

INVESTING IN WATERSHED SERVICES WITH RIOS

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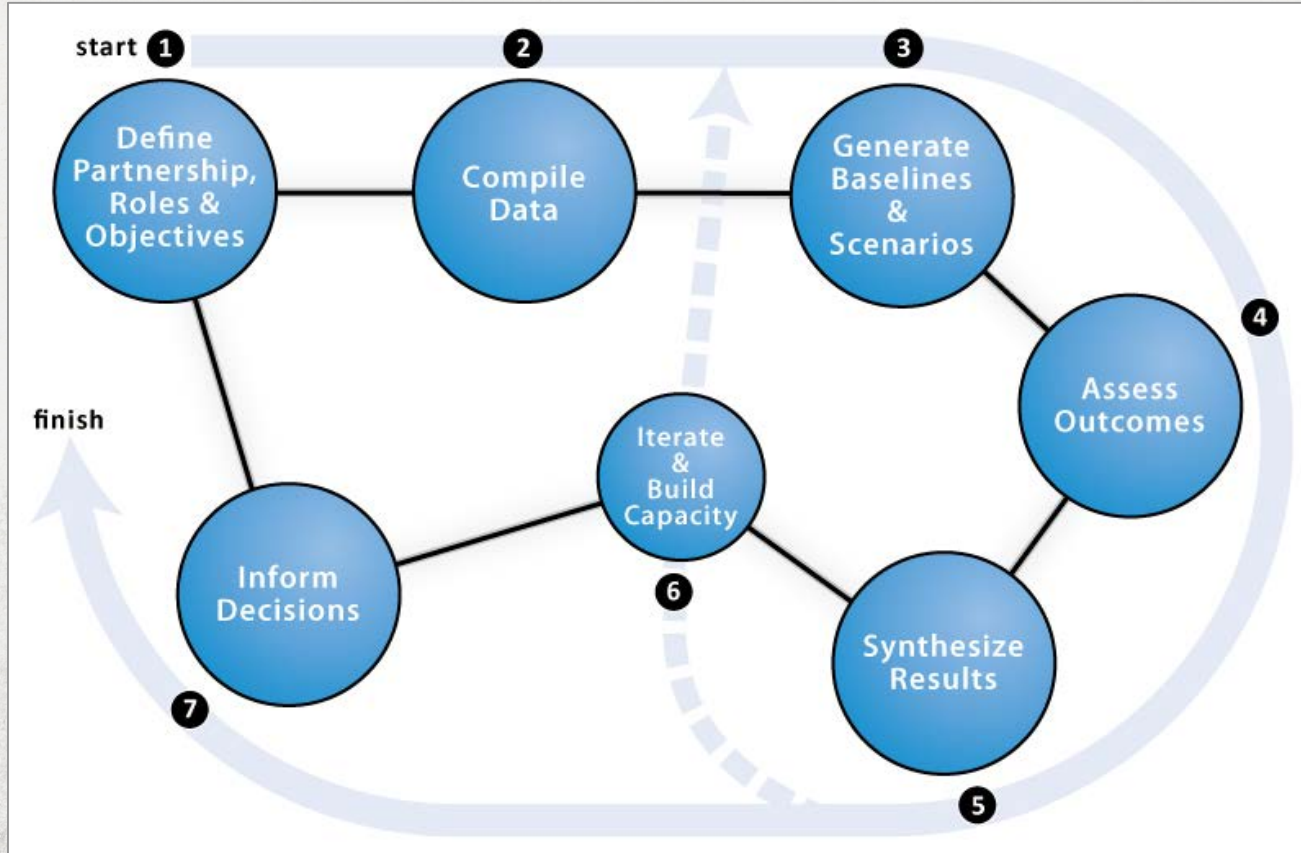
avogl@stanford.edu

