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Ecosystem Science for Policy & Practice
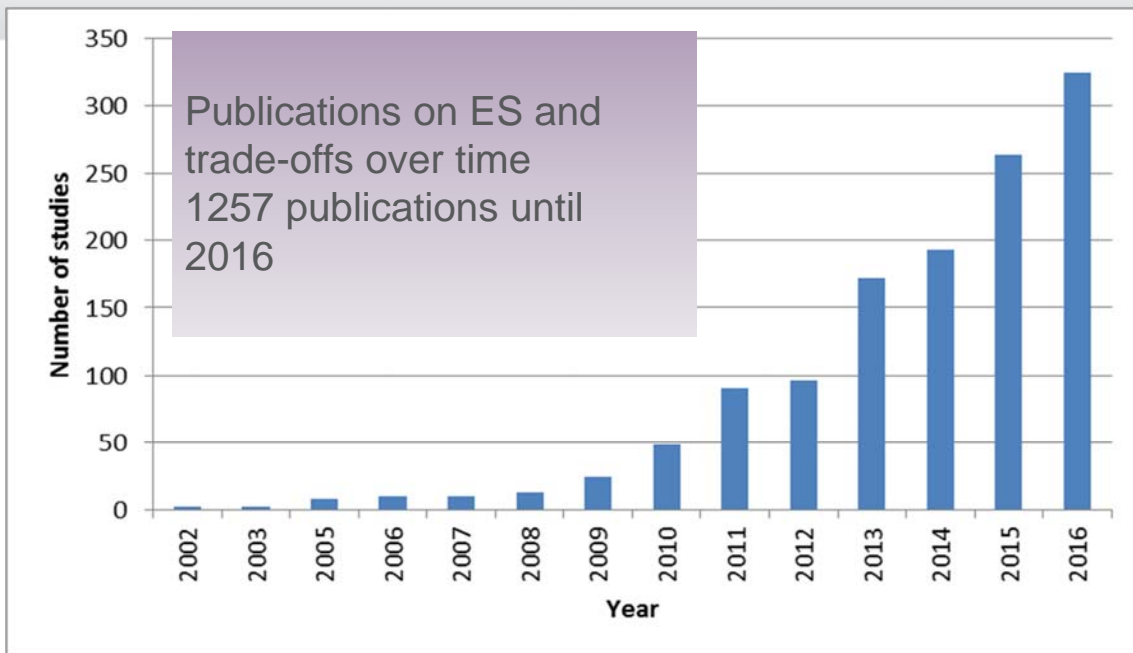
WP3 – Knowledge:

Synthesis on navigating ES trade-offs in land use and land management (D3.7)

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Trade-offs: increasingly studied in ES research

Publications on ES and trade-offs over time
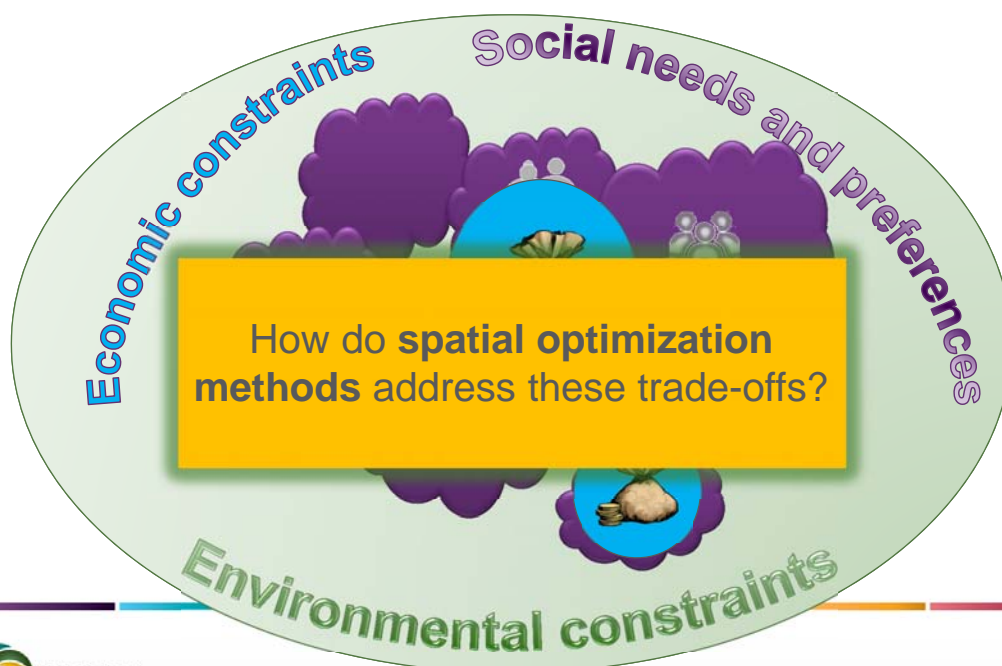1257 publications until 2016

