



PBL Netherlands Environmental
Assessment Agency

Trade-offs and synergies between grazing intensity and ecosystem services in rangelands

22-01-2015 | Dr. Katalin Petz

*FAO project workshop – Participatory assessment
of land degradation and sustainable land
management in grassland and pastoral systems*



Outline

- Introduce myself
- Draw the general context and explain my work (objective, methods, results, conclusion)
- Strength and limitations of the approach
- Relevance of my work for this FAO project



About myself...

- Researcher at the PBL Netherlands Environmental Assessment Agency
 - Modelling ecosystem services for European Nature Outlook
- Obtained PhD degree at Wageningen University (2014)
 - *“Mapping and modelling the effects of land use and land management change on ecosystem services – from local ecosystems and landscapes to global biomes”*
- Last chapter in PhD thesis
 - Petz et al. (2014) *Global Environmental Change*, Mapping and modelling trade-offs and synergies between grazing intensity and ecosystem services in rangelands using global-scale datasets and models

(Link: <http://www.sciencedirect.com/science/article/pii/S0959378014001496>)

What is the problem in rangelands?

- Natural grasslands, scrublands, woodlands and (semi-)deserts
- Livestock production principle land use
- Livelihood for 1 billion poor through pastoralism
- People rely directly on ecosystem services (ES)
- ESs supply depend on natural productivity and grazing intensity



- Increasing grazing intensity → overgrazing, biodiversity decline, accelerated climate change & erosion... → trade-offs
- Concern how manage livestock production without compromising the environment & minimize trade-offs

In this context we need to...

- Understand the spatial pattern of grazing intensity and its impact on ESs



- in order to inform policy making on states and trends of ESs and manage rangelands more sustainably



Objective

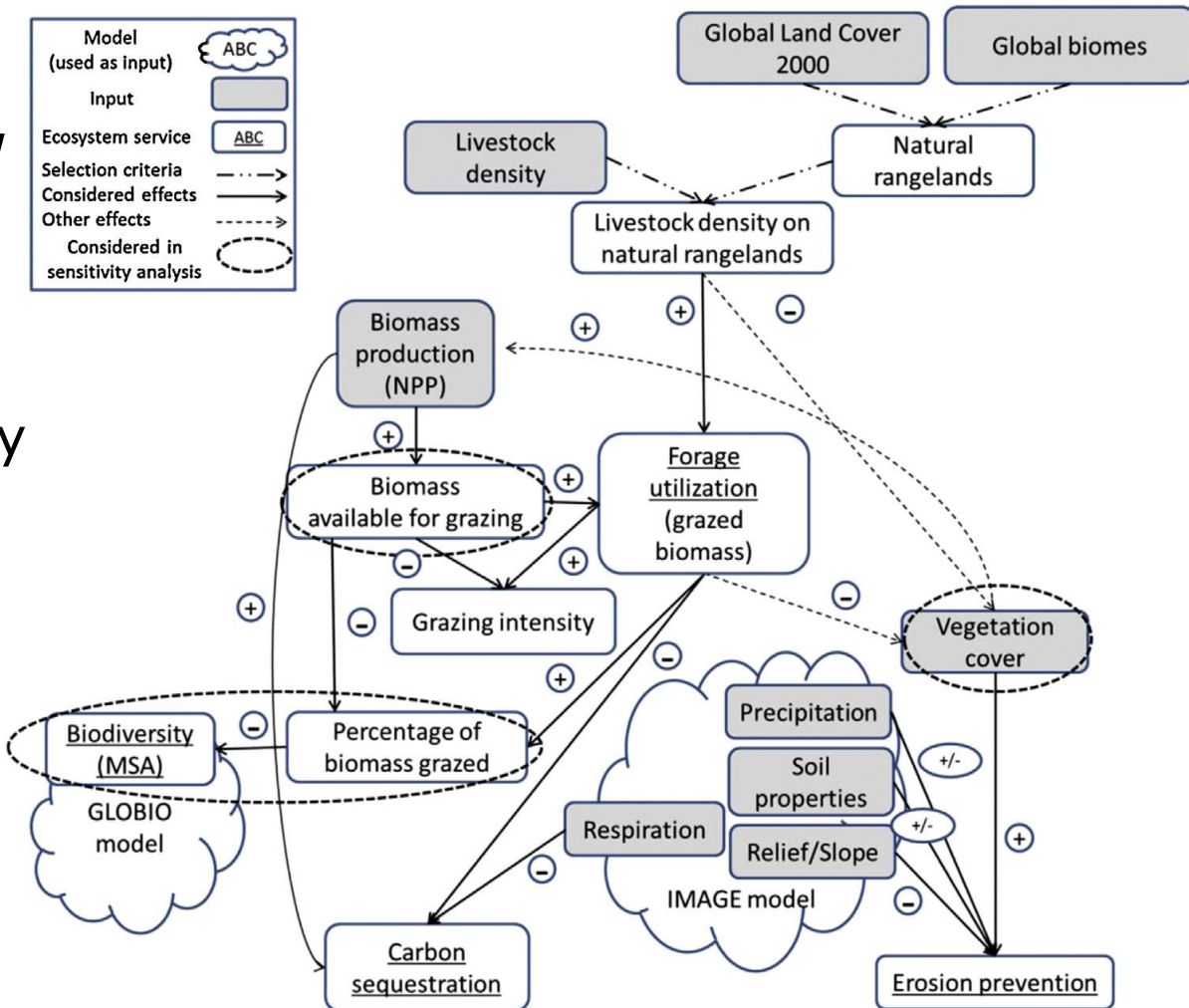
- Quantify trade-offs and synergies between forage utilization by livestock, carbon sequestration, erosion prevention and biodiversity over the gradient of grazing intensity
- Delineate areas where grazing and livestock production are unsustainable (= ESs are impaired)



