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

THE NATURAL CAPITAL PROJECT TOOLBOX

InVEST

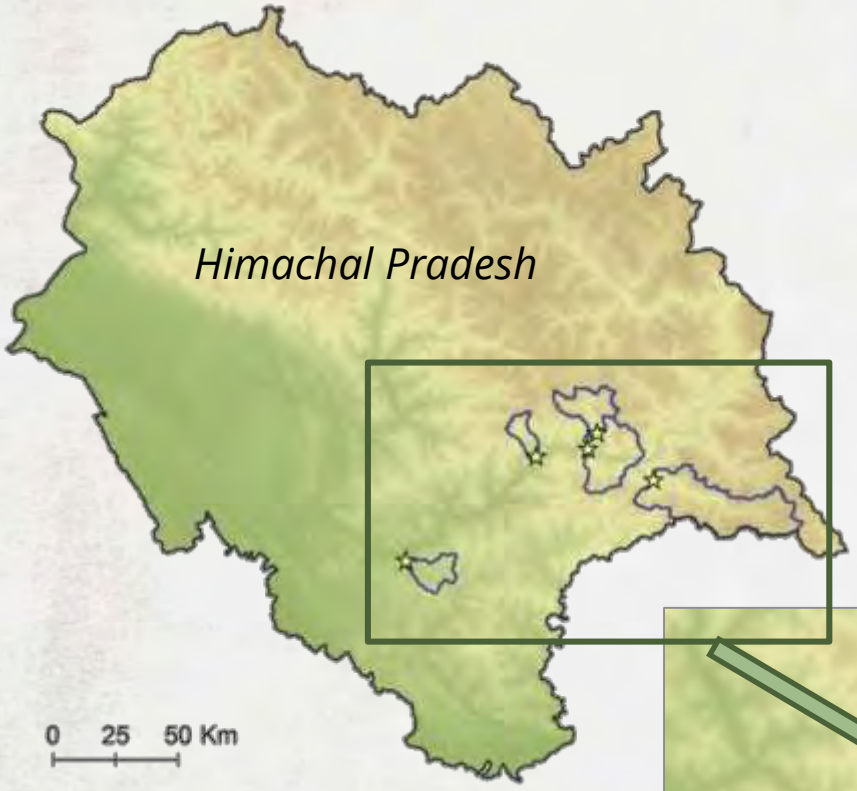
integrated valuation of environmental services and tradeoffs

RIOS

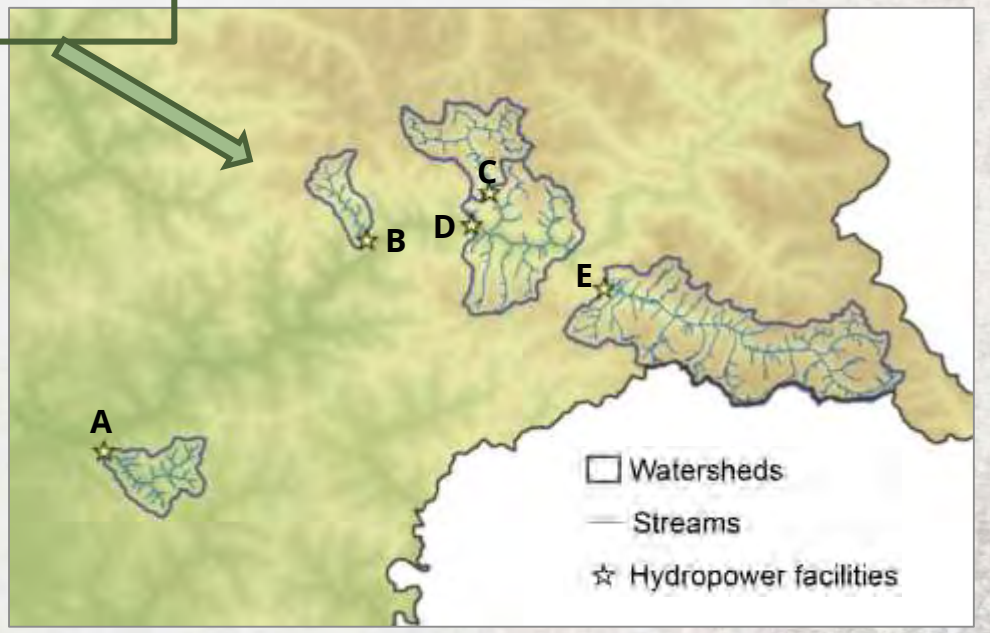
www.naturalcapitalproject.org

SITE SELECTION

- 5 pilot sites
- Selection Criteria:
  - Importance for hydropower production
  - Catchment area located entirely within HP
  - Range of conditions (land use and biophysical)
  - **Data availability**
    - Land uses
    - Flow and sediment data for calibration/validation
    - Valuation



Facility	Area (ha)
Chaba	18,878
Ghanvi I	11,741
SVP Bhaba	27,182
Nathpa Jhakri	73,486
Baspa II	99,007



MODELING APPROACH – PHASE I

- GOAL 1
  - Demonstrate method for targeting investments in watershed services in 5 pilot areas

