

FROM RIOS TO INVEST

March 25, 2015

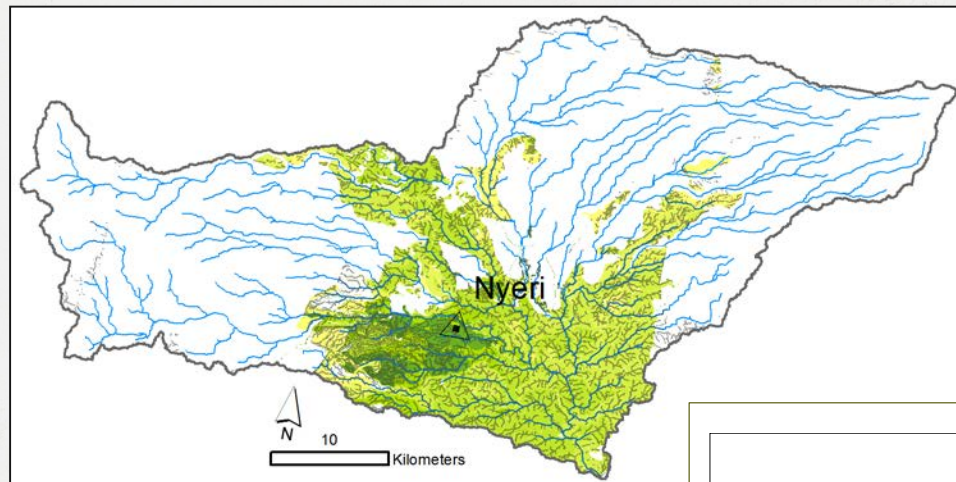
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RETURN ON INVESTMENT

TANA

How is this portfolio likely to affect the watershed services of interest?

