UNIVERSITY OF LEEDS

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

Luuk Fleskens

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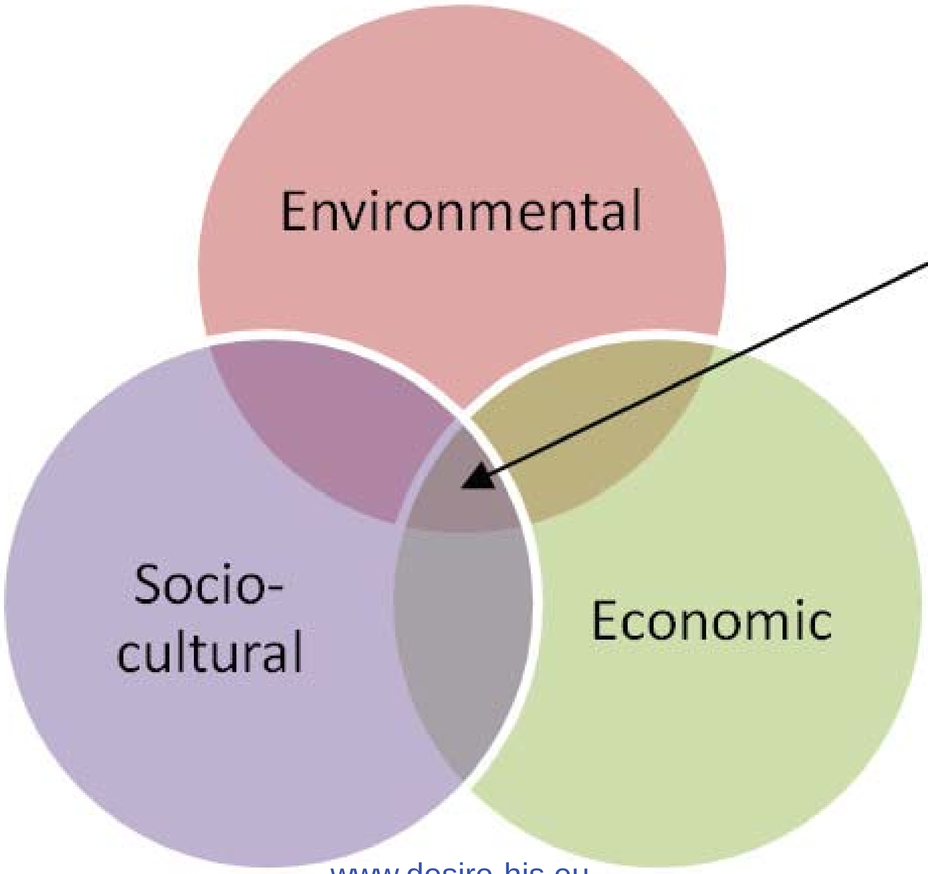
DESIRE
A global initiative to combat desertification

