



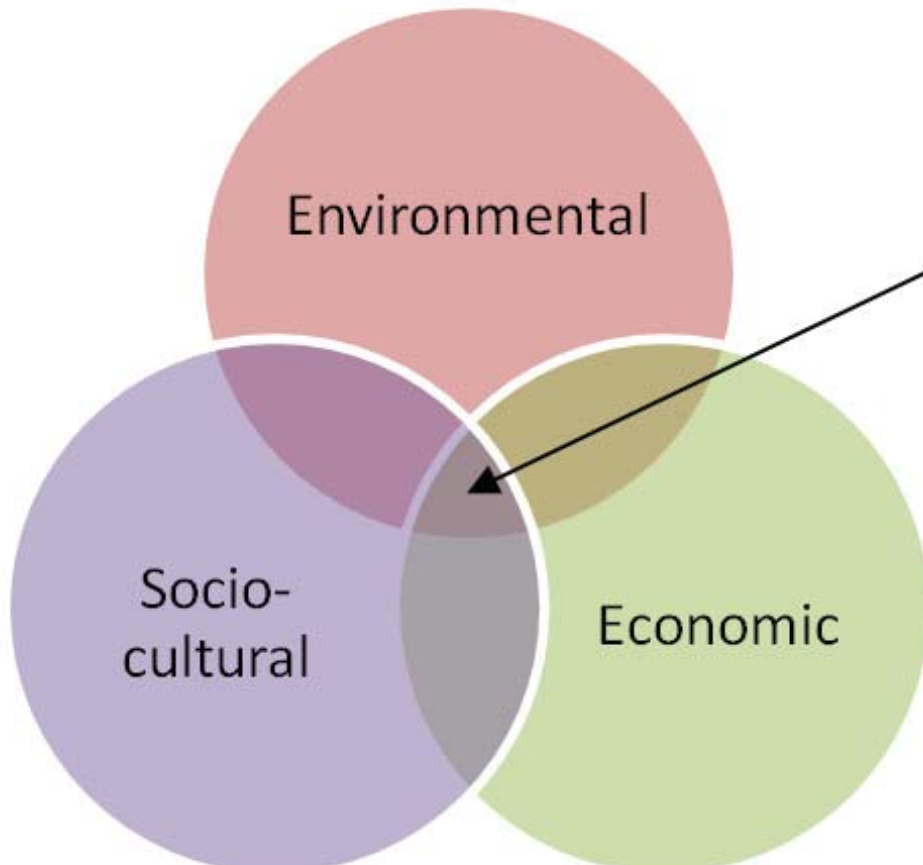
Modelling the impact and viability of sustainable land management technologies: what are the bottlenecks?

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Sustainable land management (SLM)



The best land use practices are sustainable in all three aspects: *Environmental*, *Socio-cultural* and *Economic*

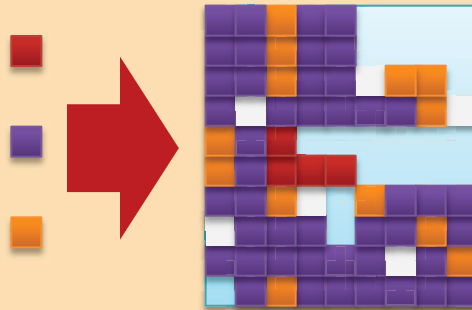
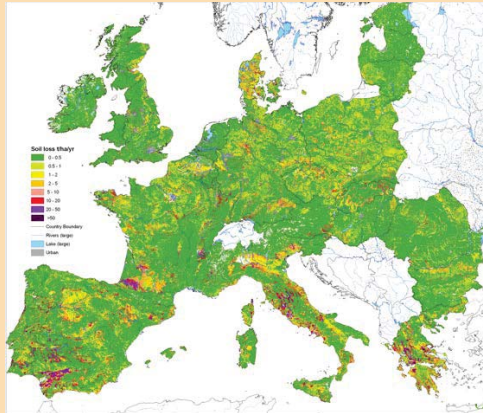
- Often requires investment
- Almost always takes time to develop beneficial effects

Modelling the effects of SLM options

Rationale:

- **experimental conditions limited**
(weather & environmental conditions)
- **trial duration too short**
(long-term impacts not tested)
- **opportunity of scenario analysis**
(evaluating performance under extreme circumstances)
- **effects across larger scales**
(aggregate effects study site)
- **alternative and complimentary approach**

The PESERA-DESMICE modelling framework

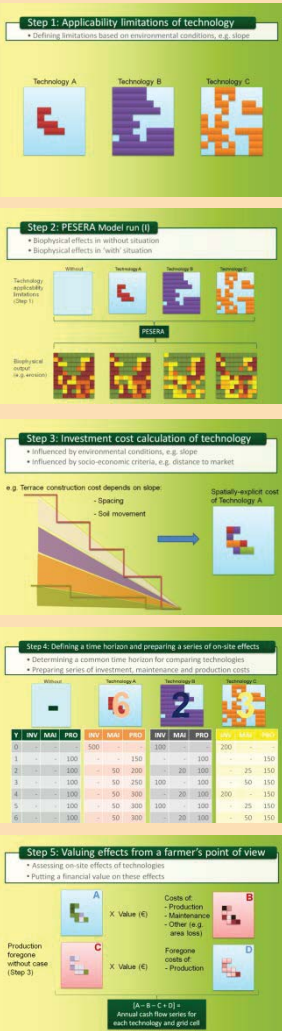


PESERA : Grid-based regional scale soil risk assessment model (grid 0.1 – 1 km), modified to take into account effect of various SLM strategies and other degradation types

DESMICE : New model scaling up SLM feasibility assessments from local to regional level using spatially-explicit financial cost-benefit analysis

Combined, these models can assess effects and viability of SLM under different scenarios.

The PESERA-DESMICE modelling approach



Step 1: Applicability limitations of technology

- Defining limitations based on environmental conditions, e.g. slope

Step 2: PESERA Model run (I)

- Biophysical effects in 'without' situation
- Biophysical effects in 'with' situation

Step 3: Investment cost calculation of technology

- Influenced by environmental conditions, e.g. slope
- Influenced by socio-economic criteria, e.g. distance to market

Step 4: Defining a time horizon and preparing a series of on-site effects

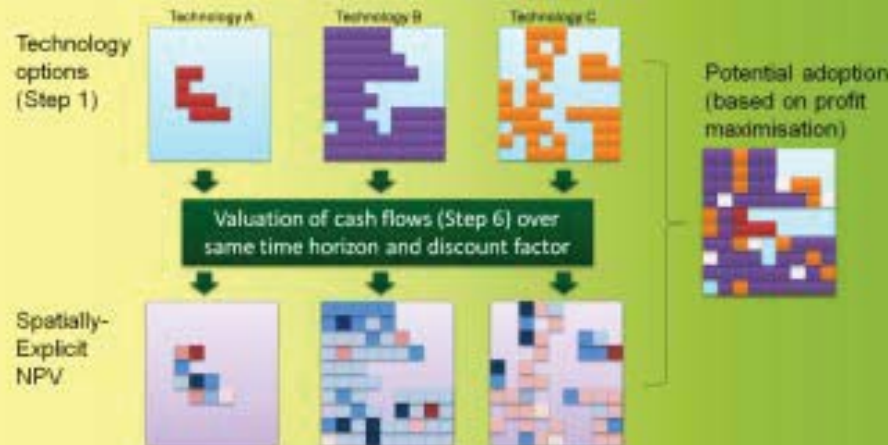
- Determining a common time horizon for comparing technologies
- Preparing series of investment, maintenance and production costs

Step 5: Valuing effects from a farmer's point of view

- Assessing on-site effects of technologies
- Putting a financial value on these effects