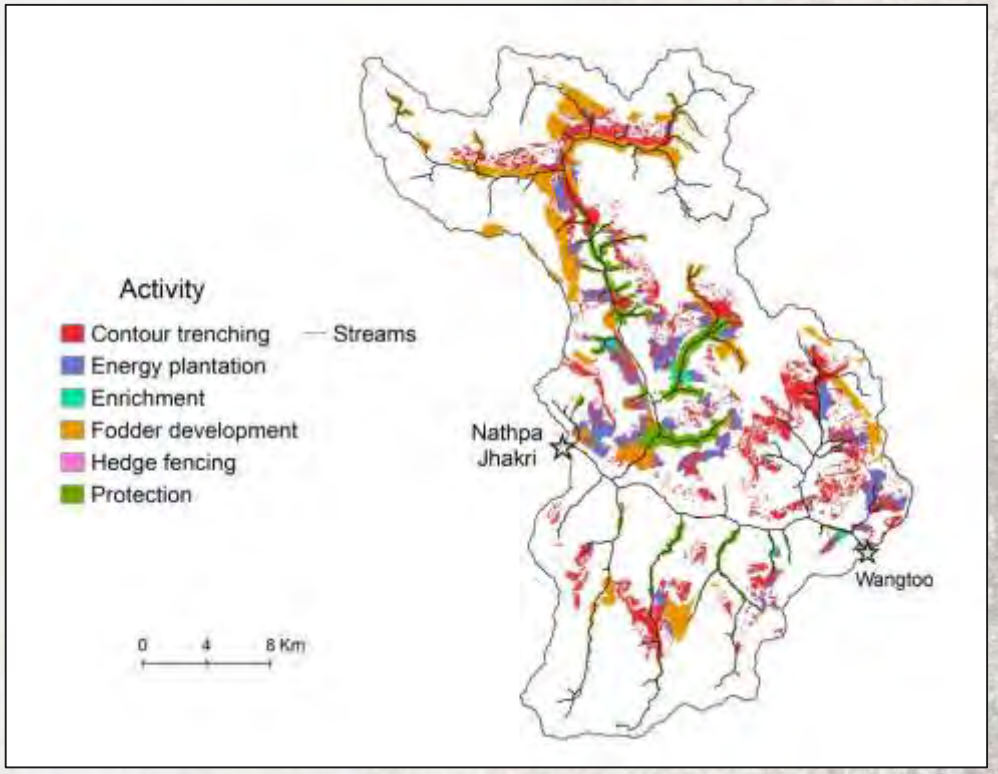
RIOS MODEL

GOALS

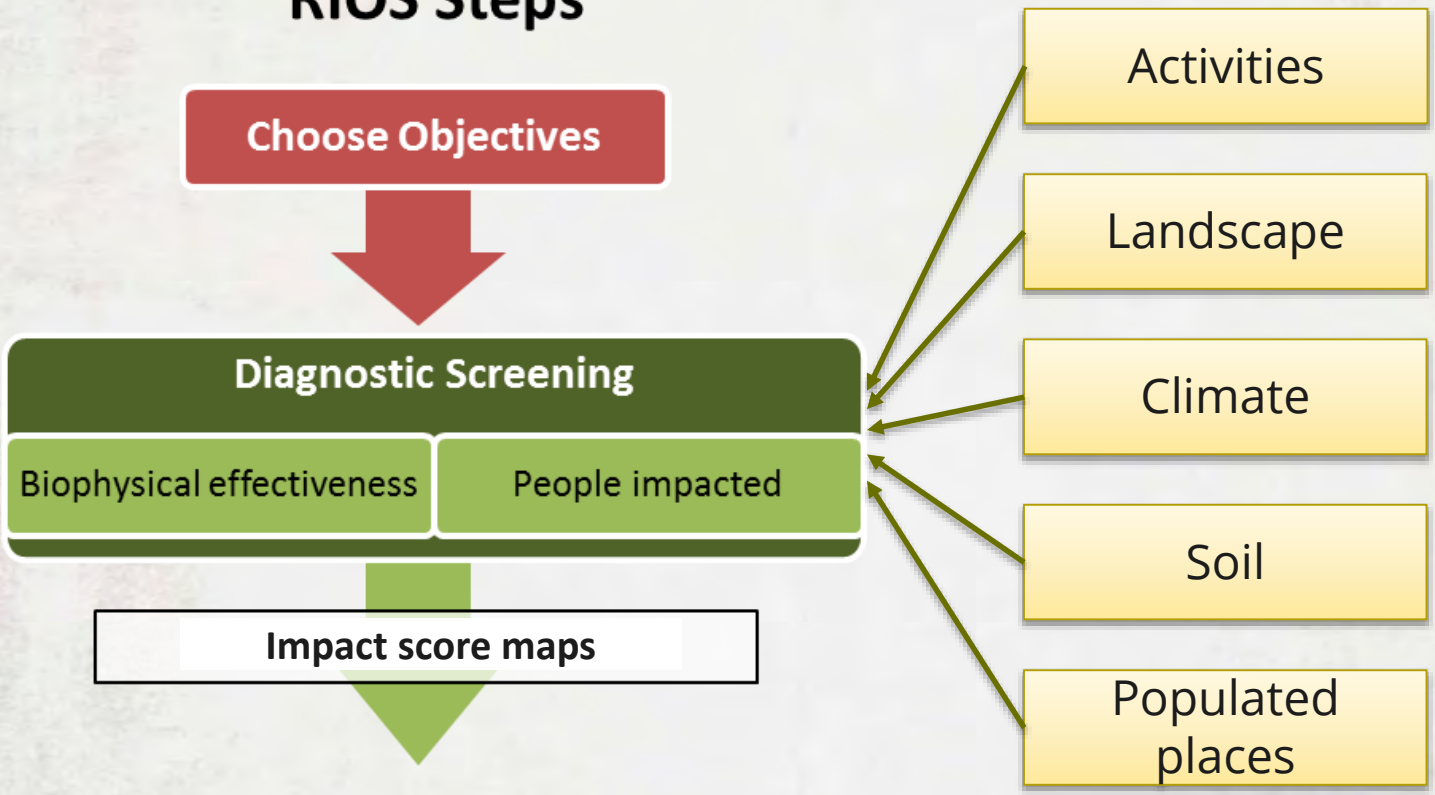
- Invest in watershed services with limited budget
- Maximize improvement in multiple services

QUESTIONS

- Which activities are most cost-effective?
- Where should they be done?