Quantify change in services with hydrology models

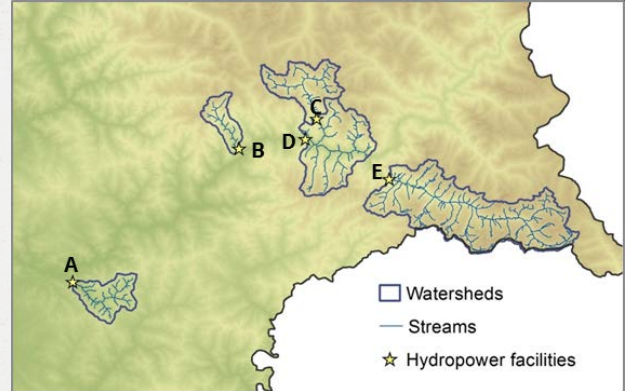


 FutureWater
SWAT analysis

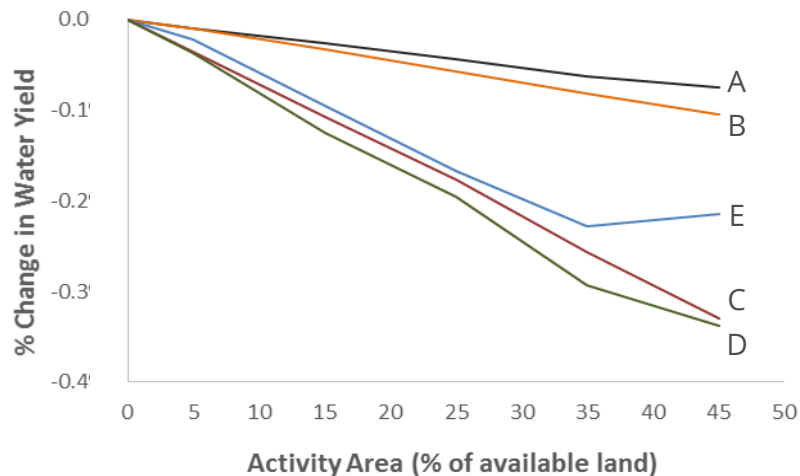
RETURN ON INVESTMENT

HIMACHAL PRADESH

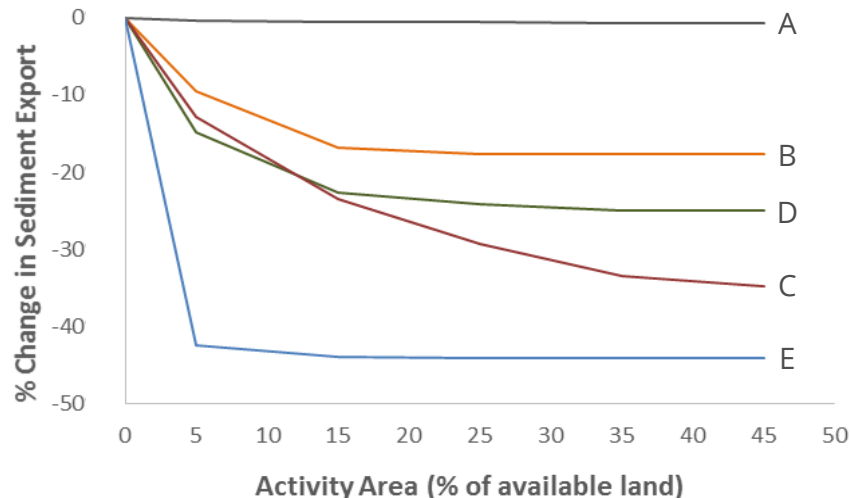
ACTIVITIES + AVOIDED DEGRADATION



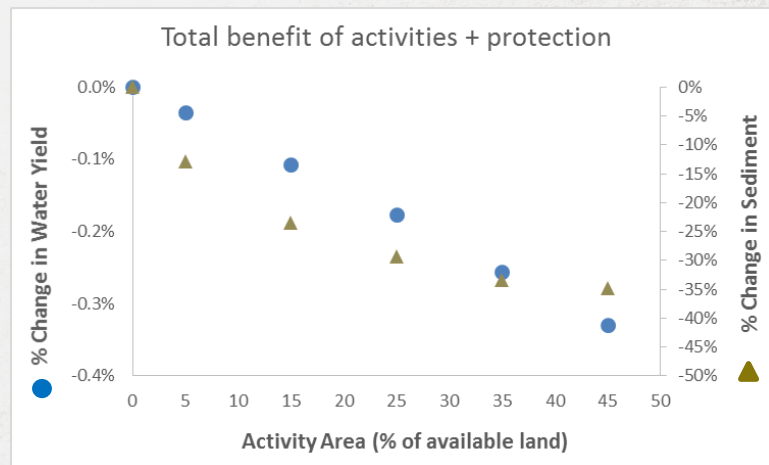
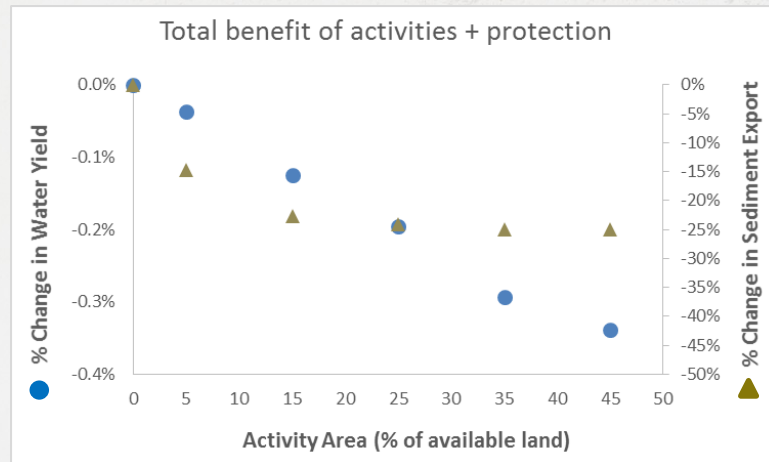
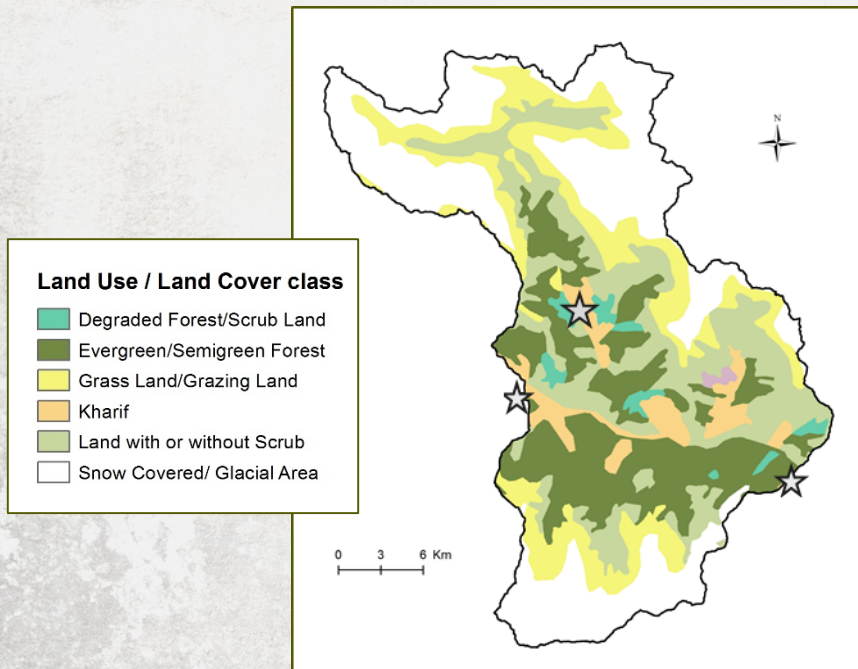
Water Yield