natural
capital
PROJECT

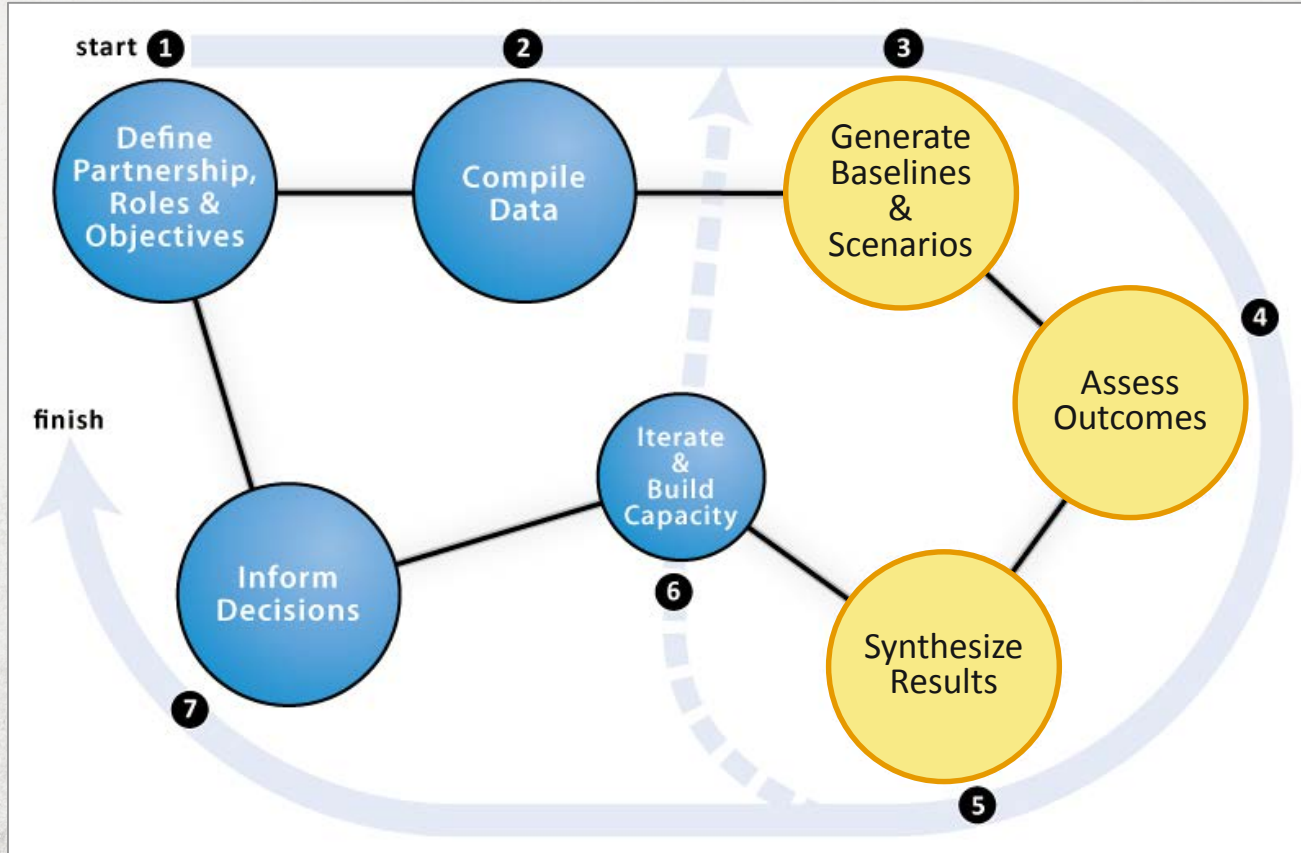


Natural Capital Symposium
24 March 2015

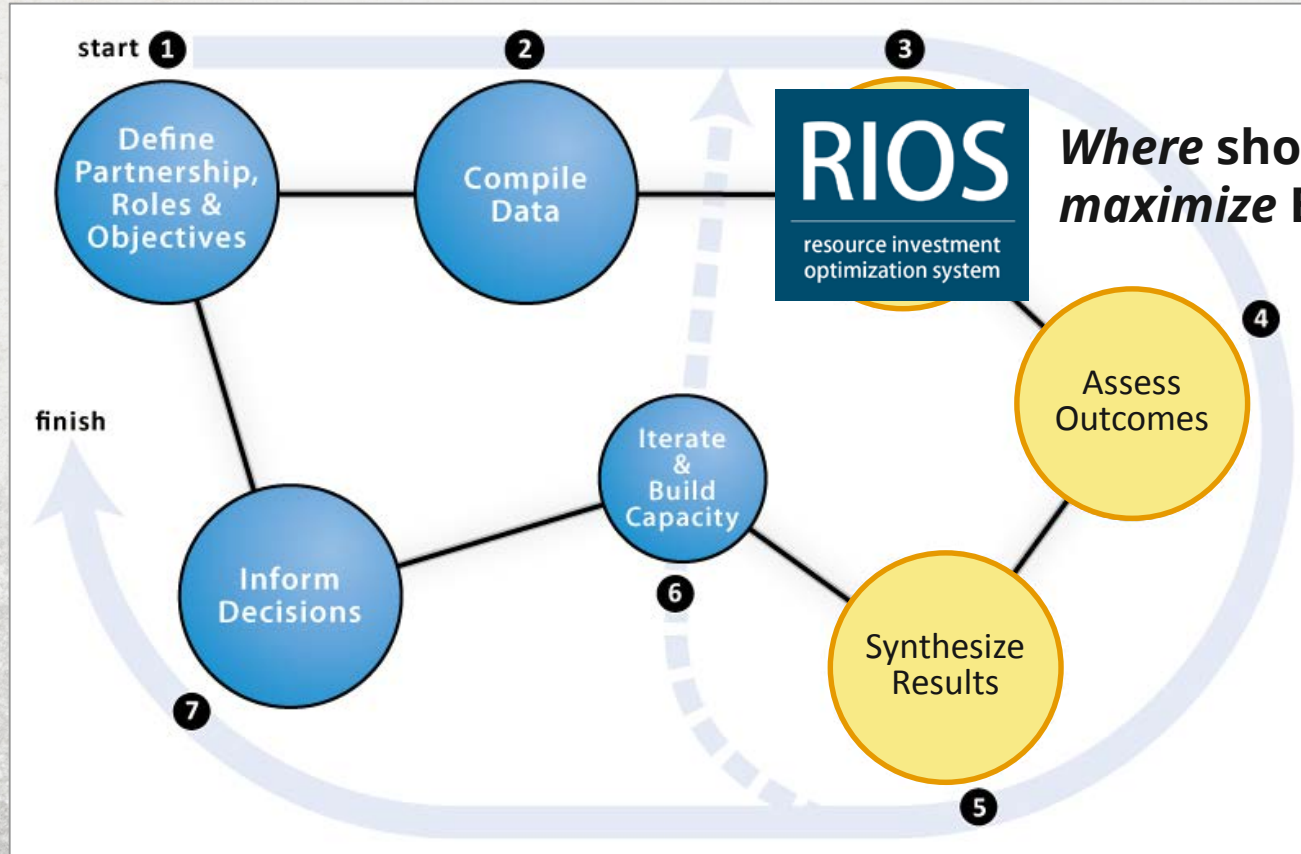
ECOSYSTEM SERVICES ASSESSMENT



ECOSYSTEM SERVICES ASSESSMENT

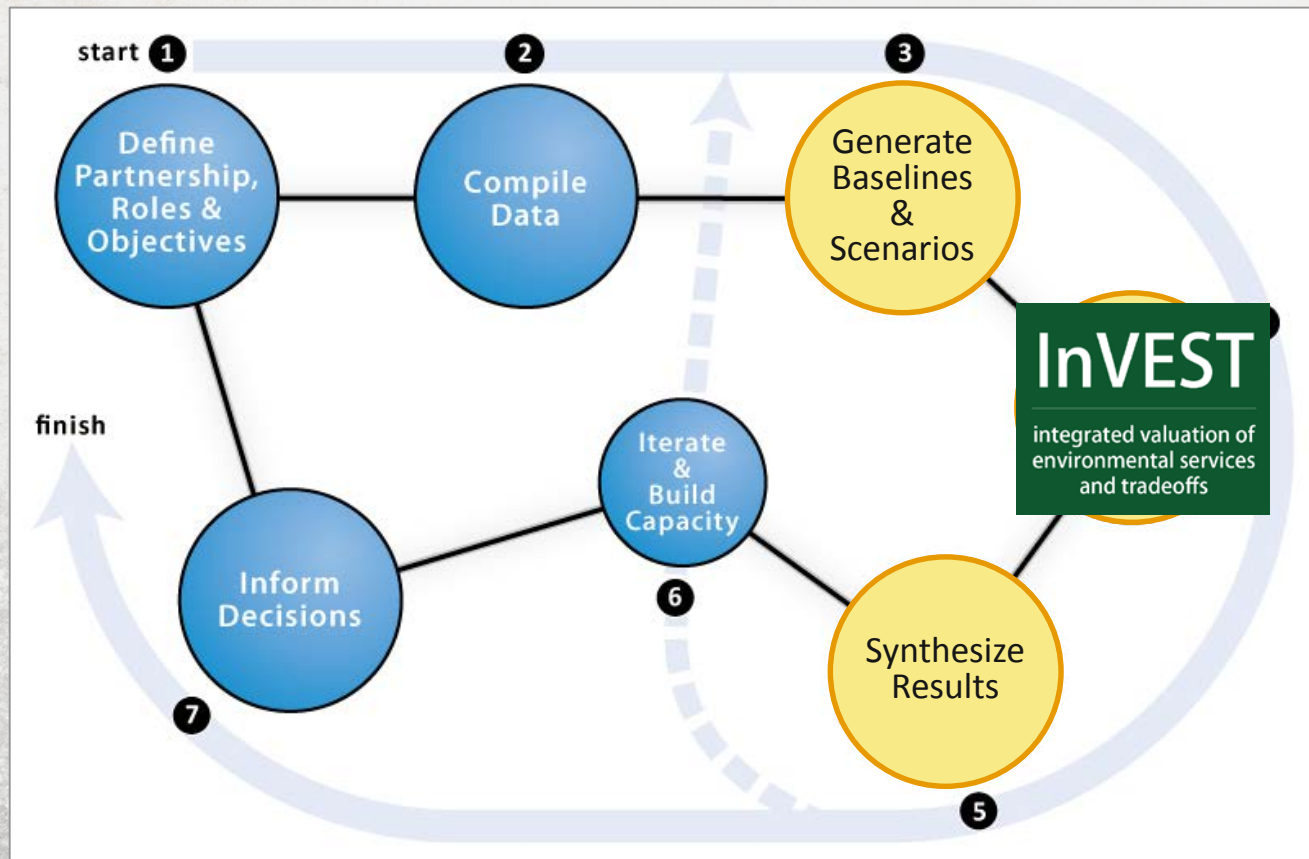


ECOSYSTEM SERVICES ASSESSMENT



**Where should I invest to
maximize ES improvement?**

ECOSYSTEM SERVICES ASSESSMENT