RIOS Steps


Choose Objectives
Diagnostic Screening
Biophysical effectiveness
People impacted
Impact score maps
Activities
Landscape
Climate
Soil
Populated places

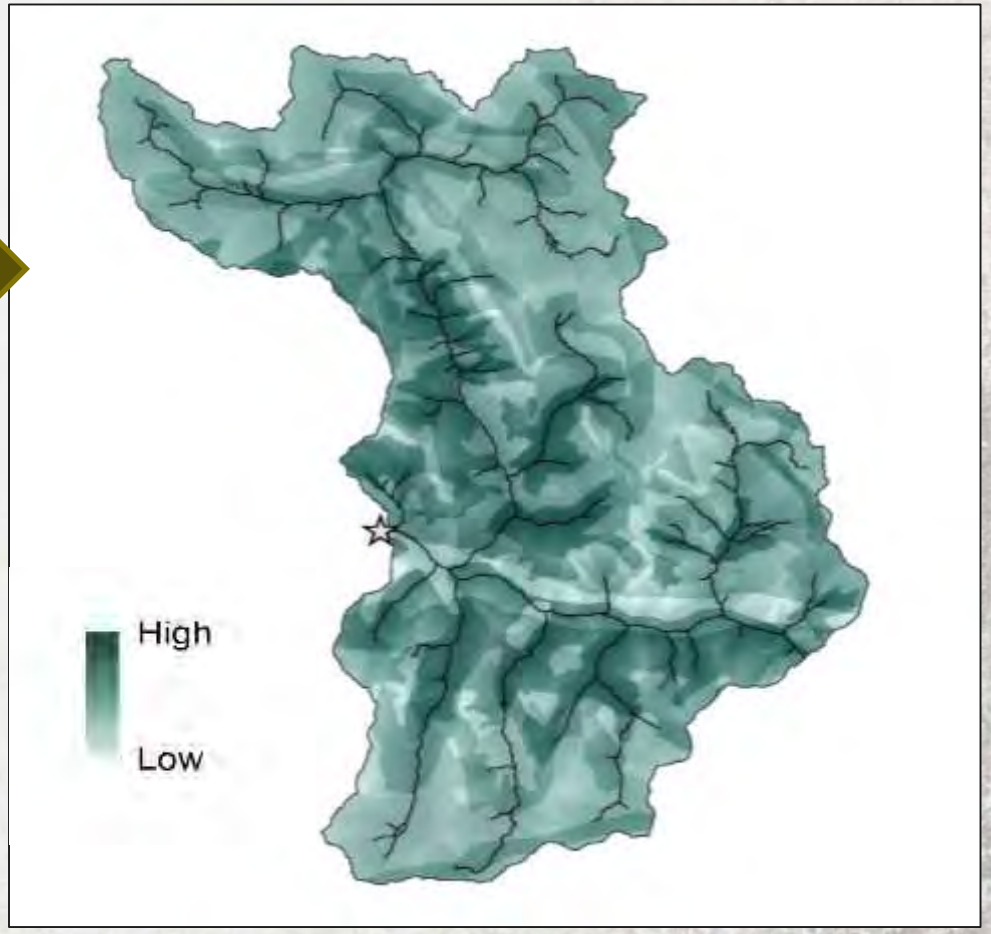
RIOS Steps

Choose Objectives

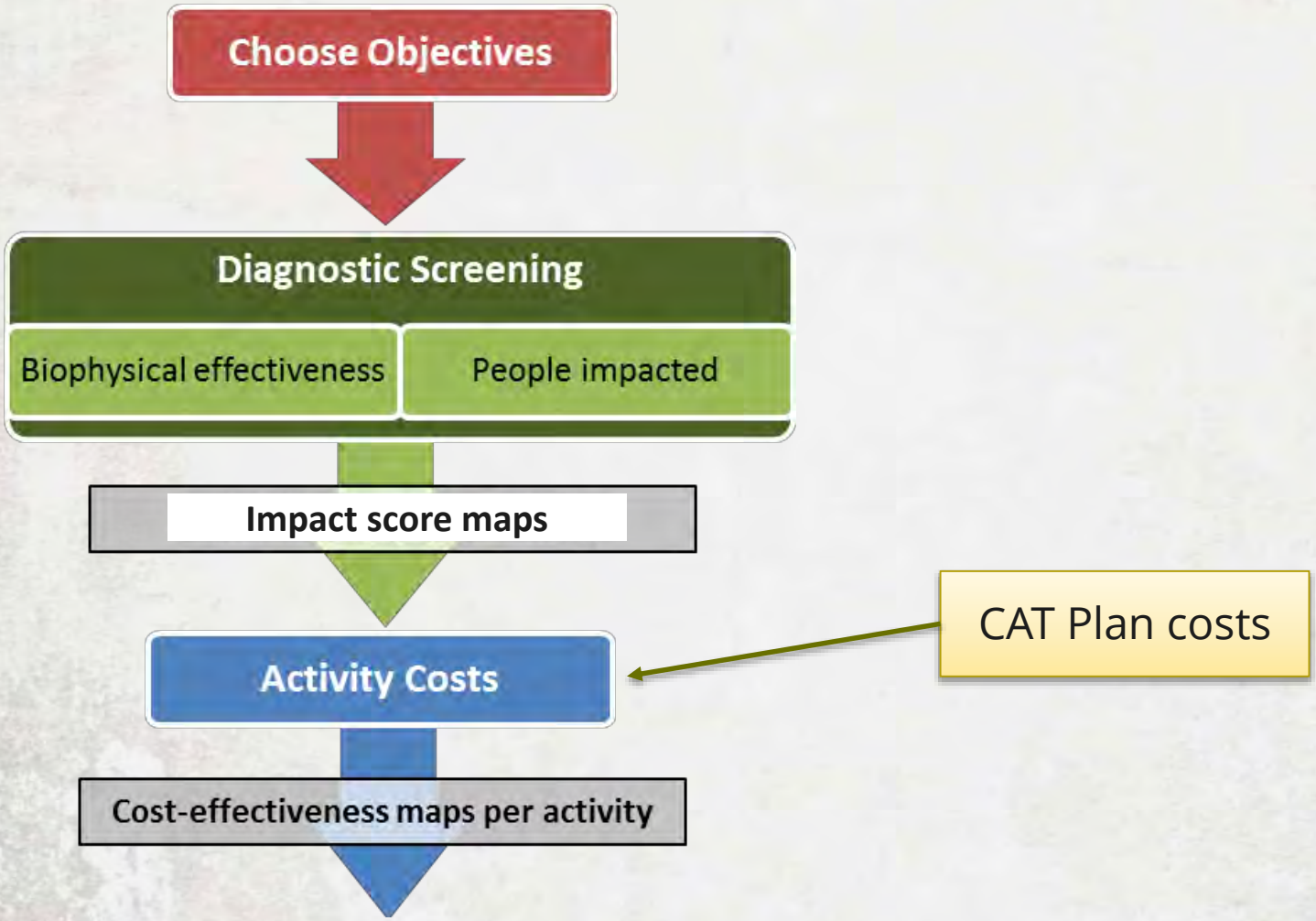
Diagnostic Screening

- Biophysical effectiveness
- People impacted

Impact score maps



RIOS Steps


Choose Objectives
Diagnostic Screening
Biophysical effectiveness
People impacted
Impact score maps
Activity Costs
CAT Plan costs
Cost-effectiveness maps per activity

RIOS Steps

Choose Objectives

Diagnostic Screening