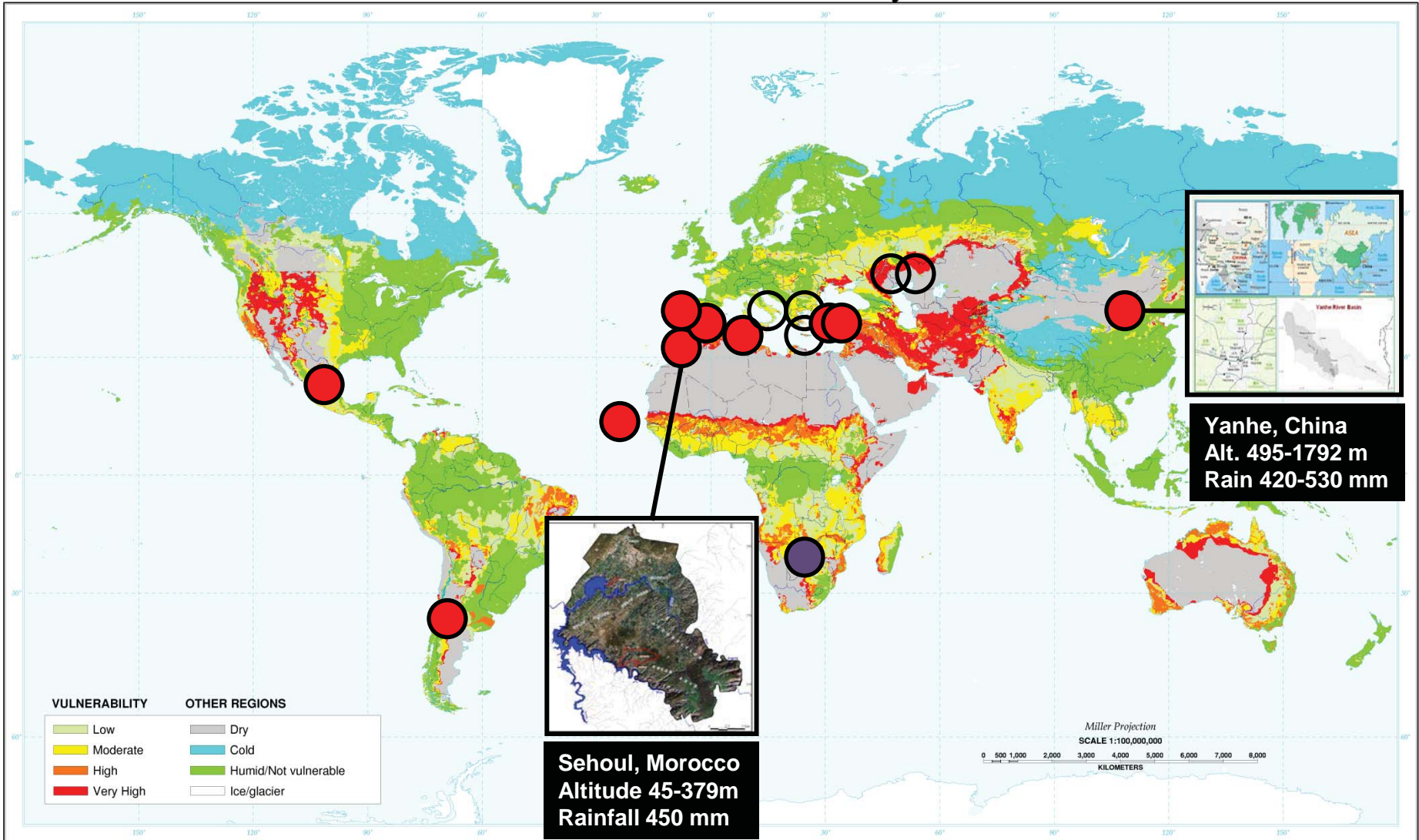
Step 6: Financial CBA integration

- Maps with Net Present Value (NPV) of each technology
- Potential adoption map based on profit maximisation