Sediment



THRESHOLDS VARY BY WATERSHED



RIOS -> INVEST PROCESS OVERVIEW

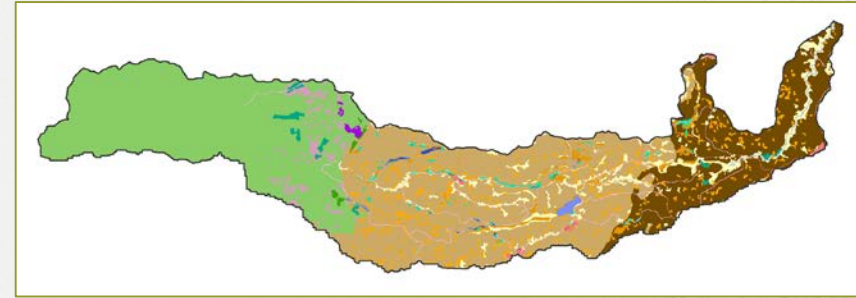
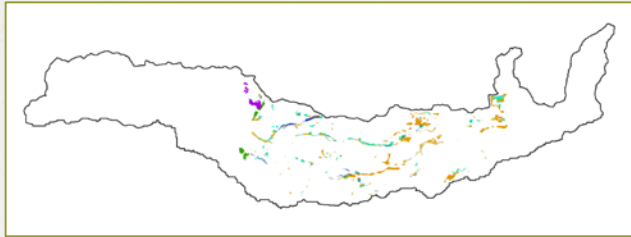
1. Combine RIOS activity portfolio with LULC map
2. Create portfolio biophysical table
3. Run InVEST using these inputs



1. Combine RIOS activity portfolio with LULC

Activity

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

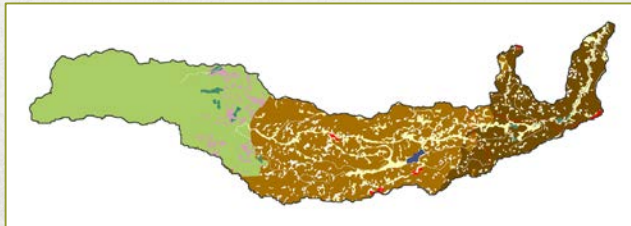


+



LULC class

- Agroforestry
- Coffee
- General agriculture
- Forest
- Forest plantation
- Grass
- Tea
- Unpaved road
- Urban / Paved road
- Water



Portfolio LULC class

- | | |
|------------------------------------|--------------------------------|
| Agroforestry | General agriculture->terracing |
| Agroforestry->grass_strips | Grass |
| Agroforestry->terracing | Grass->agroforestry |
| Coffee | Grass->reforestation |
| Coffee->grass_strips | Grass->riparian_mgmt |
| Coffee->terracing | Tea |
| Forest | Tea->agroforestry |
| Forest plantation | Tea->reforestation |
| Forest plantation->riparian_mgmt | Tea->riparian_mgmt |
| Forest->riparian_mgmt | Unpaved road |
| General agriculture | Unpaved road->road_mitigation |
| General agriculture->grass_strips | Urban |
| General agriculture->riparian_mgmt | Water |