Biophysical effectiveness | People impacted

Impact score maps

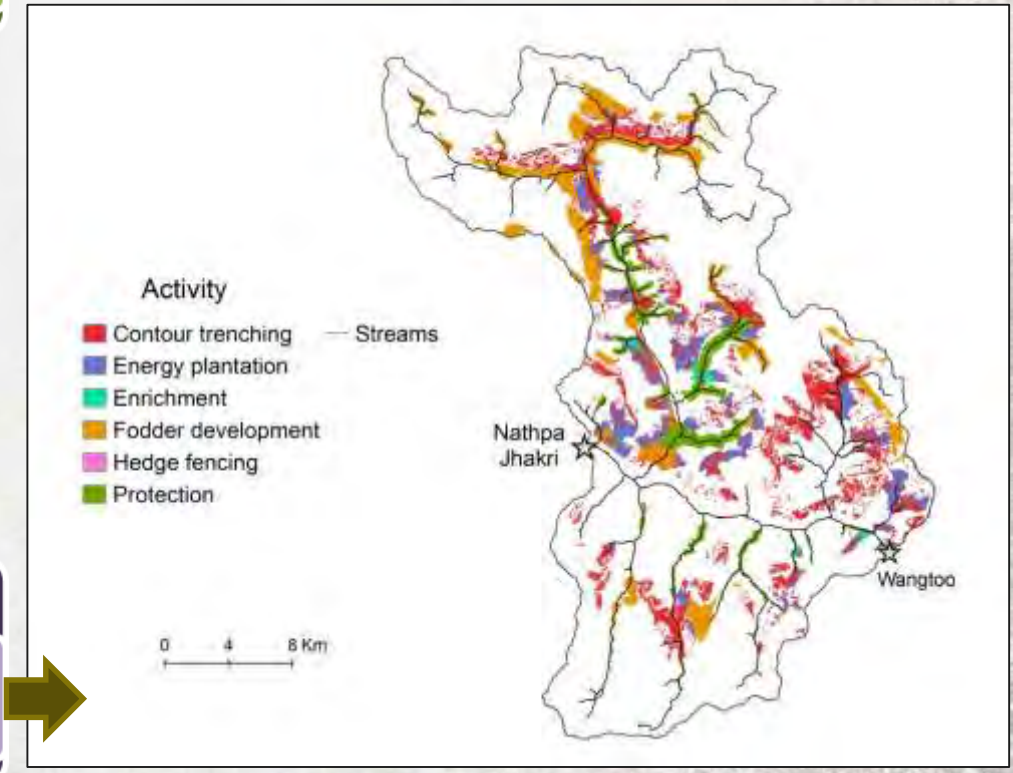
Activity Costs

Cost-effectiveness maps per activity

Select Activities

Stakeholder preferences | Feasibility/ Restrictions

WHAT activities to invest in and *WHERE*



MODELING APPROACH – PHASE I

- GOAL 1
  - Demonstrate method for targeting investments in watershed services in 5 pilot areas

- GOAL 2
  - Demonstrate potential improvement in services from targeted activities (water yield and sediment retained)

PORTFOLIOS AND RETURN ON INVESTMENT (SERVICE DELIVERY)

Methods:

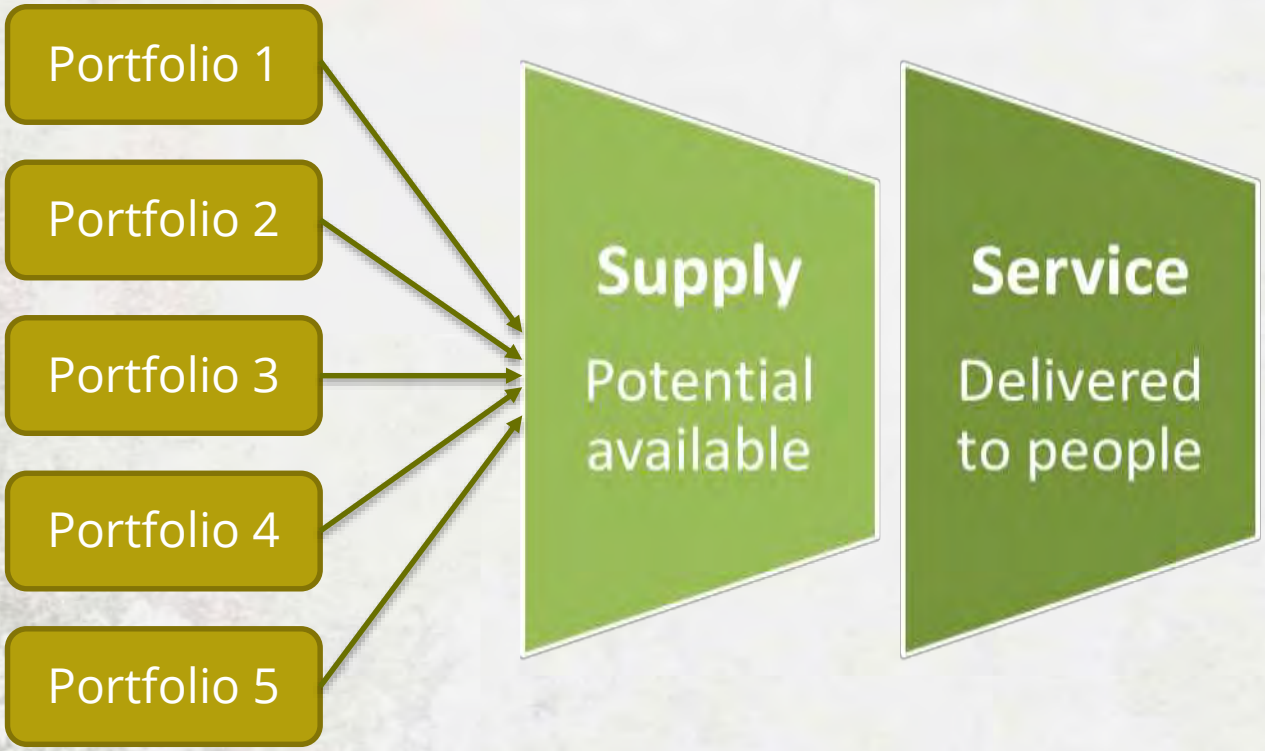
- Generated Investment Portfolios using RIOS for each study area, at five budget levels
- Budget levels correspond to an amount that would result in different amounts of available land in activities: 5%, 15%, 25%, 35%, and 45%
- Used InVEST water yield and sediment model to calculate the change in water and sediment that would result from implementation of each portfolio.
- Modified the base InVEST water yield model to account for the gross estimated contribution from snow and glacial melt (based on model validation)

