Managing Rangelands under Uncertainties

Applying Bio-Economic Models and Trust Games for Rangeland Management and Conservation under Uncertainty

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"Biodiversity of Africa - Observation and Sustainable Management for our Future!"
International Congress, 29 September – 3 October 2008, at Spier, RSA

Rangeland Management and Biodiversity

Cultural-Social-economic system

Farming system & Farming decisions

Rangeland management

Biodiversity Rangeland health

Ecosystem

Impact of important drivers of farming decisions and rangeland management

Degradation and biodiversity loss in rangelands

- Bush encroachment
- Desertification
- Vegetation clearing

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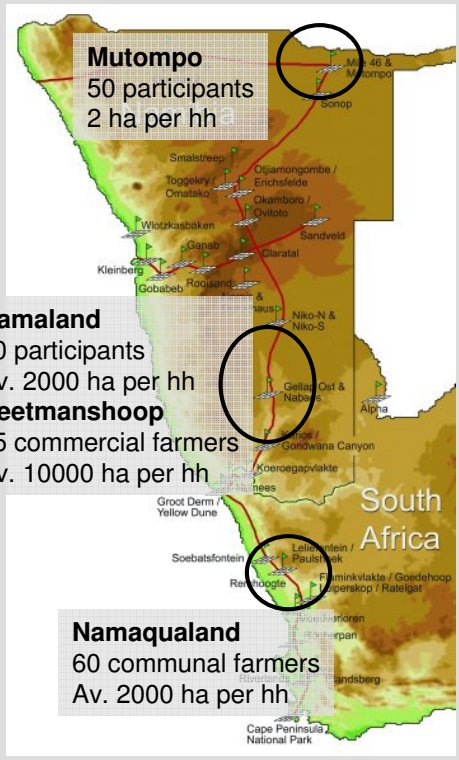
Land use, managers and study sites



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Managing rangelands under uncertainties

ERRACTIC AND LOW RAINFALLS
(CV=0.6)
Determining rangeland condition and income

HIGH PRICES VARIABILITY
due to limited markets and market accessibility

TRUST and COOPERATION
essential for functional rangeland management local institutions

Ecology and economics: modeling approach (South Namibia)

Anthropology and behavioral economics: field experiments (Namibia and South Africa)

- Which role do these uncertainties play in the adequate management of biodiversity and rangeland resources among farmers ?

- How can they be managed or reduced in order to enhance good rangeland management and conservation?

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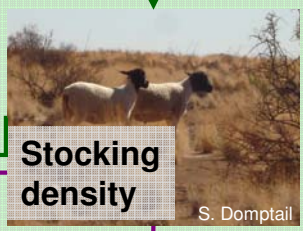
Modeling decision making under uncertainty



Rainfall ?

Biomass (grass/bush)

Bio-economic feedback

Rangeland condition

Stocking density

S. Domptail

Lamb sales

Income

Costs

Price ?

Transition Probabilities Vegetation model
-> impact of grazing on Rangeland condition

Mathematical programming model

- **Dynamic** optimization over 30 years (***indicative*** – not predictive)

- **Bio-economic**

- **Recursive (uncertainty)** with expectations for prices and rainfall

Parametrization: farm data (2005-2006) and literature

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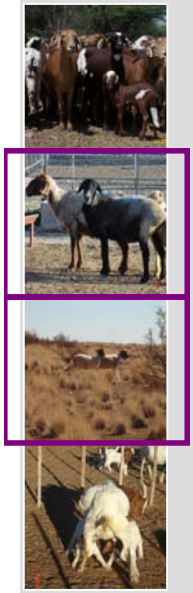
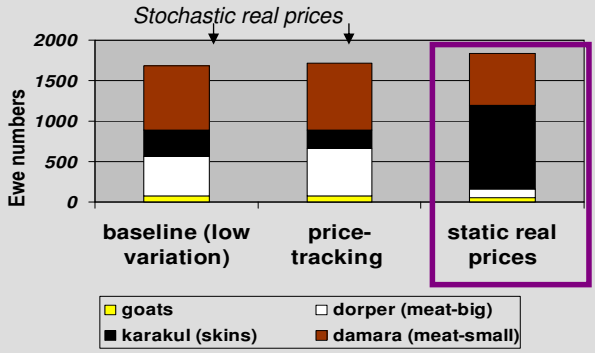
Price stochasticity and price expectations