How much will ES delivery change with different scenarios (of investment, land use change, other)?

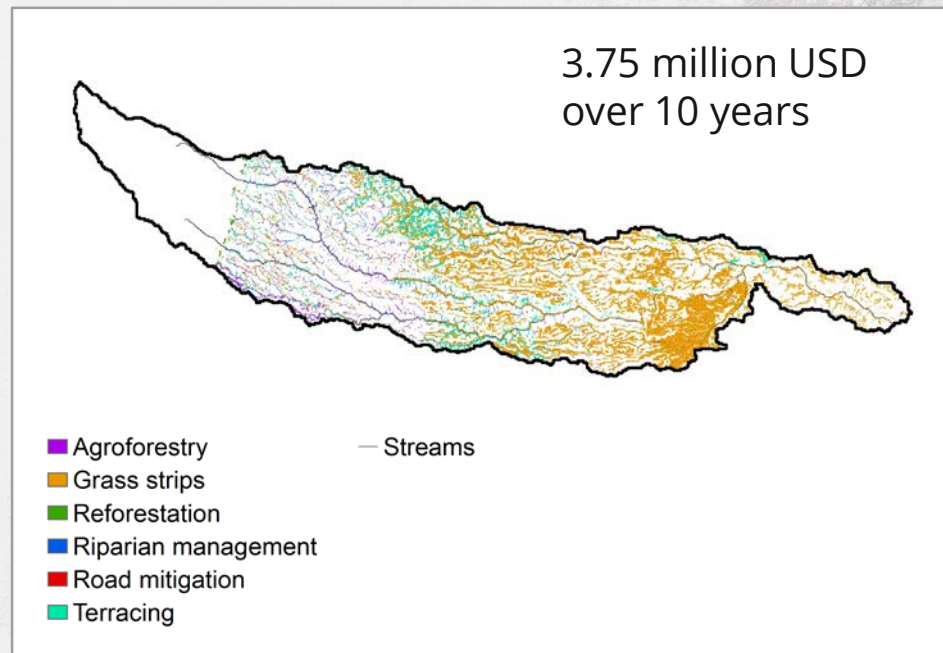
SCENARIO GENERATOR FOR A SPECIFIC CASE

GOALS

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

QUESTIONS

- Which conservation strategies are most ***cost-effective***?
- ***Where*** should I do them?