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

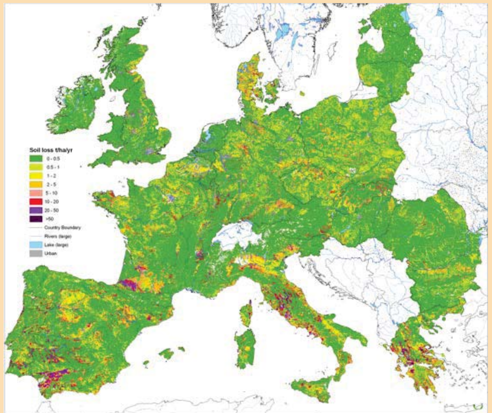
www.desire-his.eu

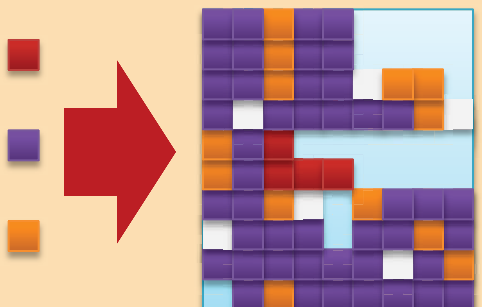
Modelling the effects of SLM options

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



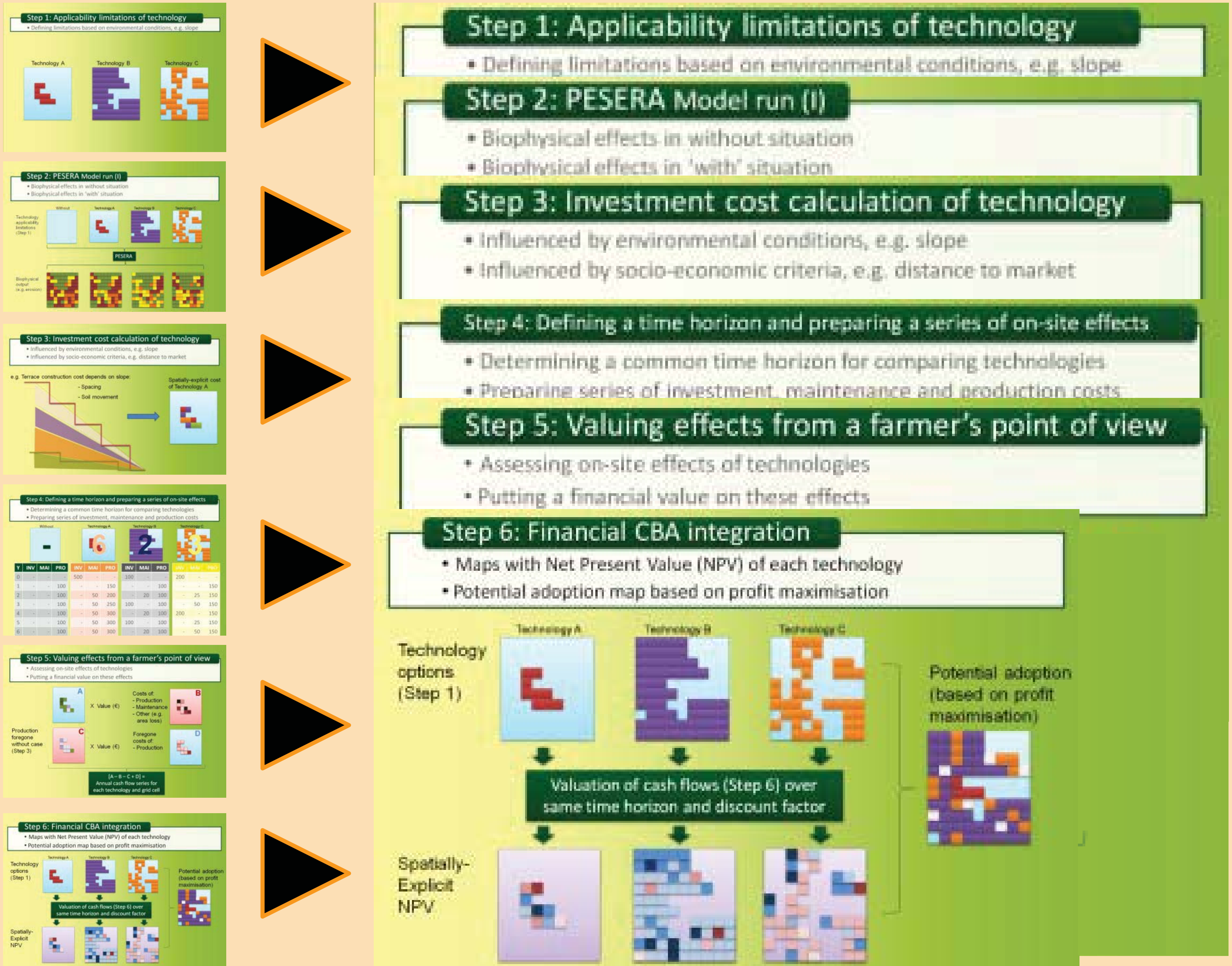


PESERA : Grid-based regional scale soil risk assessment model (grid 0.1 – 1 km), modified to take into account effect of various SLM strategies and other degradation types