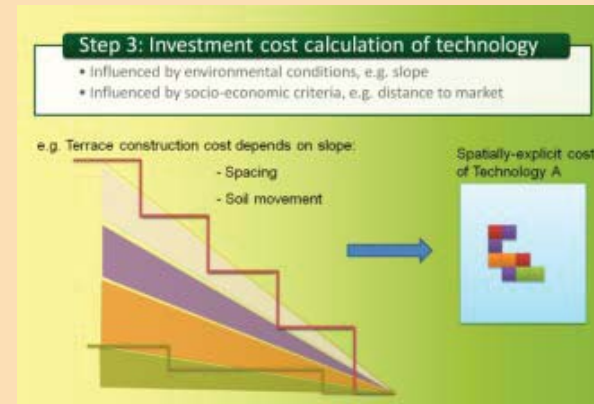
Model application DESIRE study sites

Desertification Vulnerability



Bottlenecks

Bottleneck I: Spatial variability of investment cost



$$INV_S = US\$1,823 * S/30$$

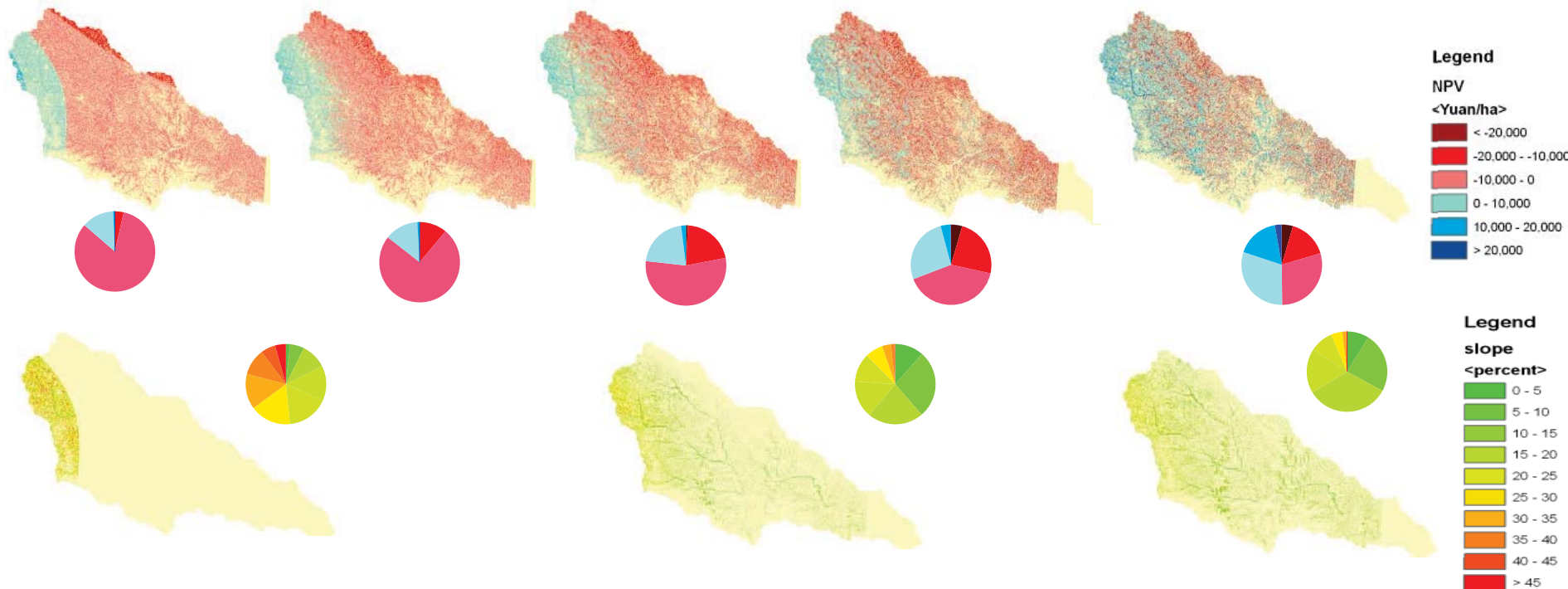
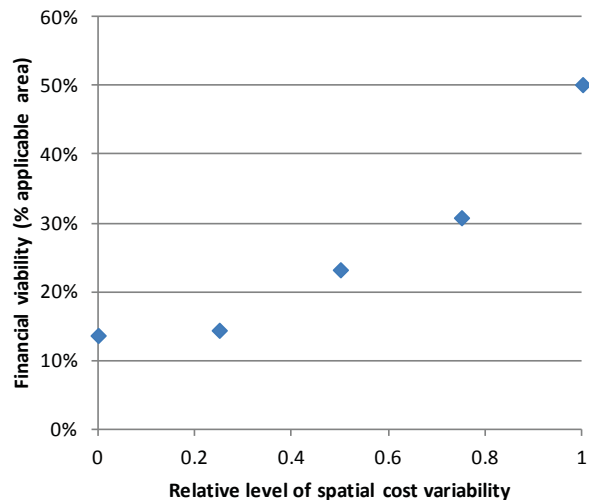
In Yanhe river basin, China bench terraces are applicable in 3,732 km²

The average cost is \$1,591 ± \$717

Subtracting mean from calculated cost, we can reduce spatial variability by multiplying by fractions 0.75, 0.5, 0.25 and 0.