Resource Investment Optimization System

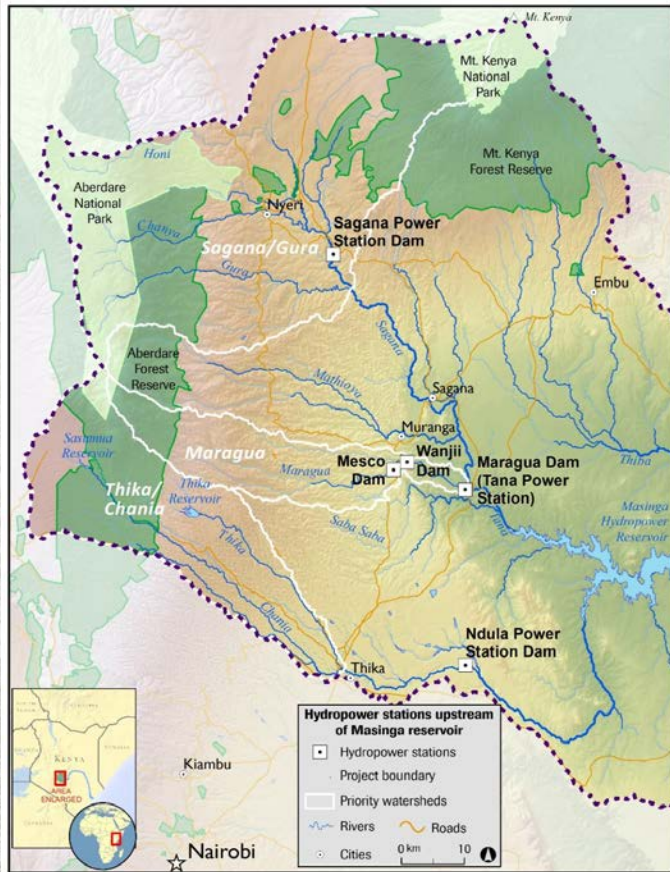
- Identify places where the benefits of activities are greatest
- An approach general enough to work globally
- Simplified data requirements
- Standard outputs
- Considers multiple objectives



CASE STUDY

Upper Tana-Nairobi Water Fund

CHALLENGES FACING THE UPPER TANA



- Sediment loss and declining dry season flow
- Impacts of sedimentation on water treatment and supply
 - Nairobi City Water and Sewerage Company
 - Households – increased pathogen transport and increased treatment costs
- Impacts of sedimentation on reservoirs
 - KenGen

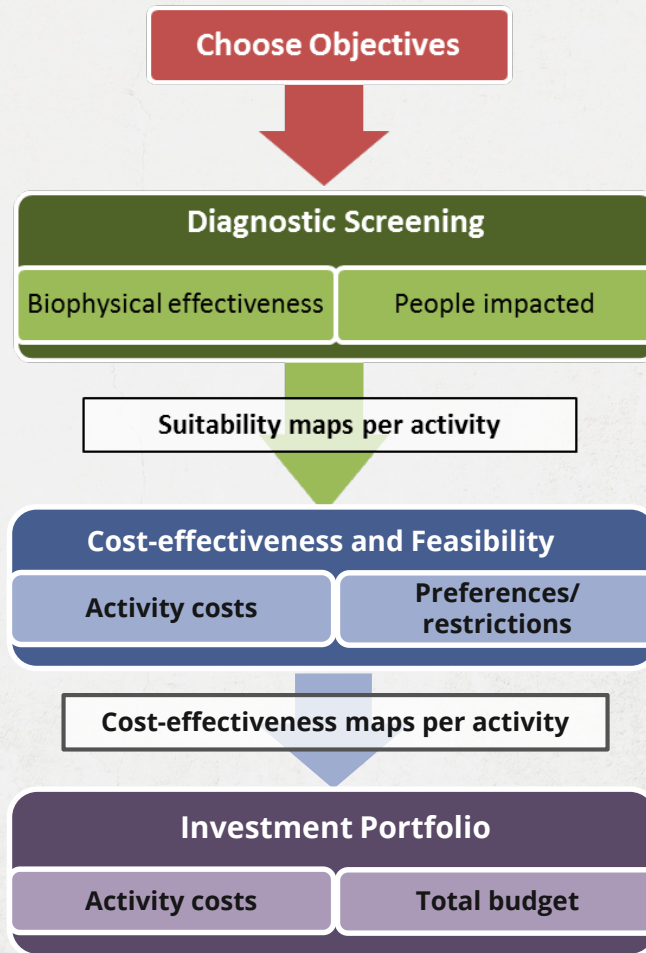
PROJECT PARTNERS



*Water fund
priority
watersheds*



RIOS WORKFLOW



File Development

Select objectives

Edit factor weights

Objective Weights

Transition Potential

Select Budget



Select workspace

C:\RIOS_workspace\Tana



LULC

C:/InVEST_3_0_0_x86/RIOS/landuse_cur_clip.tif



General LULC Coefficients

C:/InVEST_3_0_0_x86/RIOS/general_lulc_coefficients.csv



LULC Classification CSV with Activities

C:/InVEST_3_0_0_x86/RIOS/lulc_classification_table_activities1.csv



Clumping Factor (in pixels)

2



Results Suffix (optional)

tana1



Select the objectives for which you would like to build portfolios in this session. If you select more than one objective, the tool will produce portfolios that seek to achieve all of the chosen objectives.