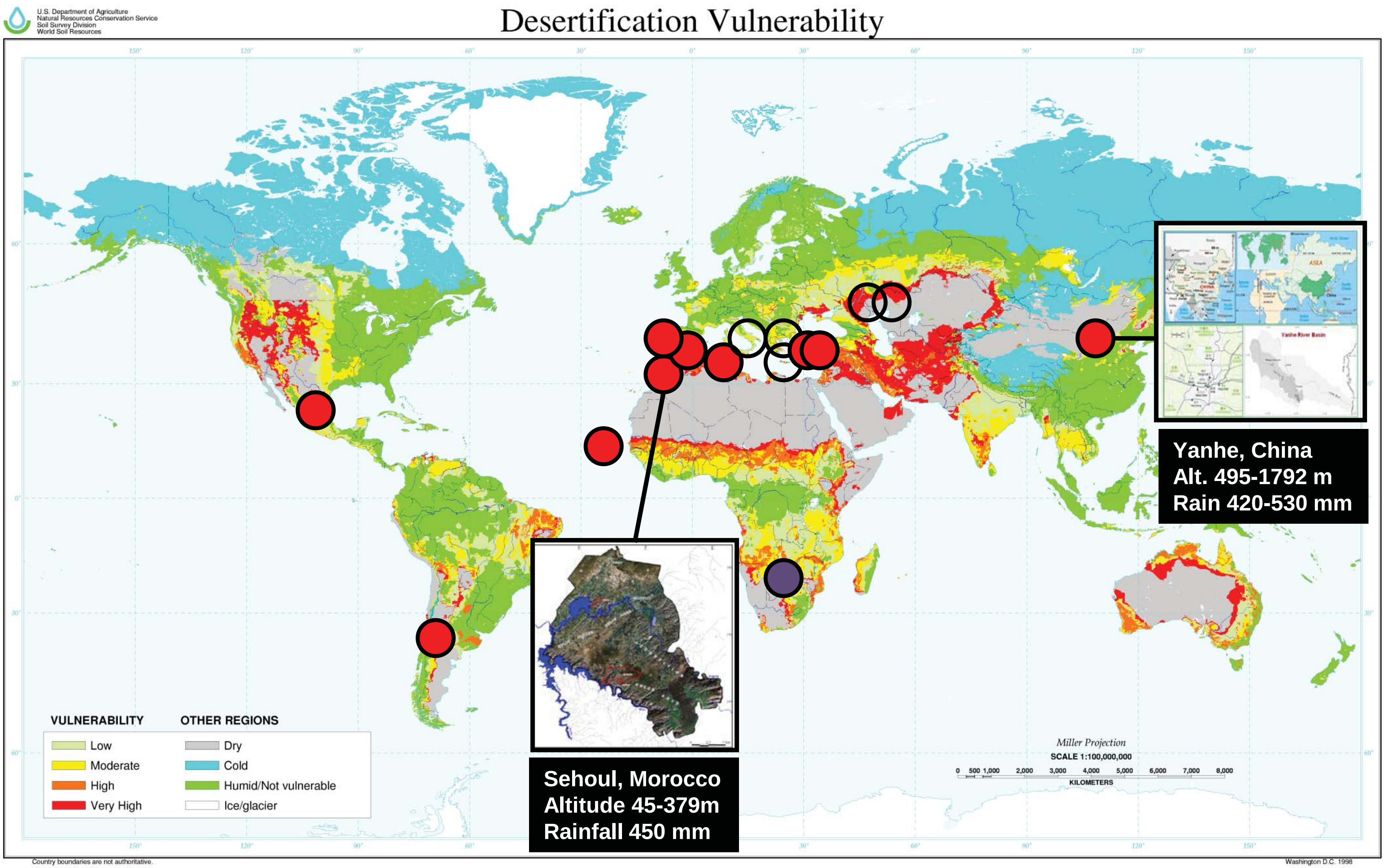
DESMICE : New model scaling up SLM feasibility assessments from local to regional level using spatially-explicit financial cost-benefit analysis

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

The PESERA-DESMICE modelling approach



Model application DESIRE study sites

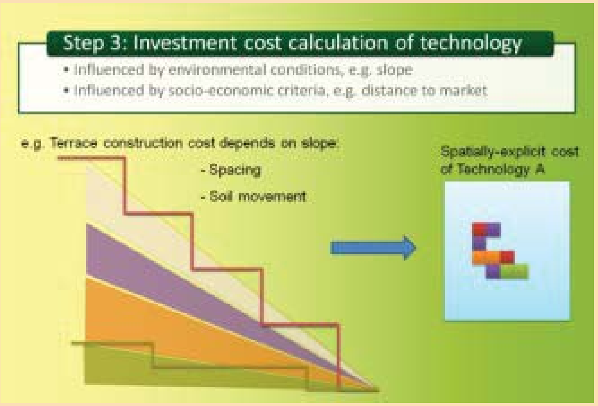


Bottlenecks

as follows:

Bottleneck 1: Spatial variability of investment cost

(1)



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

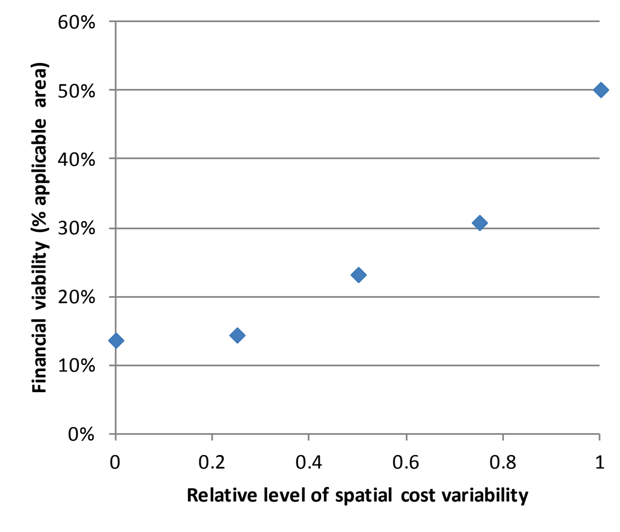
In Yanhe river basin, China bench terraces are applicable in 3,732 km2

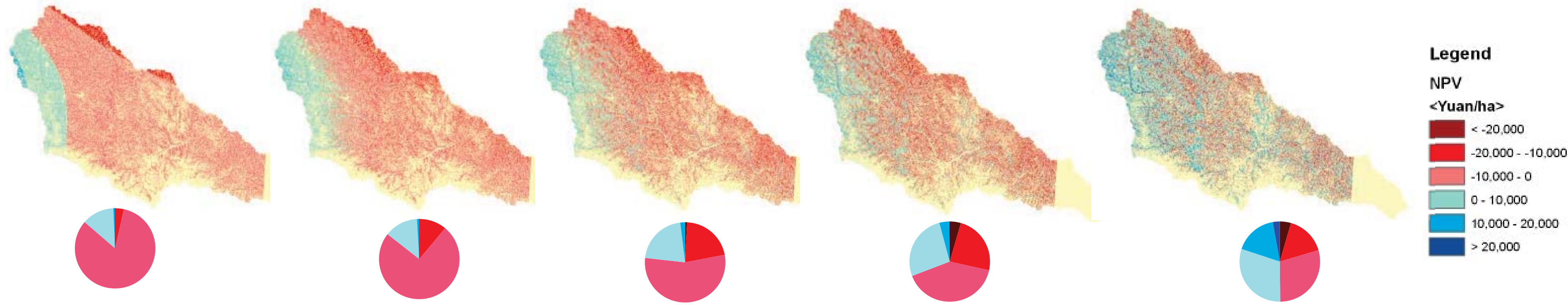
The average cost is \$1,591 ± \$717

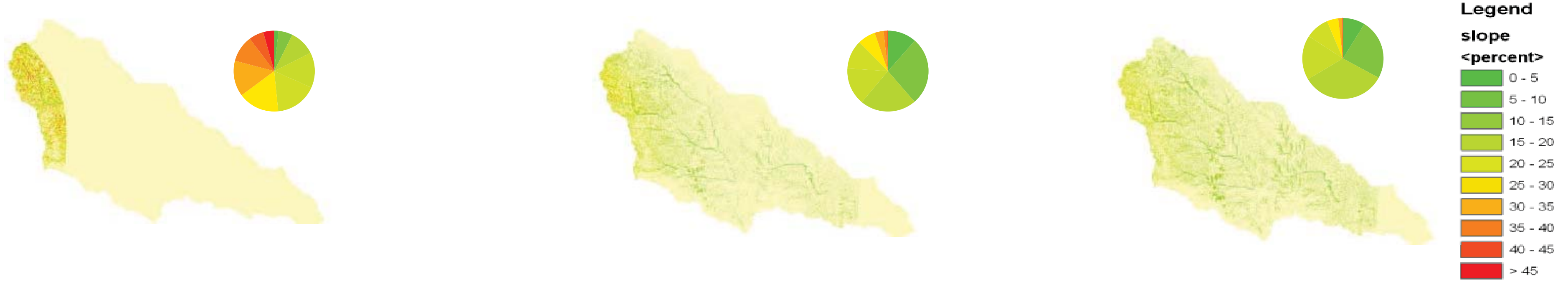
Subtracting mean from calculated cost, we can reduce spatial variability by multiplying by fractions 0.75, 0.5, 0.25 and 0.