THE NATURAL CAPITAL APPROACH

- Portfolio 1
- Portfolio 2
- Portfolio 3
- Portfolio 4
- Portfolio 5

RIOS
resource investment optimization system

THE NATURAL CAPITAL APPROACH



RIOS
resource investment optimization system

InVEST
integrated valuation of environmental services and tradeoffs

INVEST MODEL – WATER YIELD

Actual Evapotranspiration

mm/year

Water yield

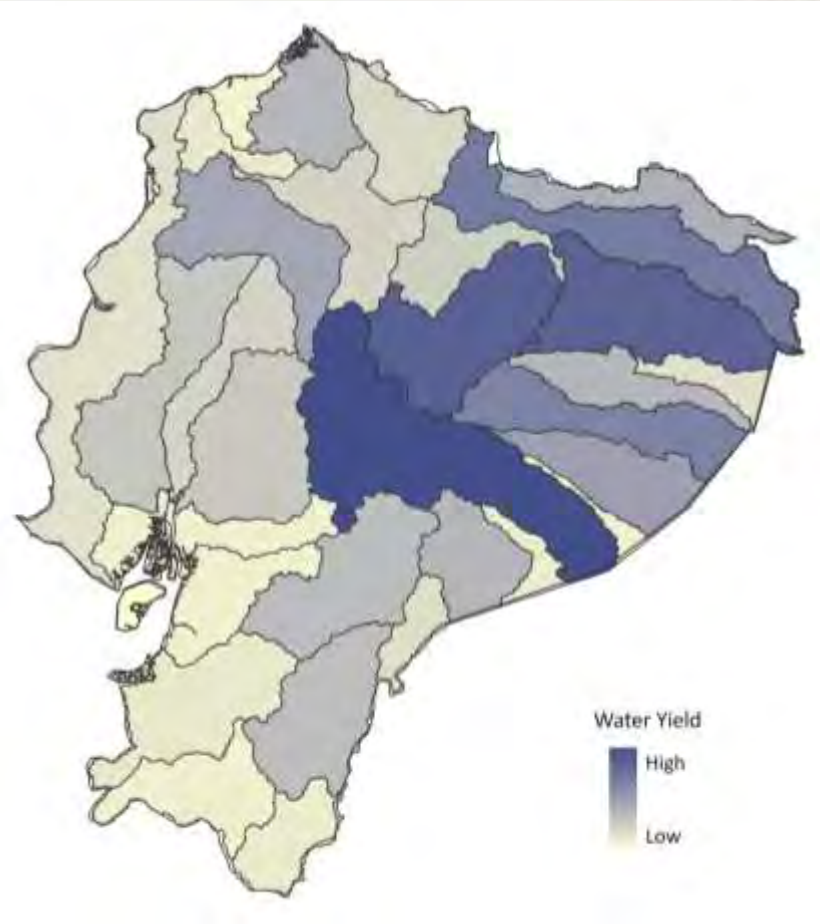
mm/year

Water supply

m^3/year

Energy/value for hydropower

Kw/currency over timespan



INVEST MODEL – SEDIMENT

Potential Soil loss

Calculated from USLE

Tons/year

Sediment Retained

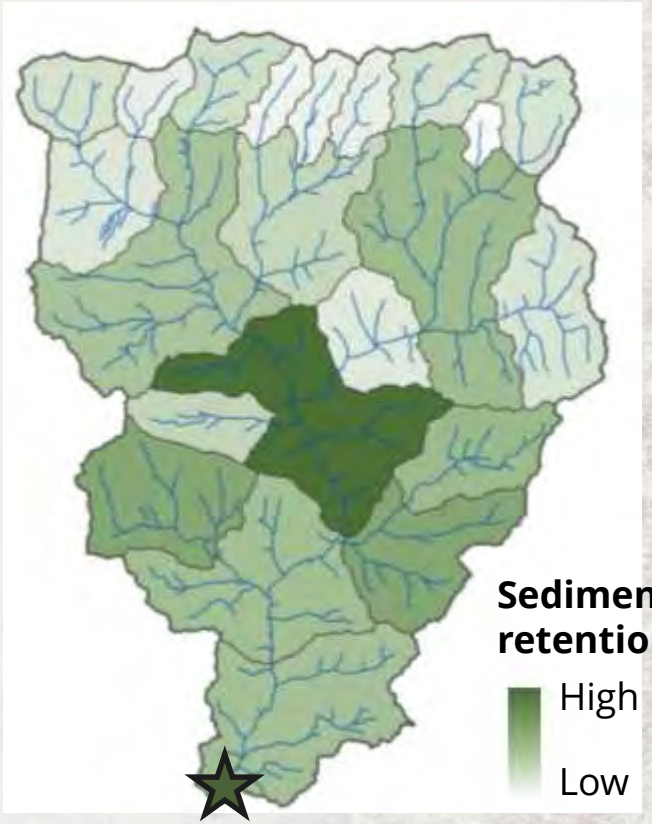
Tons/year

Sediment Exported

Tons/year

Value of Sediment Removal for Water Quality/Dredging

Currency over time period



+ Total export to reservoir

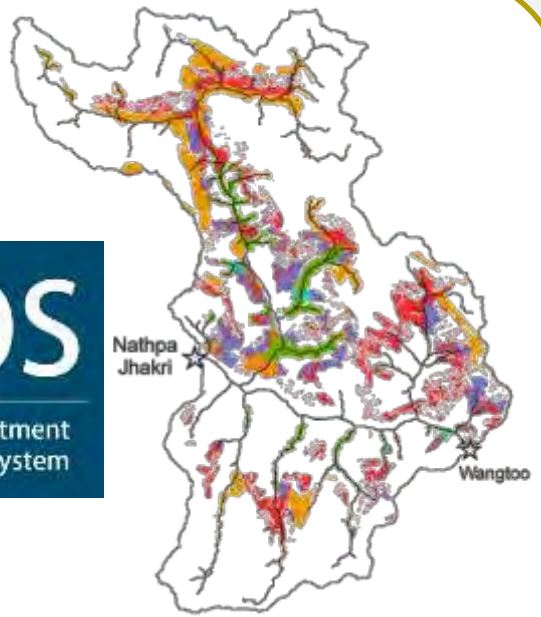
THE NATURAL CAPITAL APPROACH

RIOS
resource investment optimization system