- Global datasets and models IMAGE (Integrated Model to Assess the Global Environment) and GLOBIO (Global Biodiversity Model framework)

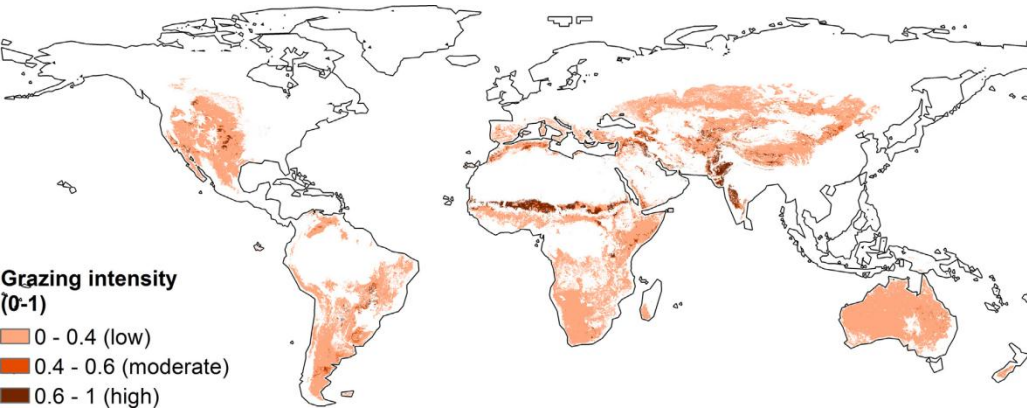
Methods

1. Comprehensive overview of global spatial datasets
2. Select input datasets
3. Delineate rangelands
4. Quantify grazing intensity (low, moderate, high)
5. Model ESs (IMAGE-GLOBIO)
6. Identify synergies and trade-offs
 - Value averaging
 - Map overlay