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Carefully navigating trade-offs is relevant because:
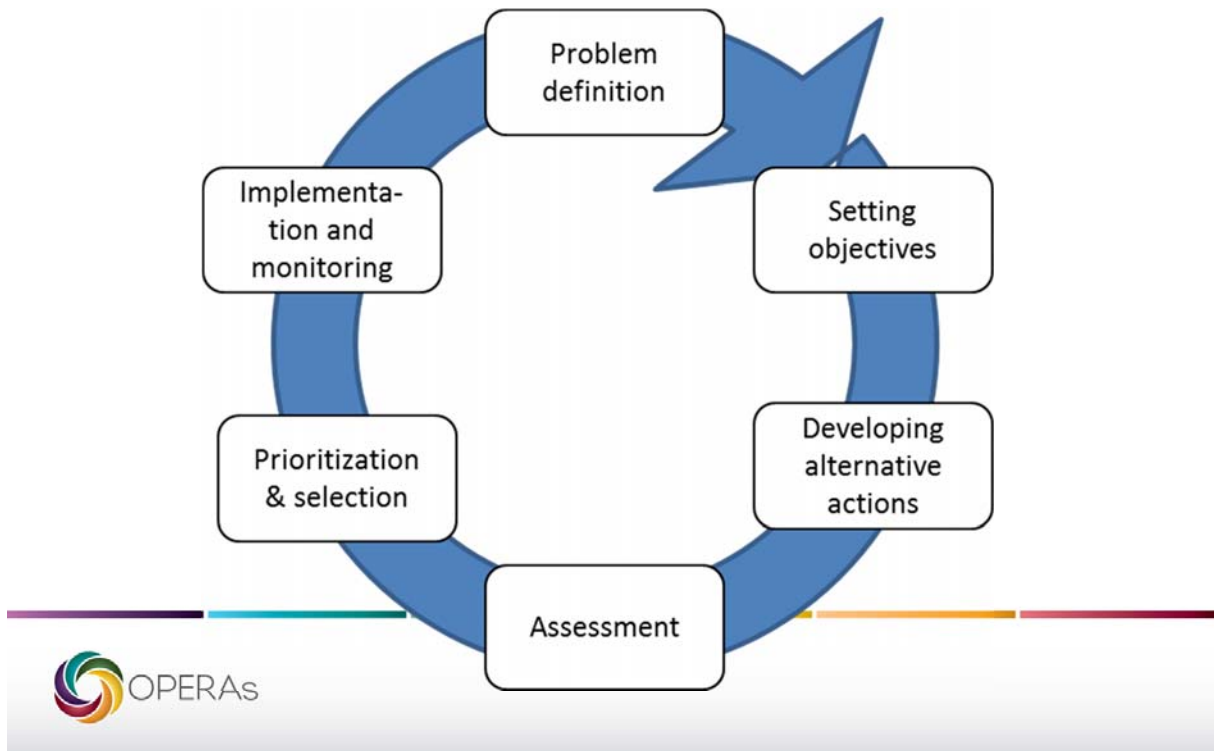
Landscape planning and management determines

- **What** benefits are maintained / enhanced / reduced

- **Where** these gains and losses are located (space)

- **When** gains and losses take effect (time)
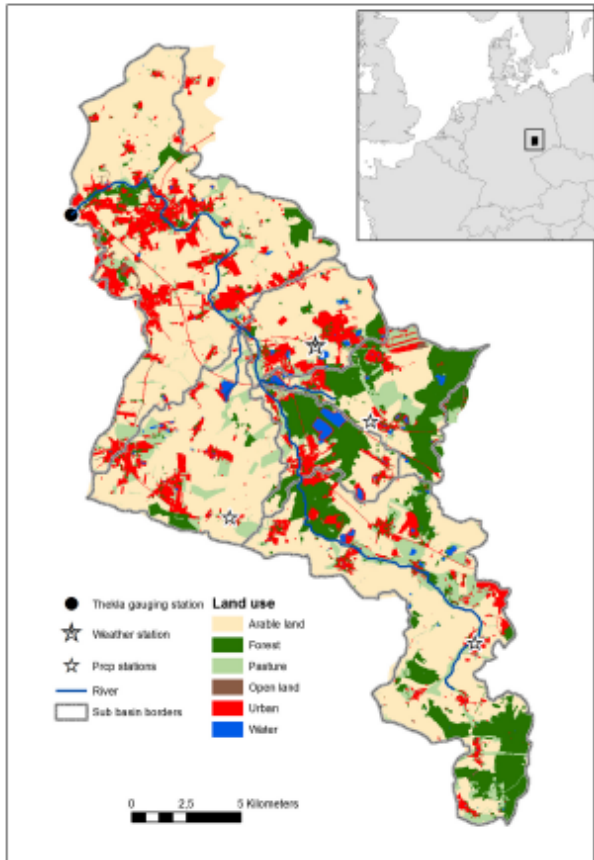
- **Who** wins and who loses