Erosion Control for Drinking Water Quality



Erosion Control for Reservoir Maintenance



Nutrient Retention (Phosphorus)



Nutrient Retention (Nitrogen)



Flood Mitigation



Groundwater Recharge Enhancement



Baseflow



Parameters have been loaded from the most recent run of this model. [Reset to defaults](#)



Reset



Run



Quit

1. CHOOSE OBJECTIVES

SERVICES

- Erosion Control
- Nitrogen Regulation
- Phosphorus Regulation
- Groundwater Recharge
- Flood Mitigation
- Dry Season Baseflow
- Biodiversity
- "Other"

WATER FUND OBJECTIVES



PRIMARY:
Sediment retention
for
Water quality

CO-BENEFITS:
Baseflow
for
Water availability



Image: Geir Kiste

DIAGNOSTIC SCREENING

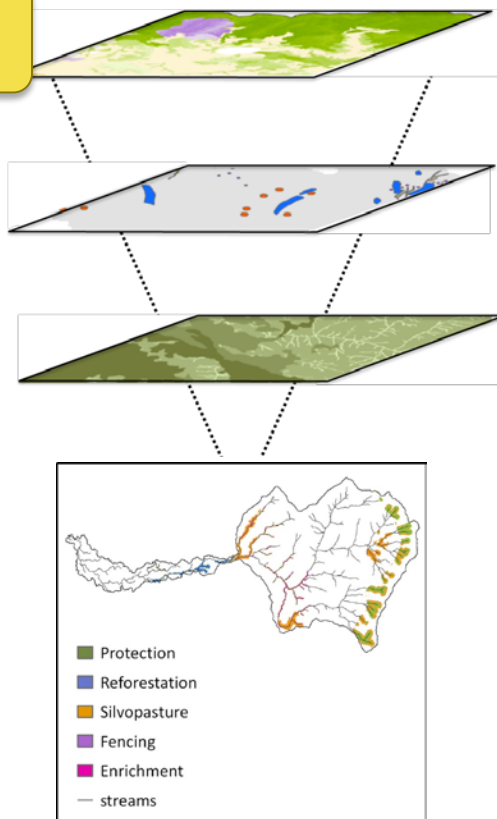
Biophysical effectiveness

Feasible activities

Stakeholder preferences

Cost data
Budget

Investment portfolio



Land use/Land cover

Vegetation retention, land practice and management

Topography

Digital elevation model, slope threshold

Erosivity

Based on intensity and kinetic energy of rainfall

Erodibility

Soil detachment and transport potential due to rainfall

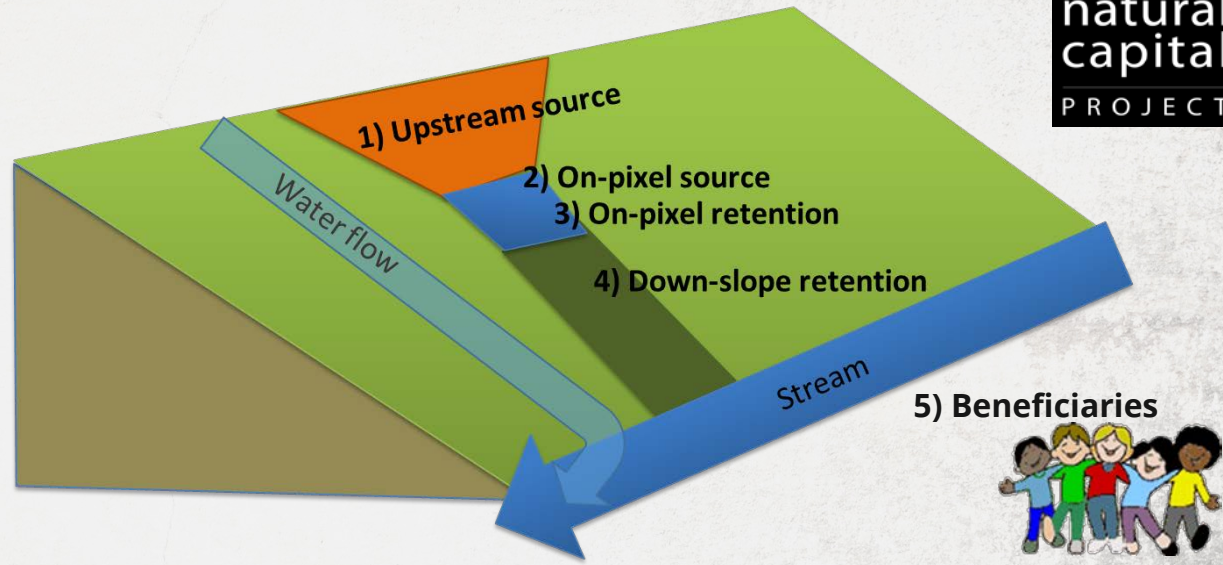
Watershed Areas

Catchment areas, beneficiaries

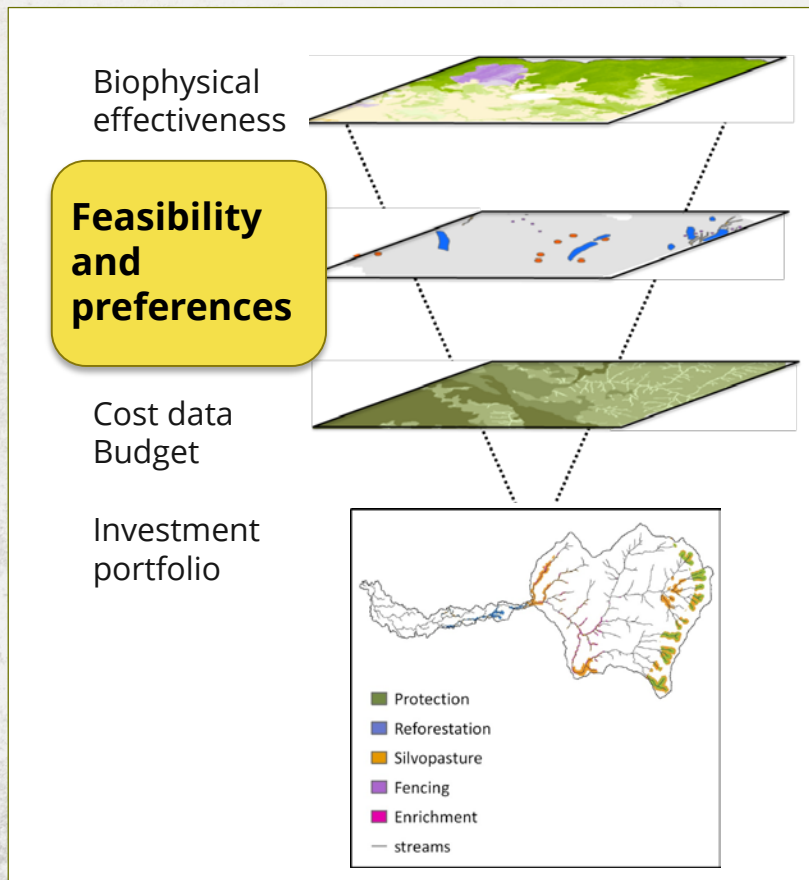
DIAGNOSTIC SCREENING

KEY FACTORS

- Factors determined with literature review
- Compromise between process representation and data availability
- Determine effectiveness of *transitions* for meeting objectives, in a specific place