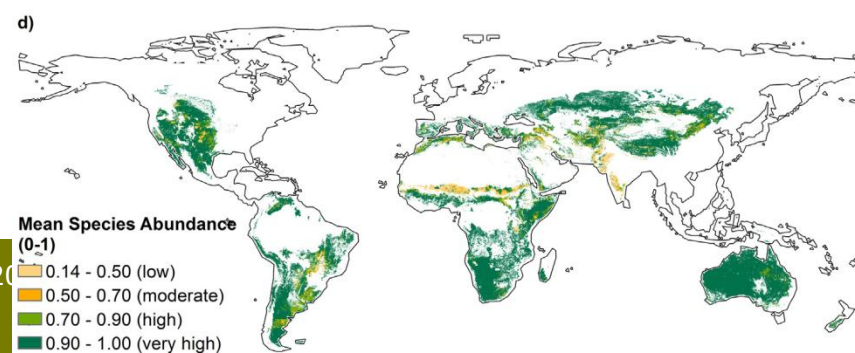
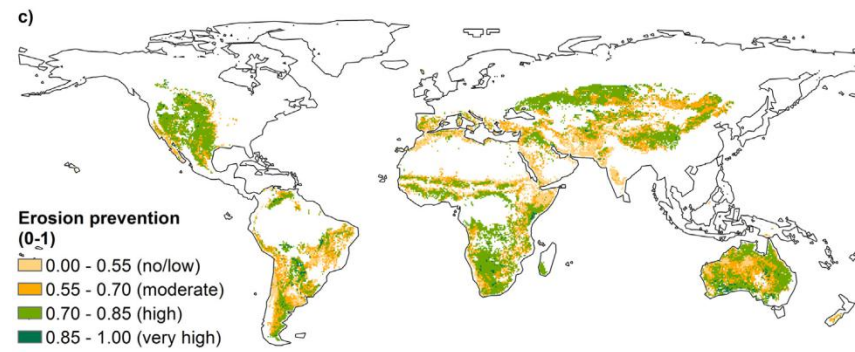
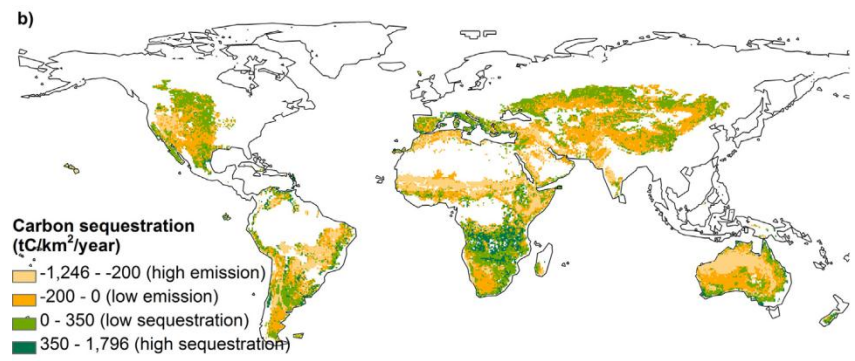
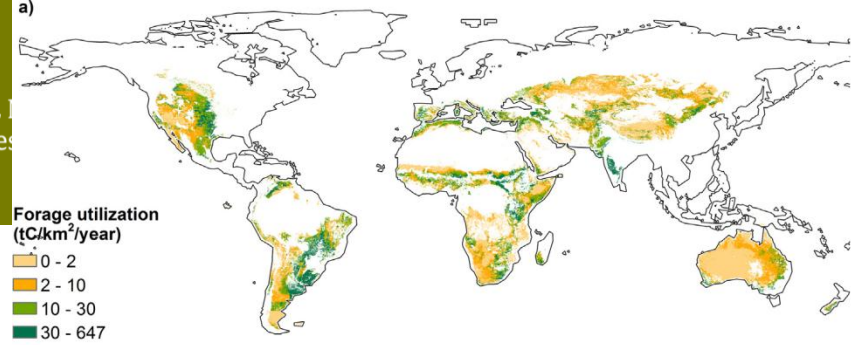




Grazing intensity & ESs



- Grazing intensity approaches natural production capacity in Sahel, Pakistan, West India
- Pattern of ESs varies
- About 4% of the produced biomass is consumed by livestock



Quantified trade-offs

Average (minimum–maximum) values of forage utilization, carbon sequestration, erosion prevention, and biodiversity for all natural rangelands and for changing grazing intensities.

Grazing intensity	Forage utilization (tC km ⁻² year ⁻¹)	Carbon sequestr. (t km ⁻²)	Erosion prevention (0–1)	MSA (0–1)
Low (0.0–0.4)	9 (0–241)	–56 (–1082 to 1456)	0.69 (0.07–1.00)	0.98 (0.73–1.00)
Moderate (0.4–0.6)	44 (0–302)	–147 (–888 to 968)	0.64 (0.16–0.98)	0.65 (0.53–0.73)
High (0.6–1.0)	43 (0–647)	–230 (–992 to 857)	0.62 (0.11–0.96)	0.24 (0.14–0.53)
All natural rangelands	12 (0–647)	–69 (–1082 to 1456)	0.68 (0.07–1.00)	0.92 (0.14–1.00)

- More forage is consumed by livestock on areas with high grazing intensity
- But these areas have
 - lower biodiversity
 - lower carbon sequestration
 - higher erosion
 than areas with low grazing intensity