Bottleneck I: Spatial variability of investment cost

Investment cost (US\$)	Relative level of spatial cost variability				
	0	0.25	0.50	0.75	1
Maximum	1,591	2,488	3,386	4,284	5,182
Minimum	1,591	1,196	801	406	12
St. deviation	0	179	359	538	717



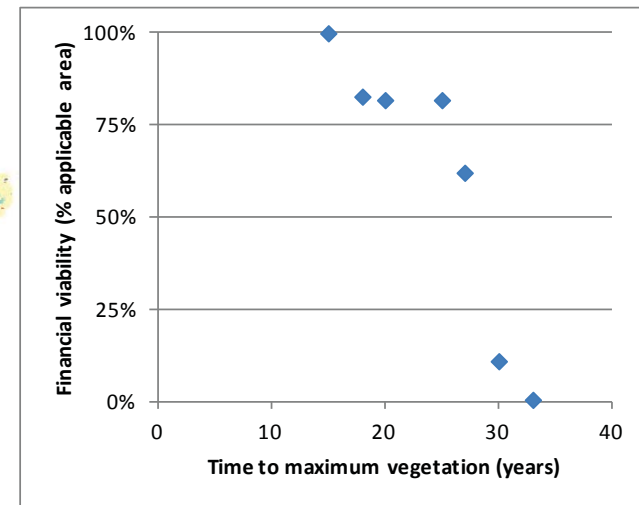
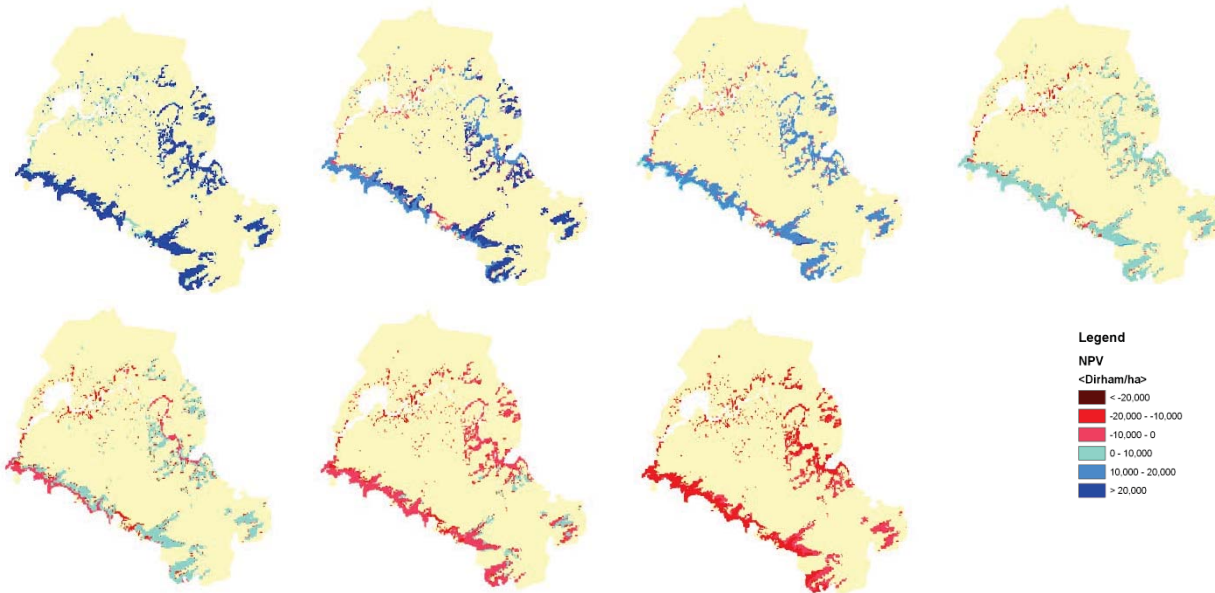
Bottleneck II: Timing of biophysical effects