DIAGNOSTIC SCREENING



Feasible locations

Stakeholder preferences

Legal and logistical restrictions

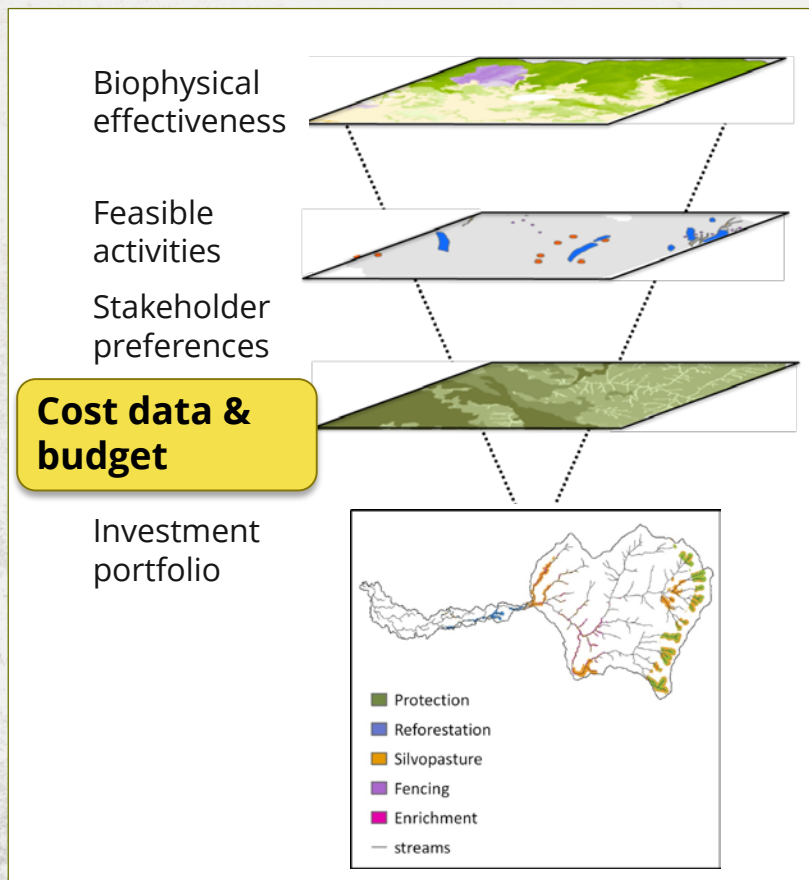
ACTIVITIES & FEASIBILITY

Activity	Allowed on
Riparian management	15m buffer alongside streams, except urban, agroforestry, roads, and natural areas. Not allowed within the border of Kenya Forest Service lands.
Agroforestry	Bare soil, grassland, and croplands (except pineapple)
Terracing	Bare soil, croplands (except tea), and agroforestry lands with >12% slope and >15m from stream channel.
Reforestation	Grassland, shrub, and croplands (except pineapple) located within 500m inside the border of Kenya Forest Service lands (anti-encroachment strategy)
Grass strips	Bare soil, croplands (except tea), and agroforestry lands with <12% slope
Road mitigation	Unpaved roads

ACTIVITIES & FEASIBILITY INPUT

Activity	Allowed on									
Riparian management	15m buffer	lucode	LULC_desc	LULC_general	grass_	riparian_	agro-	re-	road_	
	terracing				strips	mgmt	forestry	forestation	mitigation	
Agroforestry	Bare soil	1	Urban and paved roads	1	0	0	0	0	0	0
		2	Bare soil	2	1	1	1	1	0	0
		3	Grass	3	0	0	1	1	1	0
		4	Shrub	4	0	0	1	0	1	0
Terracing	Bare soil with >12m buffer	5	General agriculture	5	1	1	1	1	1	0
		6	Tea	6	0	0	1	1	1	0
		7	Coffee	7	1	1	1	1	1	0
		8	Mixed forest	8	0	0	1	0	0	0
Reforestation	Grassland located within 12m Service Level	9	Water	9	0	0	0	0	0	0
		10	Evergreen forest	10	0	0	1	0	0	0
		11	Forest plantation	11	0	0	1	0	0	0
		12	Pineapple	12	1	1	1	0	0	0
Grass strips	Bare soil with <12m buffer	13	Wetland	13	0	0	1	0	0	0
		14	Orchard	14	1	1	1	1	1	0
		15	Corn	15	1	1	1	1	1	0
Road mitigation	Unpaved road	17	Bare rock	17	0	0	0	0	0	0
		18	Unpaved road	18	0	0	0	0	0	1
		19	Agroforestry	19	1	1	0	0	0	0

DIAGNOSTIC SCREENING



Opportunity cost

How much do activities cost?