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Trade-offs in decision making

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Steps in spatial planning processes

Problem definition → Setting objectives → Developing alternative actions → Assessment → Prioritization & selection → Implementation and monitoring
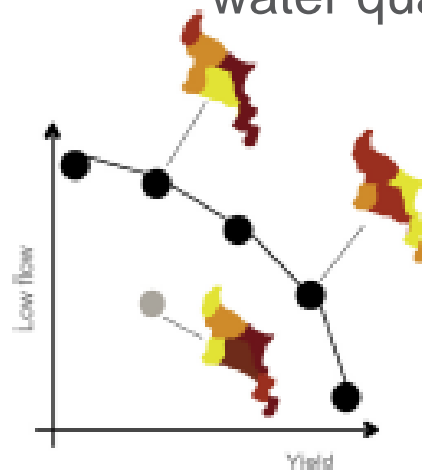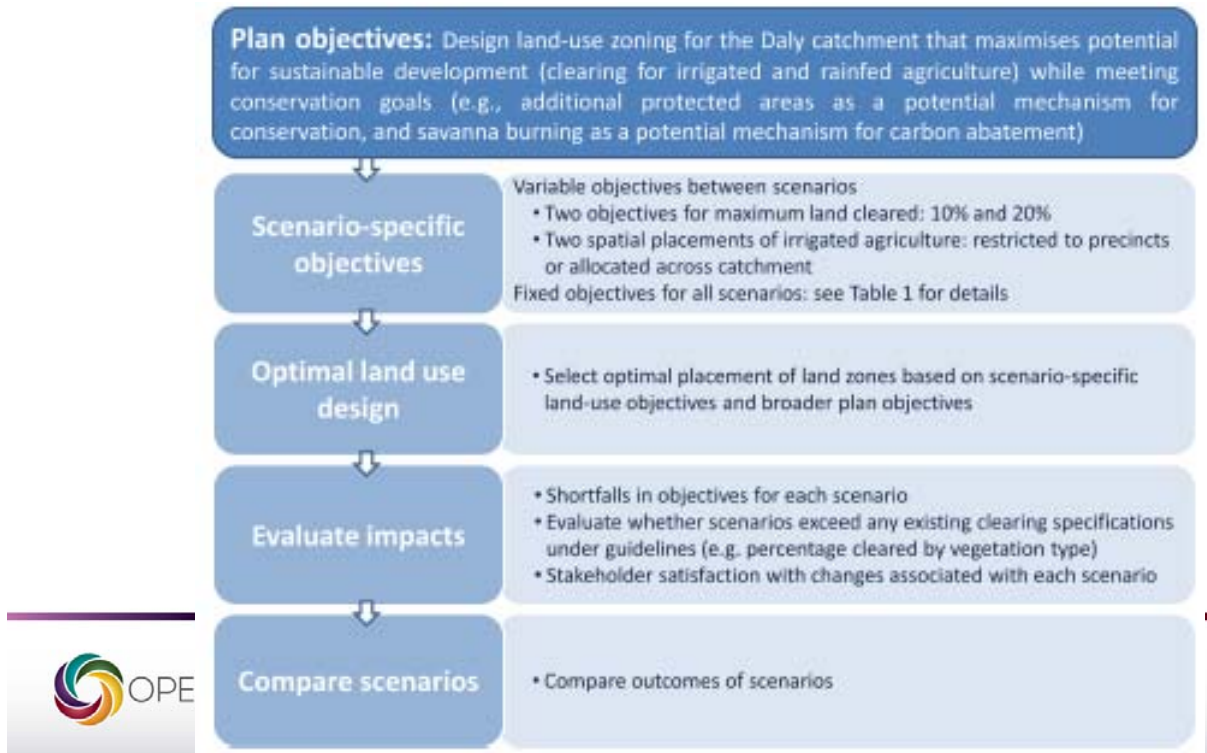
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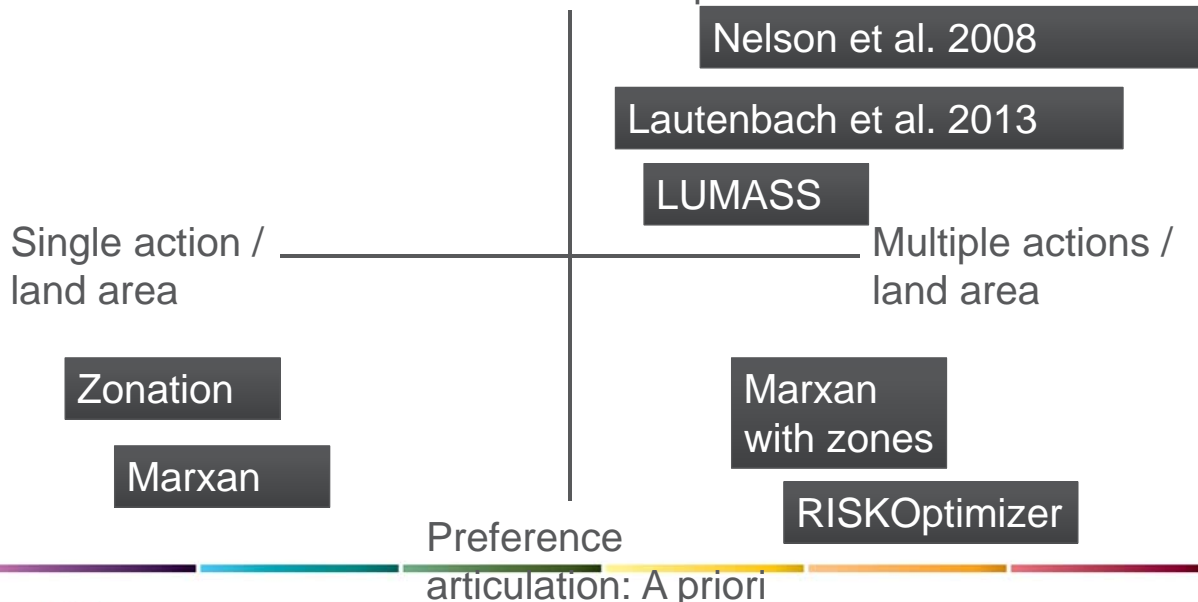S. Lautenbach et al. / Environmental Modelling & Software 48 (2013) 98–112