Change in the discounting horizon:

$$NPV_{TTM=j} = \left(\sum_{t=1}^{t=20} \frac{\max(t/j, 1)}{(1.1)^t} \right) * NPV_{TTM=20}$$

Variations relative to the standard period: 15 – 33 years

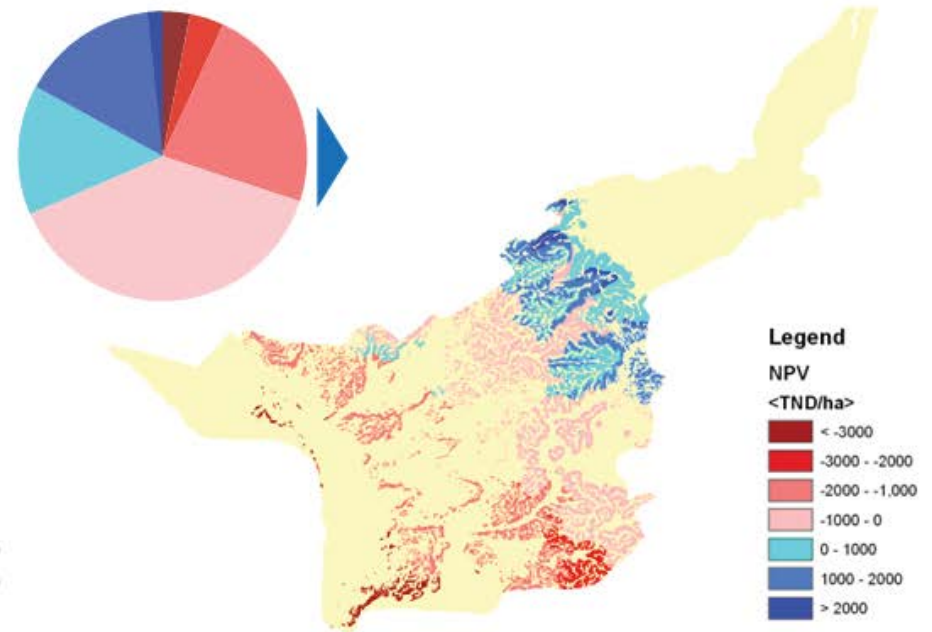
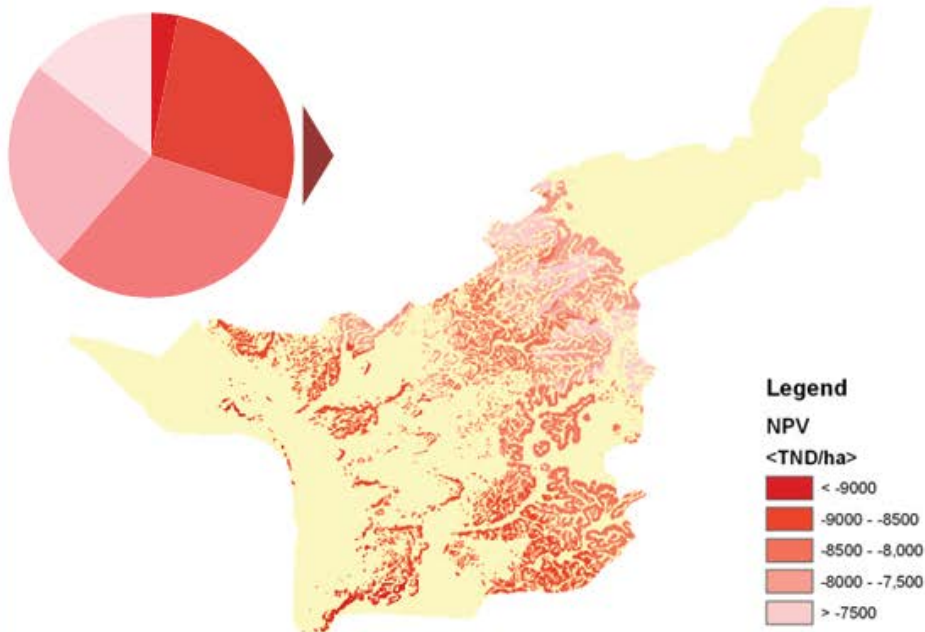