Implementation, maintenance, payments

Total budget

RIOS Workflow

Choose Objectives



Diagnostic Screening

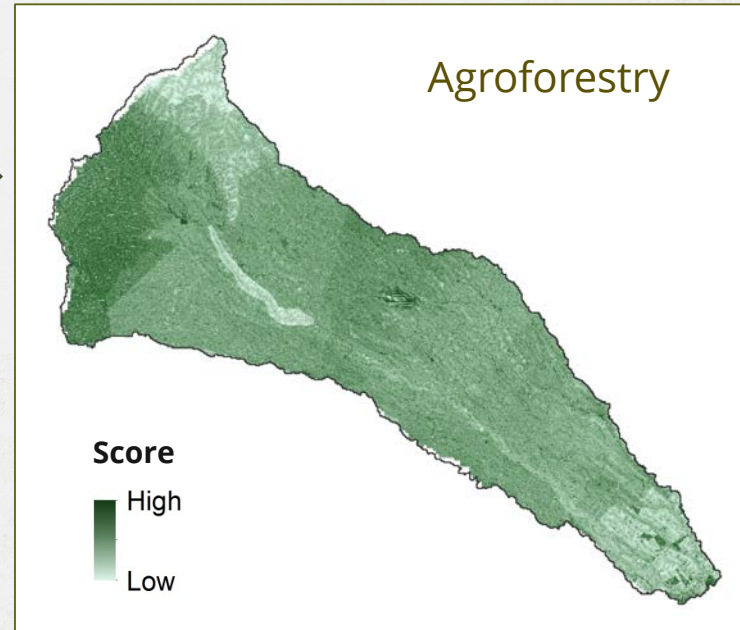
Biophysical effectiveness

People impacted

Suitability maps per activity



Impact scores per activity



RIOS Workflow

Choose Objectives

Diagnostic Screening

Biophysical effectiveness

People impacted

Suitability maps per activity

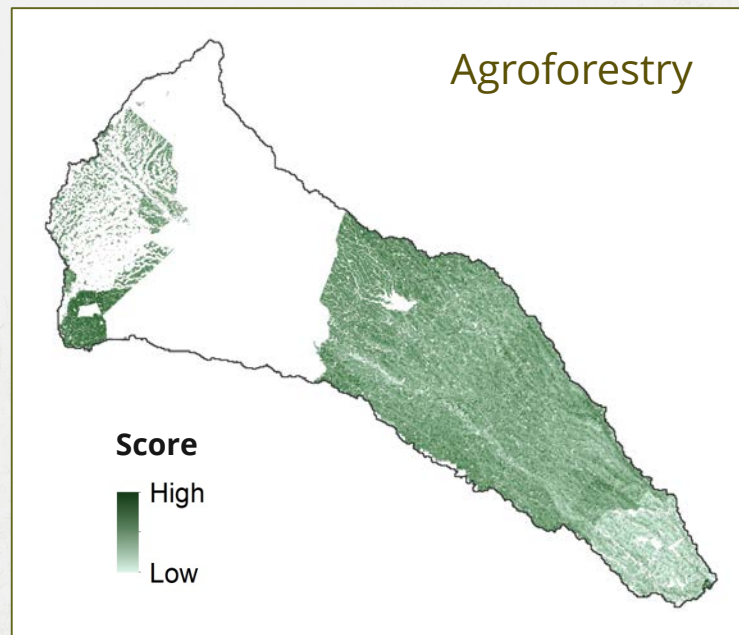
Cost-effectiveness and Feasibility

Activity costs

Preferences/
restrictions

Cost-effectiveness maps per activity

Cost-effectiveness per activity



RIOS Workflow

Choose Objectives

Diagnostic Screening

Biophysical effectiveness

People impacted

Suitability maps per activity

Cost-effectiveness and Feasibility

Activity costs

Preferences/
restrictions

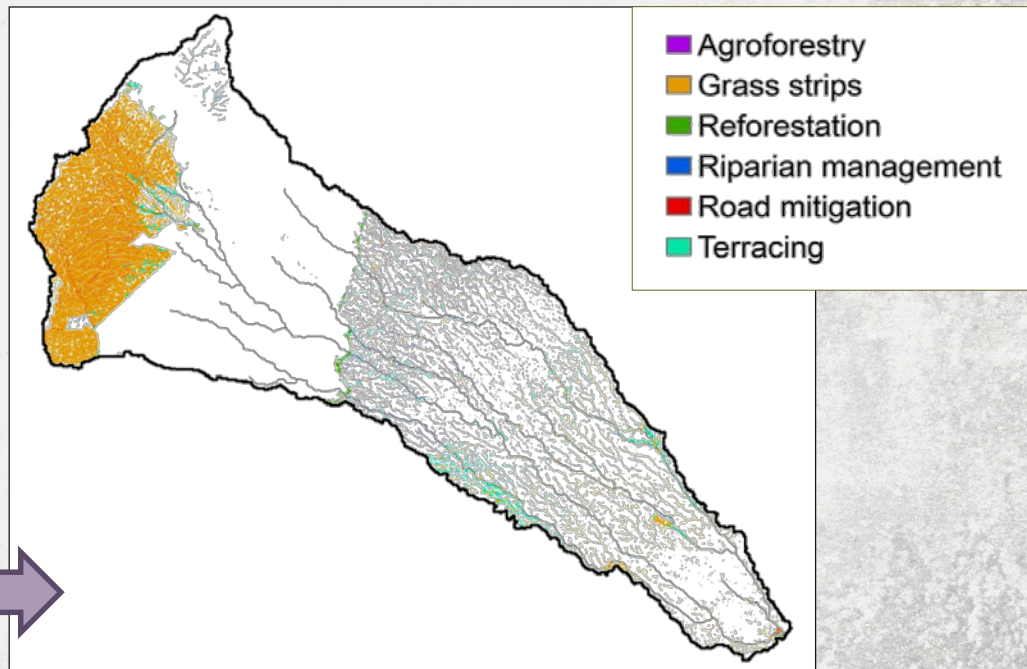
Cost-effectiveness maps per activity

Investment Portfolio

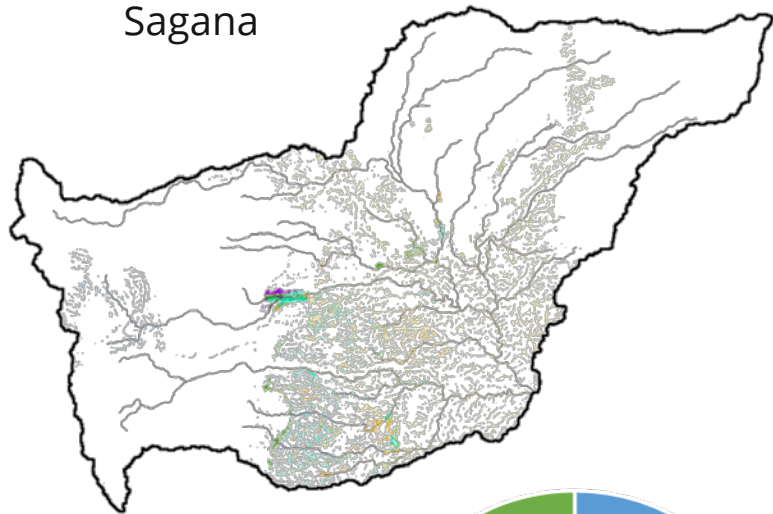
Activity costs

Total budget

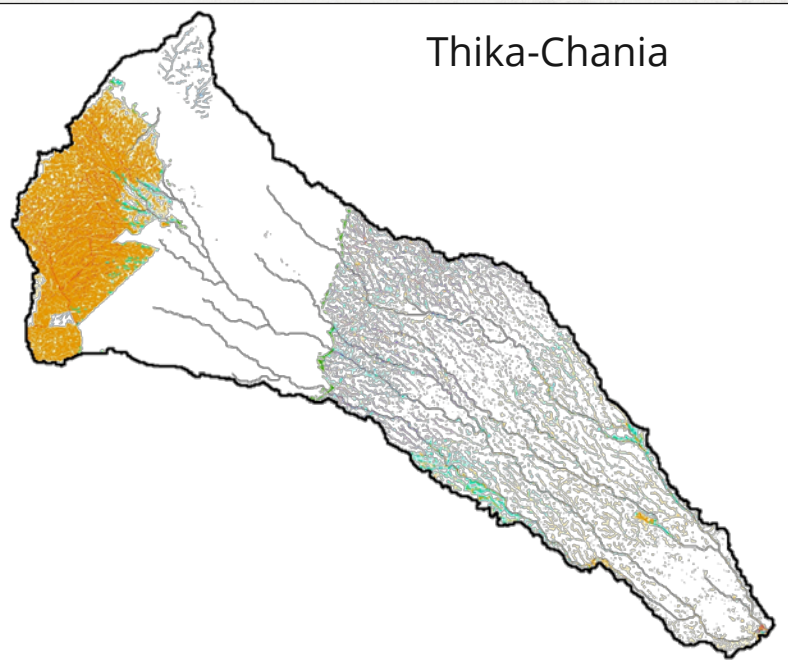
WHICH activities to invest in
and *WHERE*



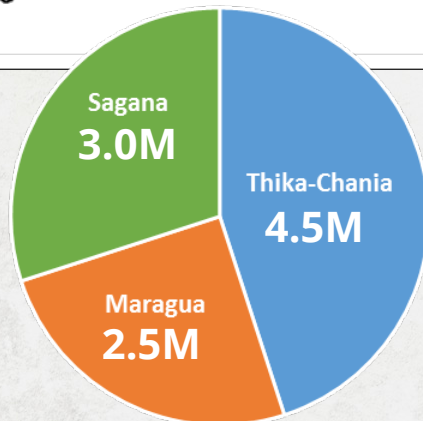
Sagana



Thika-Chania