1. Combine RIOS activity portfolio with LULC

Option 1: Do it manually

- In ArcGIS: *Combinatorial And* QGIS: *r.cross* (but...)
- Add results to original LULC: Raster math

25	Grass->riparian_mgmt
26	Grass->agroforestry
27	Grass->reforestation
28	General agriculture->riparian_mgmt
29	General agriculture->terracing
30	General agriculture->reforestation
31	General agriculture->grass_strips
32	Tea->riparian_mgmt
33	Tea->agroforestry
34	Tea->reforestation
35	Coffee->riparian_mgmt
36	Coffee->terracing
37	Coffee->grass_strips
38	Forest->riparian_mgmt
39	Forest plantation->riparian_mgmt
40	Unpaved road->road_mitigation
41	Agroforestry->terracing
42	Agroforestry->grass_strips

1. Combine RIOS activity portfolio with LULC

Option 1: Do it manually


- In ArcGIS: *Combinatorial And* QGIS: *r.cross* (but...)
- Add results to original LULC: Raster math
- Edit attribute table: New LULC codes and names
- Make versions with and without protection
- HOWTO on user forum

Option 2: Use my script – does this for you (Arc only)

Result: *Portfolio LULC raster*

description	lucode
Grass->riparian_mgmt	301
Grass->agroforestry	303
General agriculture->grass_strips	500
General agriculture->riparian_mgmt	501
General agriculture->terracing	502
General agriculture->agroforestry	503
Tea->riparian_mgmt	601
Tea->agroforestry	603
Coffee->grass_strips	700
Coffee->riparian_mgmt	701
Coffee->terracing	702
Coffee->agroforestry	703

**activity
lucode** = *base lucode* + 0 + *activity id*



2. Create portfolio biophysical table

*Original InVEST
biophysical table*

Corresponds
with baseline
LULC map

	A	B	C	D	E	F	G
1	description	lucode	LULC_veg	usle_c	usle_p	root_depth	Kc
2	Urban and paved roads	1	0	0.99	1	0	0.2
3	Bare soil and unpaved roads	2	0	1	1	500	0.15
4	Grass	3	1	0.034	1	2000	0.865
5	Shrub	4	1	0.128	1	2000	0.3
6	General agriculture	5	1	0.412	1	1000	1.1
7	Tea	6	1	0.08135	1	1850	1.015
8	Coffee	7	1	0.4393	1	1600	1.055
9	Mixed forest	8	1	0.025	1	3500	1.008
10	Water	9	0	0	1	10	1.05
11	Evergreen forest	10	1	0.025	1	3500	1.008
12	Forest plantation	11	1	0.121	1	3500	1.008
13	Pineapple	12	1	0.055	1	3500	0.4
14	Wetland	13	0	0.003	1	2200	1.2
15	Orchard	14	1	0.412	1	1000	1.1
16	Corn	15	1	0.412	1	1000	1.1
17	Native montane bunchgrass	16	1	0.03	1	2000	0.925
18	Bare rock	17	0	1	1	500	0.15
19	Unpaved road	18	0	1	1	500	0.15
20	Agroforestry	19	1	0.121	0.6	3500	1.008