Bottleneck 1: 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





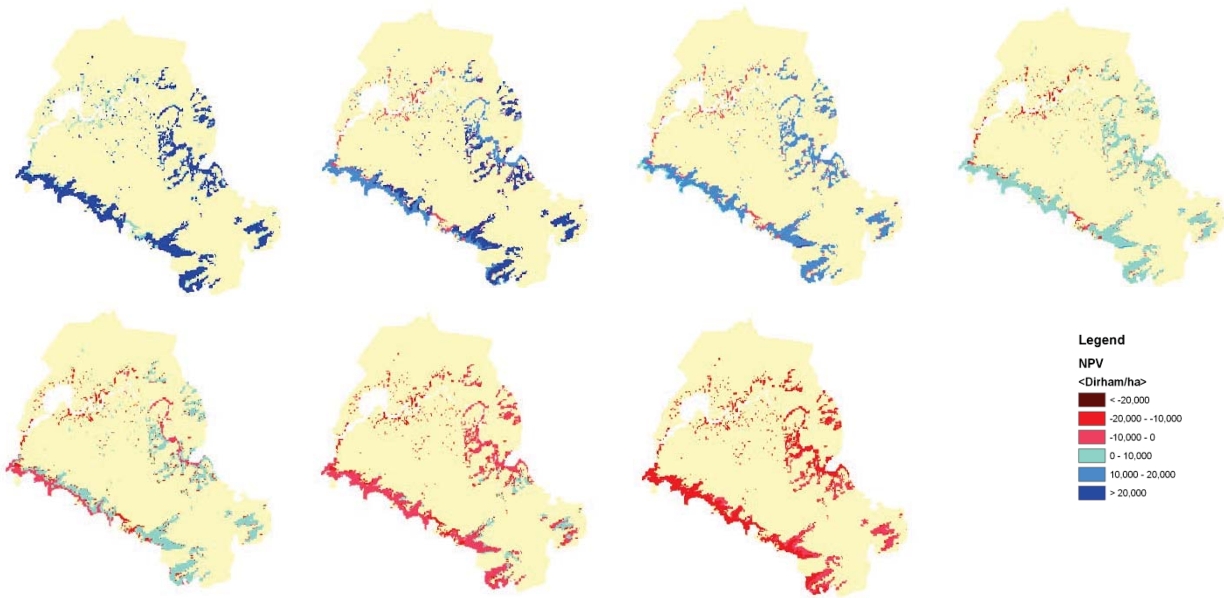


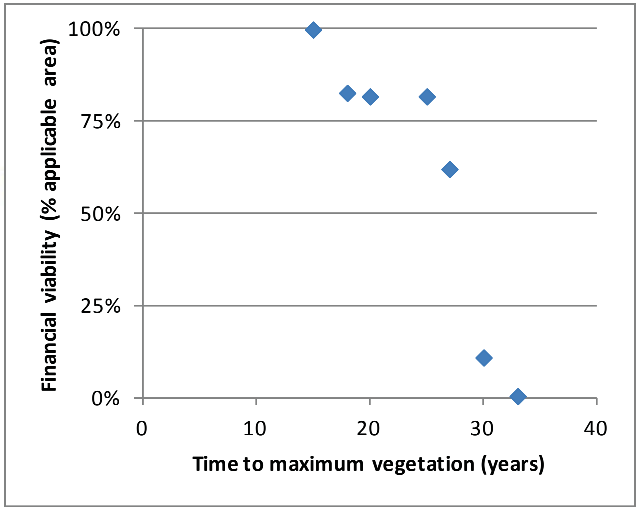
Bottleneck II: Timing of biophysical effects