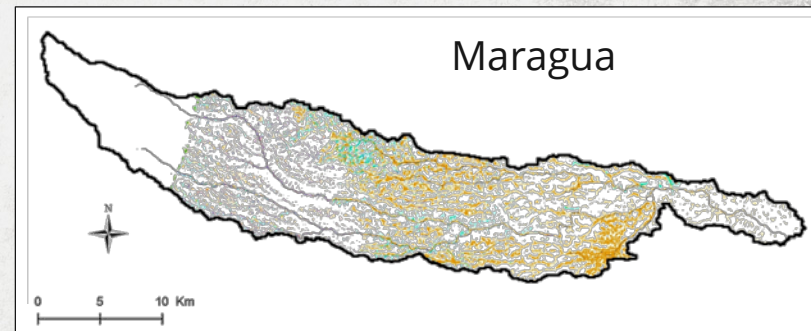


- Agroforestry
- Grass strips
- Reforestation
- Riparian management
- Road mitigation
- Terracing



\$10 million USD over 10 years

Maragua



Phase I (2014)

Where to invest to achieve goals?



Select priority activity areas

Portfolio of activities



What is the return on investment?

SWAT

Changes in flow, erosion



Value of that change



Upper Tana-Nairobi Water Fund
A Business Case

nature.org/africa-water

Phase I (2014)

Where to invest to achieve goals?



Select priority activity areas

Portfolio of activities



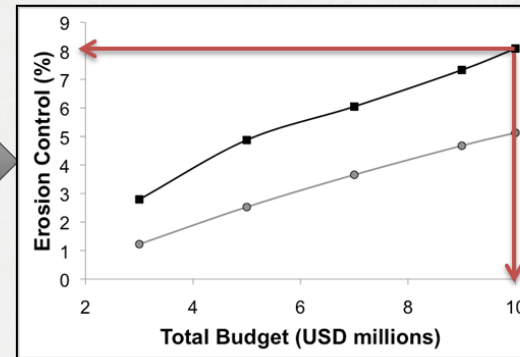
What is the return on investment?

InVEST
integrated valuation of
environmental services
SWAT

Changes in flow,
erosion



Value of that change



Phase II
Set Goals & Targets
(short and long term)

- Monitoring
- Iterative Modelling & Targeting

ACKNOWLEDGEMENTS

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Conservancy



INSTITUTE ON THE
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UNIVERSITY OF MINNESOTA
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HANDS-ON

RIOS in the Gura Sub-watershed