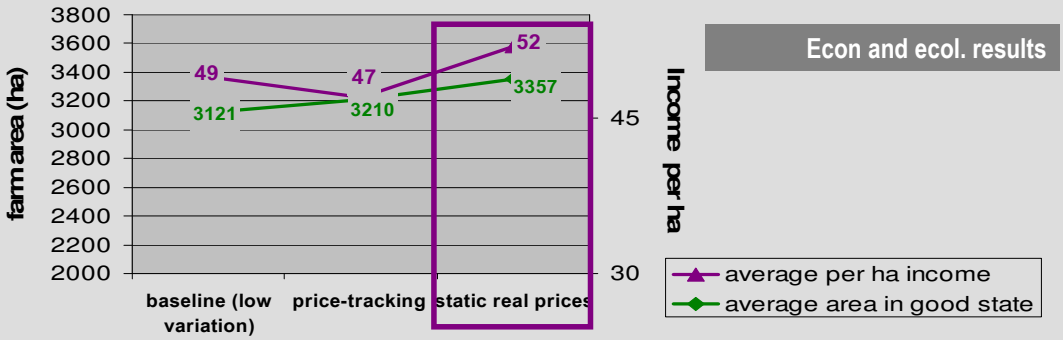


Herd composition

- Stochasticity of prices determines herd composition and diversification
  ⇒ Price stability is a major driver for dorper adoption



Econ and ecol. results



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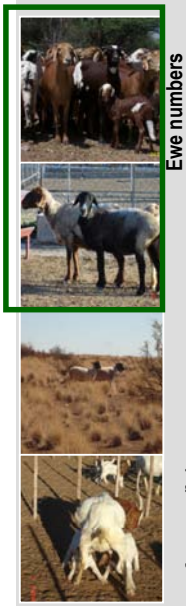
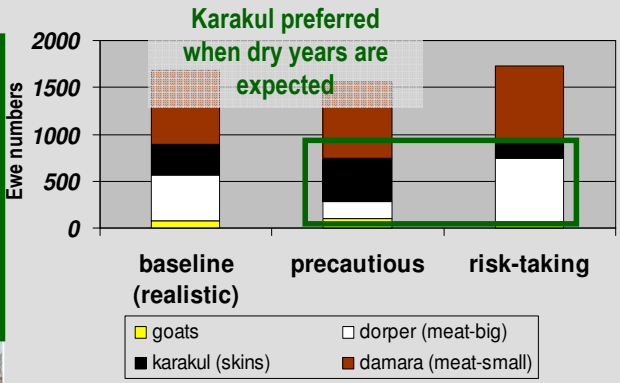
Rainfall expectations and ecological consequences

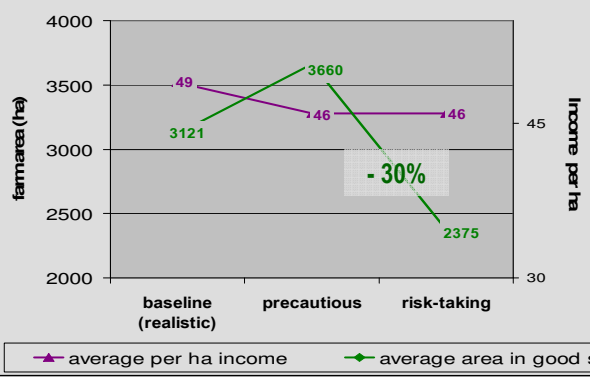




Herd composition

- Light sheep such as Karkaul and Damara seem optimal in precautionary approaches (lower rainfall)

Econ and ecol. results



- Precautionary attitude has the highest E-E payoff
- Expectations over rainfall have the highest impact on rangeland conservation

Domptail & al. in prep.