Change in the discounting horizon:

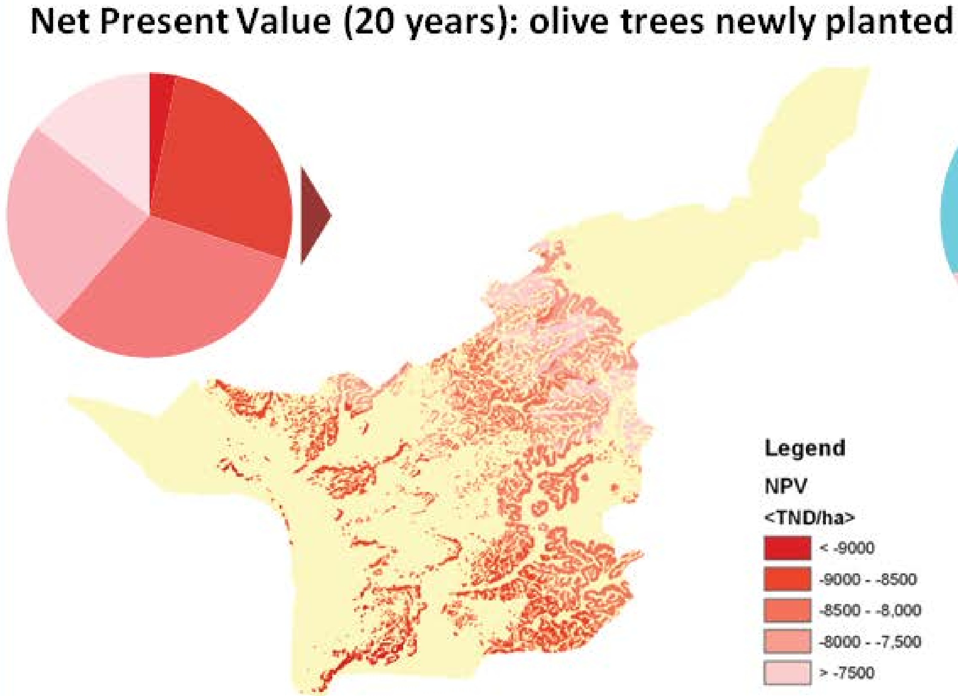
$$NPV_{TTM=j} = \left(\sum_{t=1}^{t=20} \frac{max(t/j,1)}{(1.1)^t} \right) * NPV_{TTM=20}$$

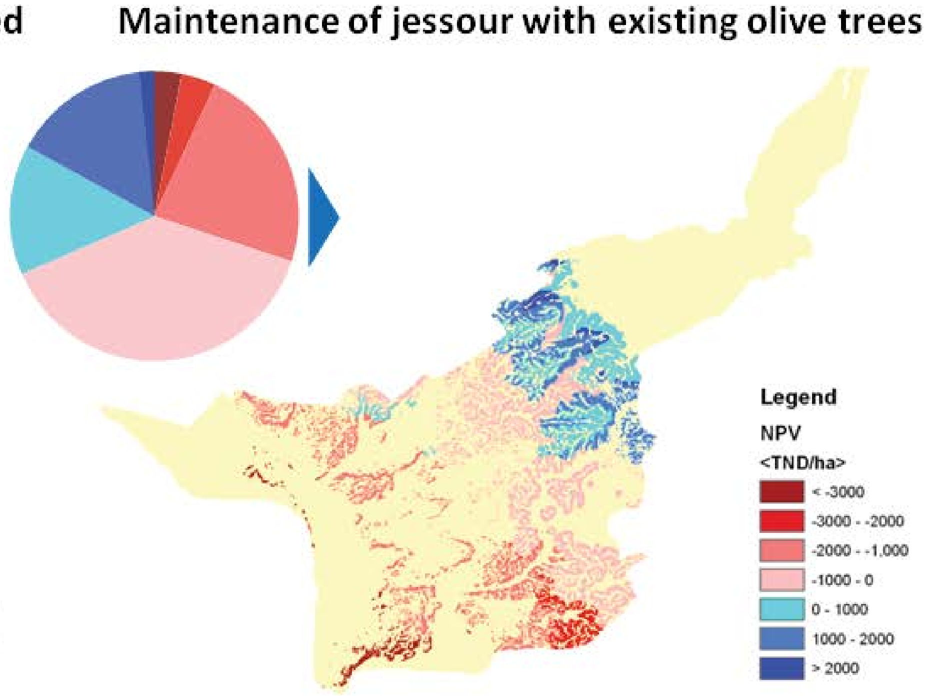
Variations relative to the standard period: 15 – 33 years