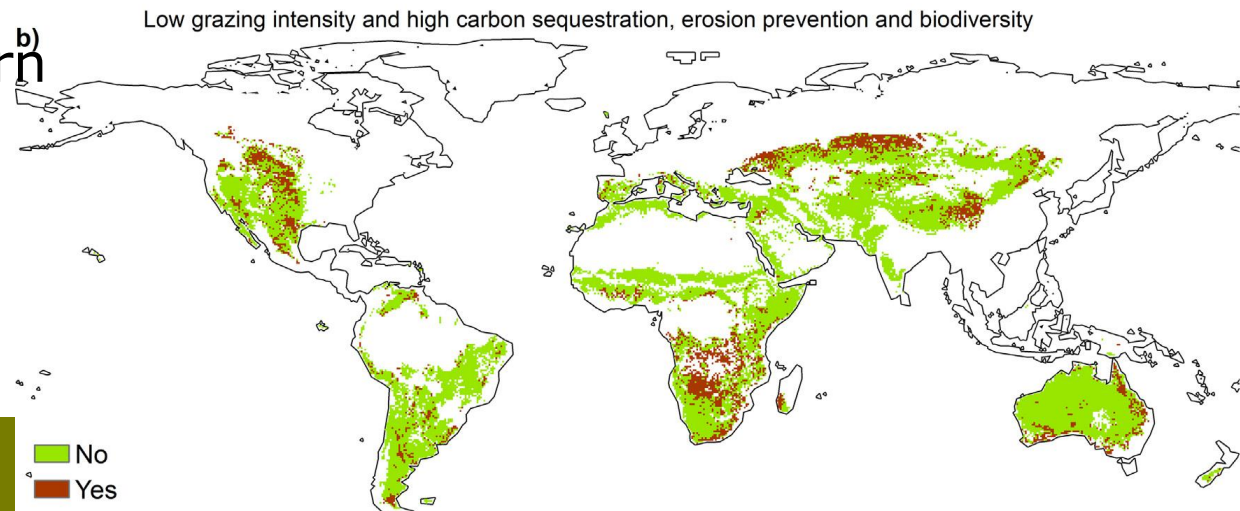
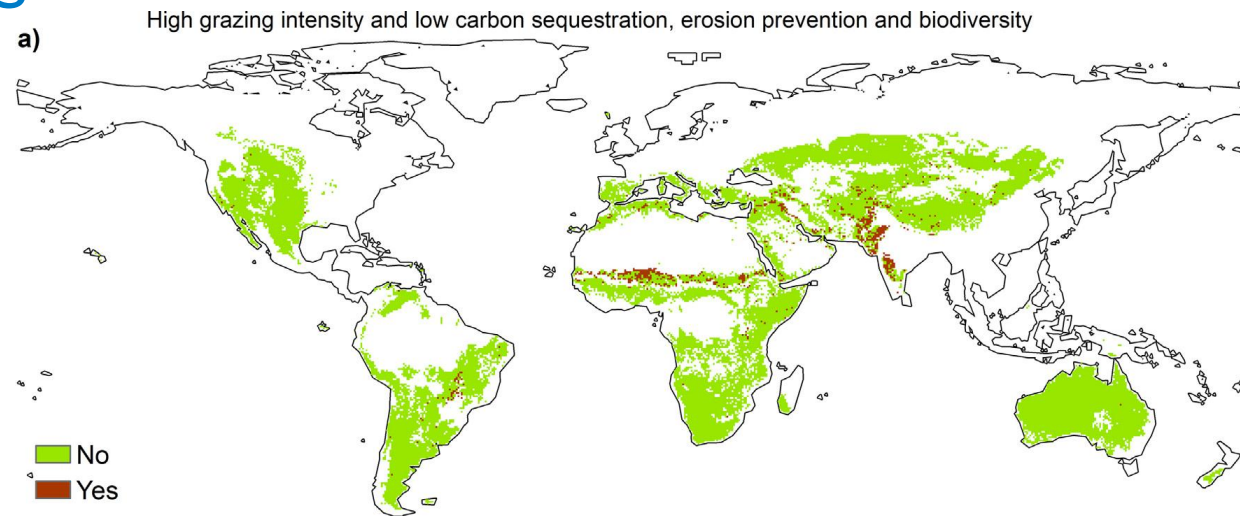
Spatial trade-offs

- Sahel, Pakistan and West India are most threatened by overgrazing

→ *application of feed supplement required*

- Grazing is most sustainable in Southern Africa and parts of Central Asia

→ *valuable for conservation*



Conclusion

- Global modelling enables the understanding of grazing patterns and their quantitative impacts on ESs & helps to identify areas threatened by livestock grazing



- Policy-making and rangeland management important role in improving ESs provision



Strength and limitations

- - due to limited data availability the same dataset used for multiple purposes
- - proper validation of data difficult
- - amount of feed applied not included
- - no socio-economic linkages
- - combining different datasets and models induce uncertainty
- + uncertainty of input addressed with sensitivity analysis
- + improved model relations (e.g. grazed biomass – MSA)
- + new quantitative information generated by combining spatial datasets and model relations



Relevance of my work for the FAO project

- Fits well the scope of the project
- Contributes to the understanding of rangelands (extent, condition, amount of grazed biomass)
- 'Grazing intensity' is a measure of sustainability
- Framework describes how ESs are generated and influenced by management → indicator framework
- New spatially-explicit quantitative information & quantified ES trade-offs ('hard data') → base for assessment, monitoring and modelling
- Comprehensive overview of global biophysical and socio-economic spatial datasets relevant for environmental monitoring and modelling



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Thank you for your
attention!

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