InVEST
integrated valuation of environmental services and tradeoffs

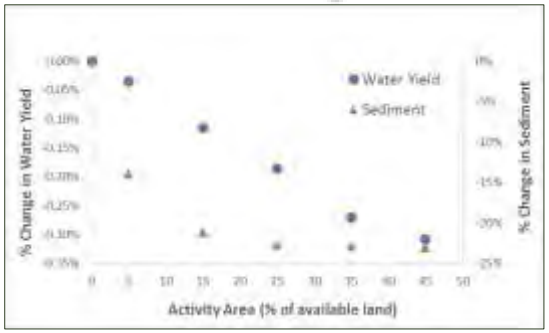
MODELING APPROACH – PHASE I

RIOS
resource investment optimization system



Alternative Investment Portfolios

InVEST
integrated valuation of environmental services and tradeoffs

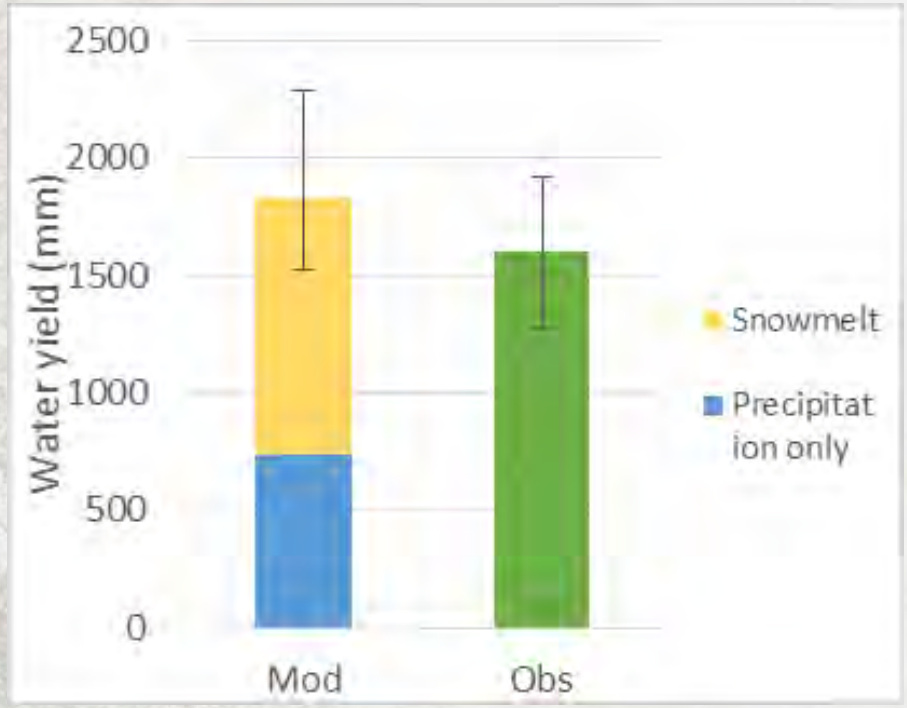


Relative Change in Physical Flows

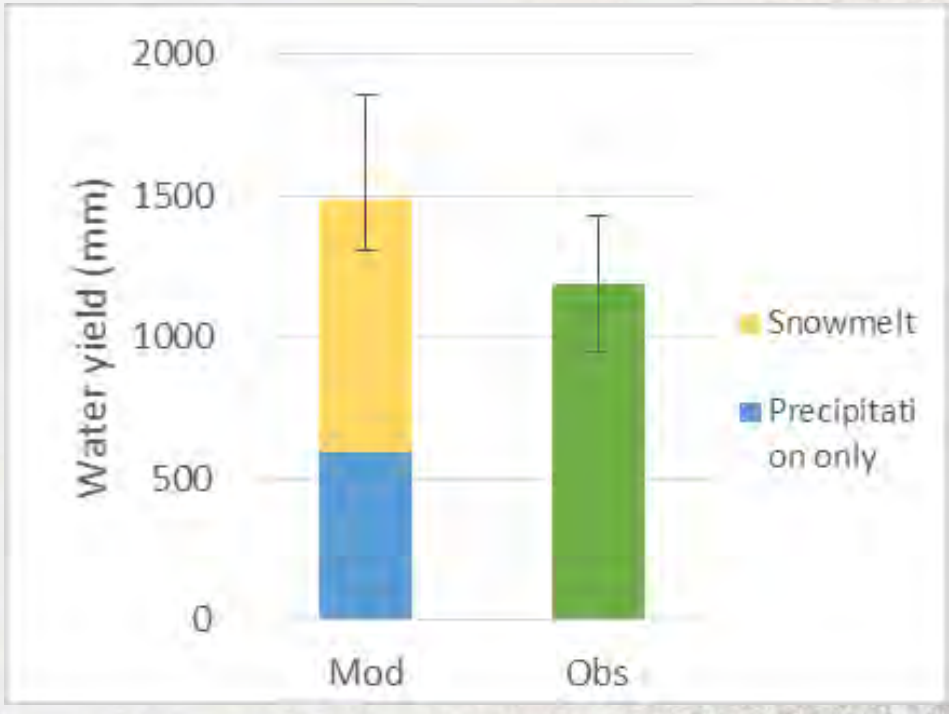
MODEL VALIDATION

WATER YIELD

- Compared modeled to observed water yield for two catchments



Ghanvi

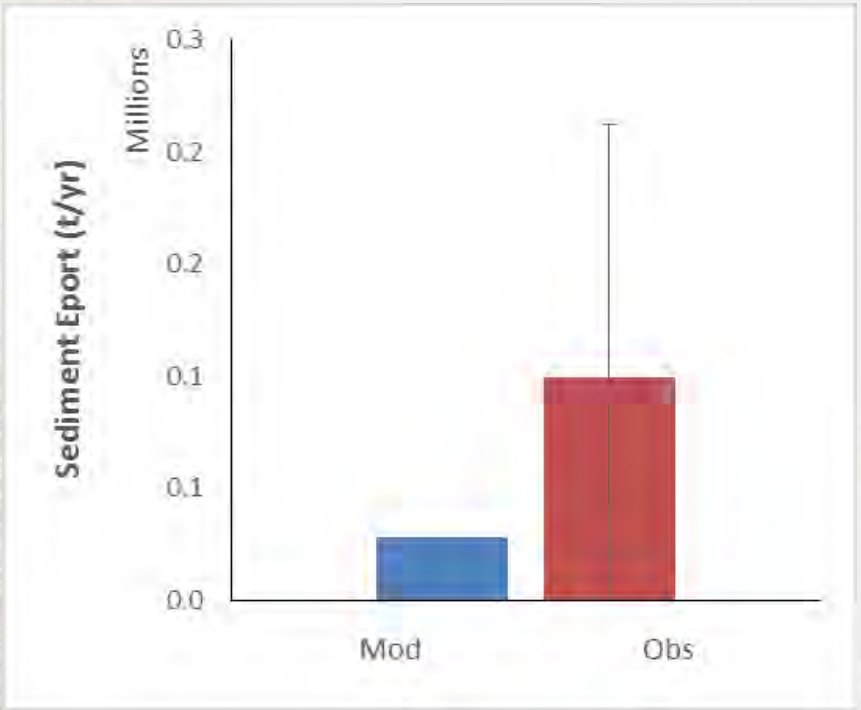


Baspa

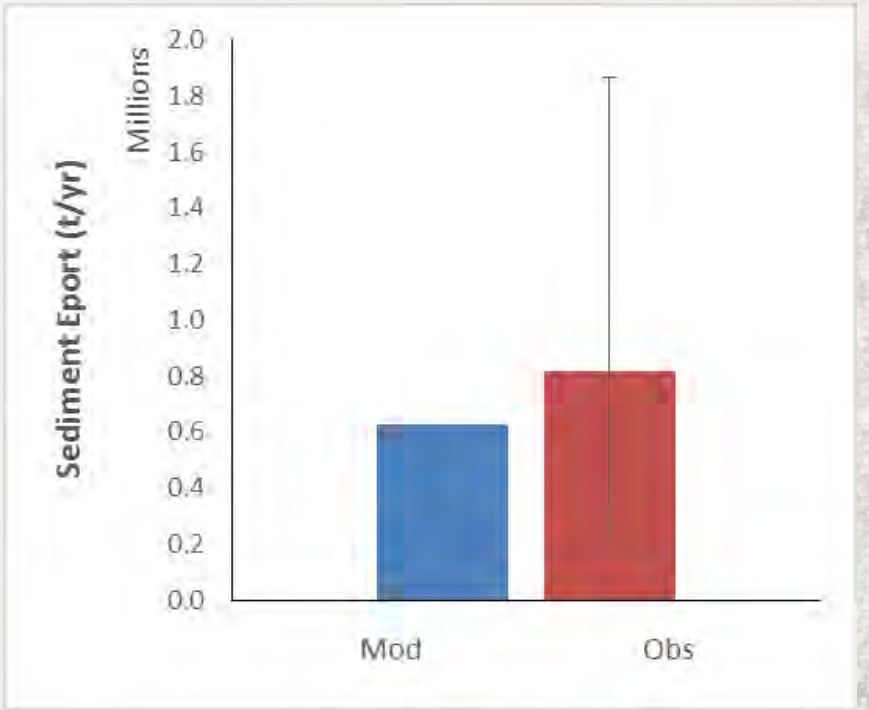
MODEL VALIDATION

SEDIMENT

- Compared modeled to observed sediment load for two catchments



Ghanvi



Baspa

MODEL VALIDATION

ADJUST OUTPUTS

- Accounting for glacier/snow melt
  - Model predicts only rainfall runoff
  - Model predictions modified to reflect estimated 60% contribution from glacier/snow melt