Bottleneck III: Scale and circumstances

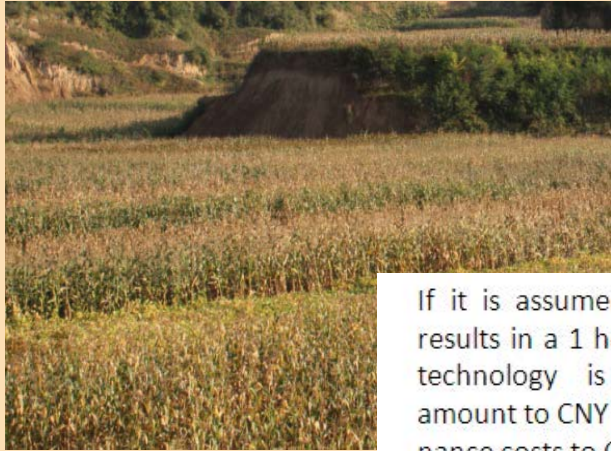


Net Present Value (20 years): olive trees newly planted

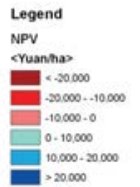
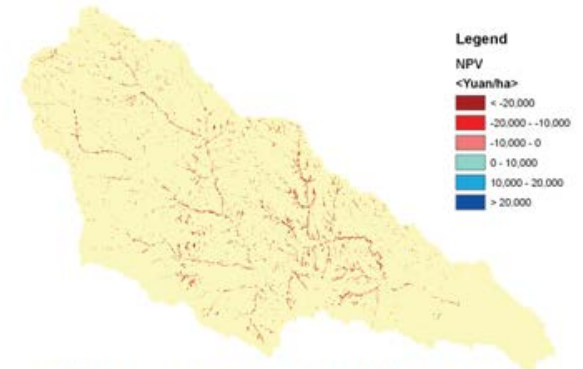
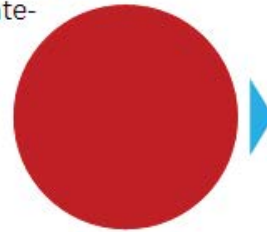
Maintenance of jessour with existing olive trees



Bottleneck III: Scale and circumstances

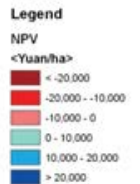
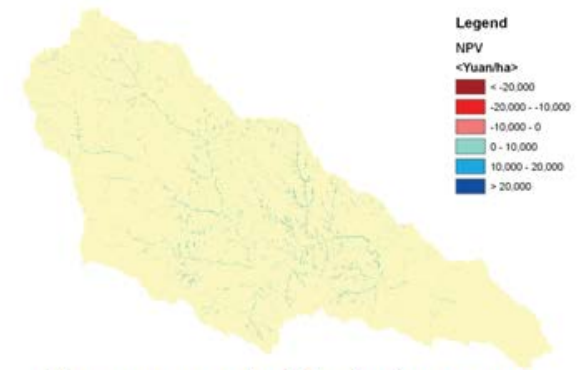


If it is assumed that each check-dam implemented results in a 1 hectare of improved cropping land, the technology is too expensive. Investment costs amount to CNY 40,495 (€4,993) and maintenance costs to CNY 900 (€111) per year.



**Net present value if ratio investment:
improved cropping land 1:1**

If 1 ha of treated land leads to 3 ha land with improved yield, the analyses reverts to a 100% profitable outcome.



**Net present value if ratio investment:
improved cropping land 1:3**

Conclusions

- (Simple) technological options exist that can minimize land degradation and increase food production. A major bottleneck for adoption is investment cost, and its spatial variability is poorly documented.
- Timing of effects is crucial. Models need to get the temporal detail right in order to perform meaningful analyses.
- There are important scale design and opportunity cost considerations which influence the analysis. For larger (more expensive) technologies feasibility studies will need to be done on a case by case basis. Model can be used for first approximation.



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