2. Create portfolio biophysical table

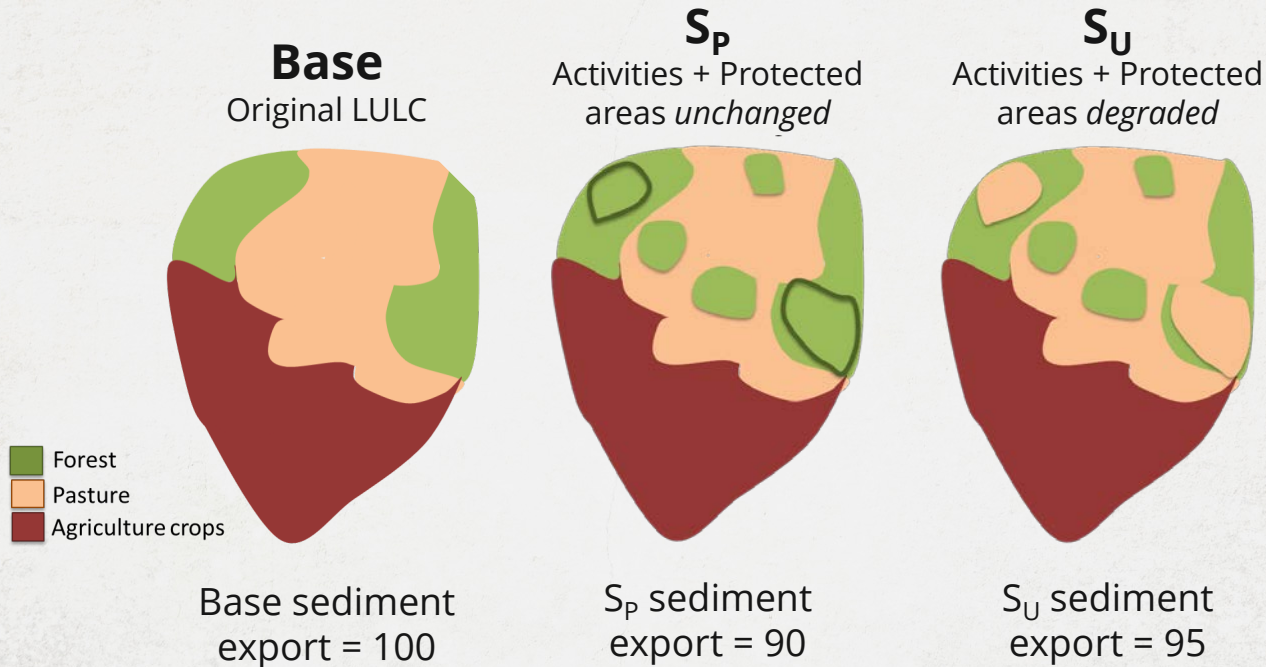
Portfolio InVEST biophysical table

1. Export portfolio LULC attribute table to .dbf (Arc only)
2. Open in Excel, fill in model parameters
3. Save to .csv

	A	B	C	D	E	F	G
1	description	lucode	LULC veg	usle c	usle p	root depth	Kc
21	Grass	3	1	0.034	1	2000	0.865
22	General agriculture	5	1	0.412	1	1000	1.1
23	Tea	6	1	0.08135	1	1850	1.015
24	Coffee	7	1	0.4393	1	1600	1.055
25	Grass->riparian_mgmt	300	1	0.025	0.3	3500	1.008
26	Grass->agroforestry	301	1	0.121	0.6	3500	1.008
27	Grass->reforestation	303	1	0.025	0.3	3500	1.008
28	General agriculture->riparian_mgmt	500	1	0.025	0.3	3500	1.008
29	General agriculture->terracing	502	1	0.206	0.1	1000	1.1
30	General agriculture->reforestation	503	1	0.025	0.3	3500	1.008
31	General agriculture->grass_strips	504	1	0.034	0.3	2000	0.865
32	Tea->riparian_mgmt	600	1	0.025	0.3	3500	1.008
33	Tea->agroforestry	601	1	0.121	0.6	3500	1.008
34	Tea->reforestation	603	1	0.025	0.3	3500	1.008
35	Coffee->riparian_mgmt	700	1	0.025	0.3	3500	1.008
36	Coffee->terracing	702	1	0.22	0.1	1600	1.055
37	Coffee->grass_strips	704	1	0.034	0.3	2000	0.865
38	Forest->riparian_mgmt	800	1	0.025	0.3	3500	1.008
39	Forest plantation->riparian_mgmt	1100	1	0.025	0.3	3500	1.008
40	Unpaved road->road_mitigation	1805	0	0.5	0.1	500	0.15
41	Agroforestry->terracing	1902	1	0.06	0.1	3500	1.008
42	Agroforestry->grass_strips	1904	1	0.034	0.3	2000	0.865

3. Run InVEST

- Use combined portfolio LULC raster as model input
- Use updated biophysical table as model input
- If using a Protection activity, run with both 'protected' and 'unprotected' scenarios
- Compare results to baseline LULC...



Total benefit:

$$S_p - \text{Base} = 90 - 100 = \mathbf{-10}$$

$$S_p - S_U = 90 - 95 = \mathbf{-5}$$

$$\mathbf{Net\ benefit: -10 + -5 = -15}$$