- Accounting for other sediment sources
  - Model lacking landslide/gully erosion
  - Model predictions modified to reflect estimated contribution from other sediment sources (~50%)

MODELING APPROACH – PHASE I

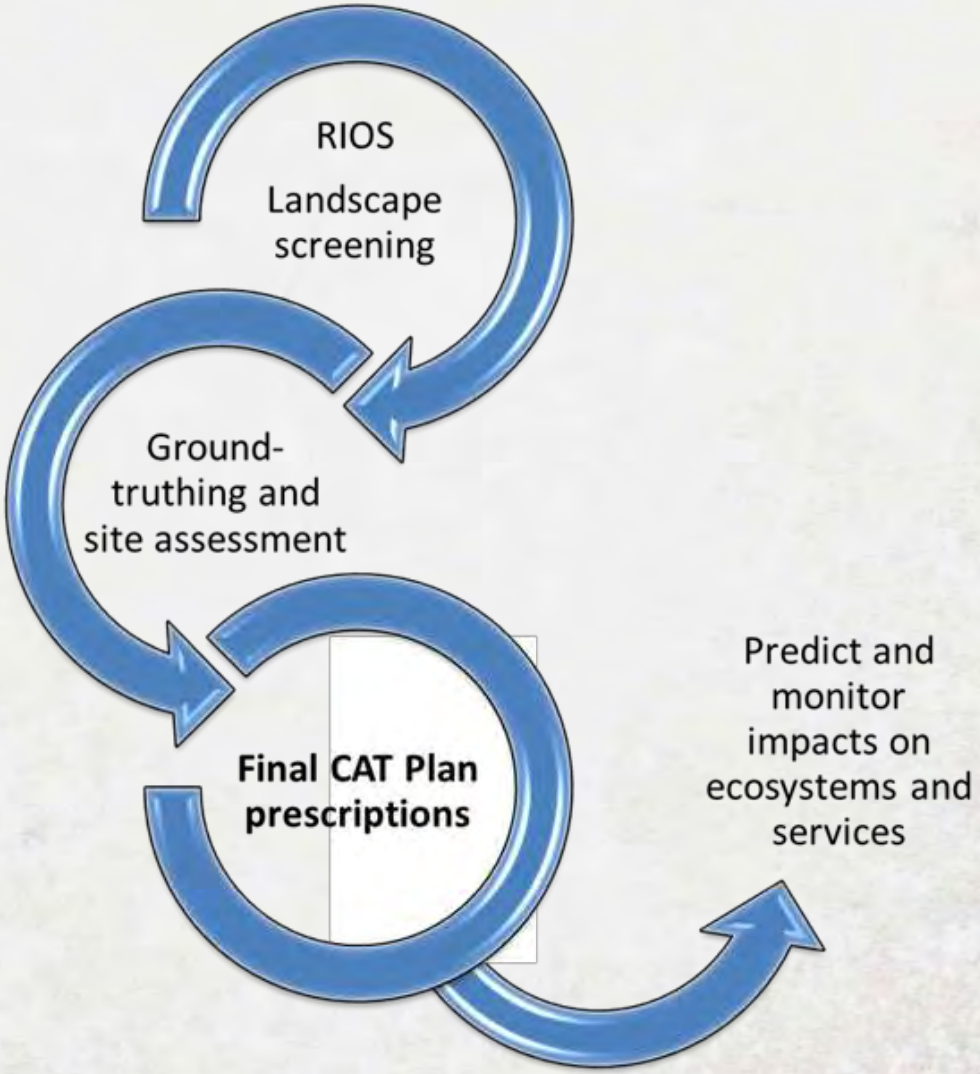
- GOAL 3
  - Compare with CAT Planning process

MODELING APPROACH – PHASE I

GOAL 3 – RESULTS

- CAT Plan determined activity areas by visiting villages, talking to people, getting stakeholder input
- RIOS is done from remote, satellite-data based land cover map
- Direct comparison is not possible because of different data sources and methods
- Emphasizes need to coordinate the on-the-ground knowledge with model inputs so the two processes can inform each other
- RIOS provides landscape context and CAT in-depth process provides ground-truthing, feasibility, and stakeholder buy-in.

RIOS AND CAT PLANNING



ACKNOWLEDGMENTS

- InVEST
  - Rich Sharp, Heather Tallis, Taylor Ricketts, Anne Guerry, Spencer Wood, Becky Chaplin-Kramer, Eric Nelson, Driss Ennaanay, Stacie Wolny, Nasser Olwero, Kari Vigerstol, Derrick Pennington, Guillermo Mendoza, J. Aukema, J. Foster, J. Forrest, D. Cameron, Katie Arkema, E. Lonsdorf, C. Kennedy, Gregg Verutes, C.K. Kim, Greg Guannel, Michael Papenfus, Jodie Toft, M. Marsik, Joey Bernhardt, Robb Griffin, Kathryn Glowinski, Nicolas Chaumont, N., Adam Perelman, Martin Lacayo, Lisa Mandle, and Perrine Hamel.
- RIOS in Himachal Pradesh
  - Stacie Wolny, Perrine Hamel, Urvashi Narain, Rich Sharp, James Douglass, Heather Tallis, and S.S. Negi.