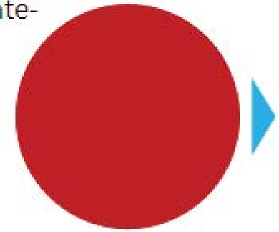
Bottleneck III: Scale and circumstances

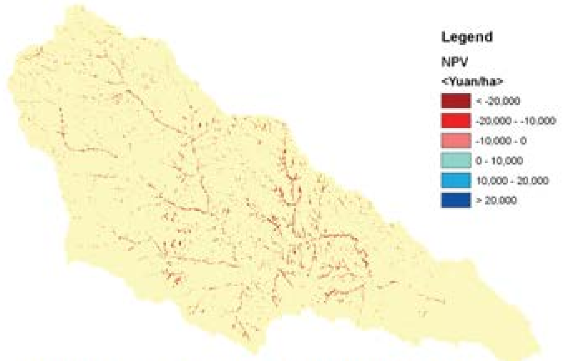




Bottleneck III: Scale and circumstances

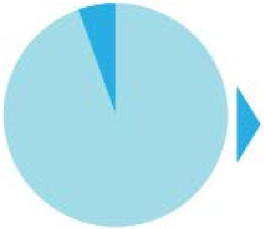
If it is assumed that each check-dam implemented results in a 1 hectare of improved cropping land, the technology is too expensive. Investment costs amount to CNY 40,495 (€4,993) and mainte-nance costs to CNY 900 (€111) per year.

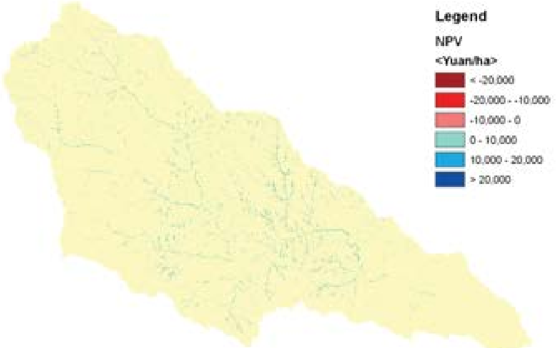




Net present value if ratio investment: improved cropping land 1:1

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





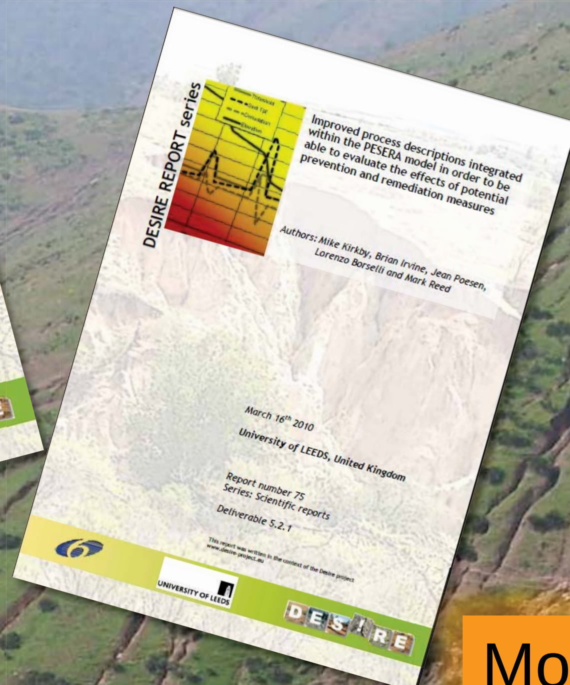
Net present value if ratio investment: improved cropping land 1:3

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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DESIRE &
PESERA-DESMICE:
www.desire-his.eu
l.fleskens@leeds.ac.uk