Lautenbach et al 2013: Optimizing
Crop rotation schemes
- bioenergy production
-food/fodder production
-water quantity
water quality

Thekla gauging station
Weather station
Prop stations
River
Sub basin borders

Land use
Arable land
Forest
Pasture
Open land
Urban
Water

0 2.5 5 Kilometers

Plan objectives: Design land-use zoning for the Daly catchment that maximises potential for sustainable development (clearing for irrigated and rainfed agriculture) while meeting conservation goals (e.g., additional protected areas as a potential mechanism for conservation, and savanna burning as a potential mechanism for carbon abatement)

Scenario-specific objectives

Variable objectives between scenarios
- Two objectives for maximum land cleared: 10% and 20%
- Two spatial placements of irrigated agriculture: restricted to precincts or allocated across catchment

Fixed objectives for all scenarios: see Table 1 for details

Optimal land use design

- Select optimal placement of land zones based on scenario-specific land-use objectives and broader plan objectives

Evaluate impacts

- Shortfalls in objectives for each scenario
- Evaluate whether scenarios exceed any existing clearing specifications under guidelines (e.g. percentage cleared by vegetation type)
- Stakeholder satisfaction with changes associated with each scenario

Compare scenarios

- Compare outcomes of scenarios

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Preference articulation: A posteriori

Nelson et al. 2008

Lautenbach et al. 2013

LUMASS

Single action / land area

Multiple actions / land area

Zonation

Marxan

Marxan with zones

RISKOptimizer

Preference articulation: A priori

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- The field of ecosystem services is actively testing and developing ways to integrate ecosystem services into land use planning, including through the use of optimization decision support tools.

- a wide variety of approaches originating from e.g. conservation planning, agricultural sciences and land use modelling.

- While most of the studies reviewed here are merely academic exercises still, there are also reports of actual on-the-ground planning studies.

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Many studies/methods originate from biodiversity conservation planning. Important differences with ecosystem services:

- The role of beneficiaries / ES flows (conservation areas may be located in remote places, for many ES this is not an option)

- Input data: species one may count, estimate population viability – for ES quantification is often not straightforward and many different techniques are needed

- Setting quantitative objectives for ES…

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