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Uncertainty in cooperation for rangeland management


B. Vollan


M. Pröpper


S. Prediger

- **How to measure trust as a pre-condition for cooperation?**
- **How to evaluate the impact of rules on the success of cooperation?**

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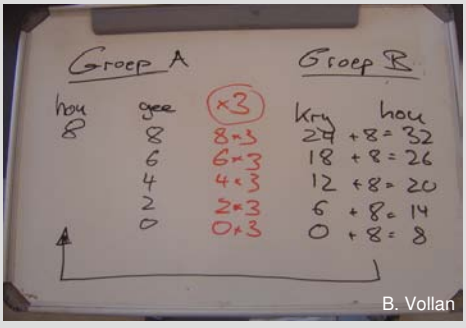
Uncertainty in cooperation for rangeland management: Trust game methodology


B. Vollan



B. Vollan

Rules: Players A and B both receive 8R each. Players do not directly interact, rather they decide anonymously.

A – the ‚Truster' - can give a share of that sum – if he thinks that he can trust an unknown B...

That share will be tripled on the way to be (e.g. A gives 3N$ then B receives 12R)

B – the trustee - can reciprocate A's move by sharing and sending money back to A.

• Game reveals the trust levels related to the **social history** of the community

1 USD = 8 Rand

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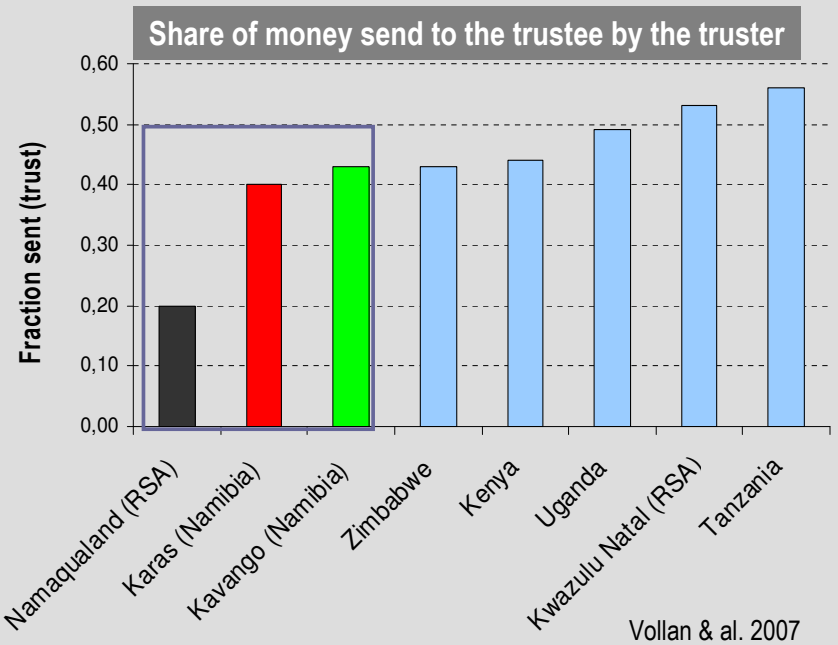
Uncertainty in cooperation : trust game results



Mann-Whitney test South-Africa/Namibia: Z=3.43; p<0.1

Vollan & al. 2007
Pröpper, 2008

- Overall trust levels are low: 'small scale reciprocity'
- Trust in communities of Namaqualand is outstandingly limited

=> Limits the potential for cooperation

- Role of education:

One additional year of schooling raises the amount sent by 13%

Uncertainty in cooperation for rangeland management: The grazing game

Rules- Players choose among two grazing areas [A or B]

Choose the intensity for farming [0, 1, 2]

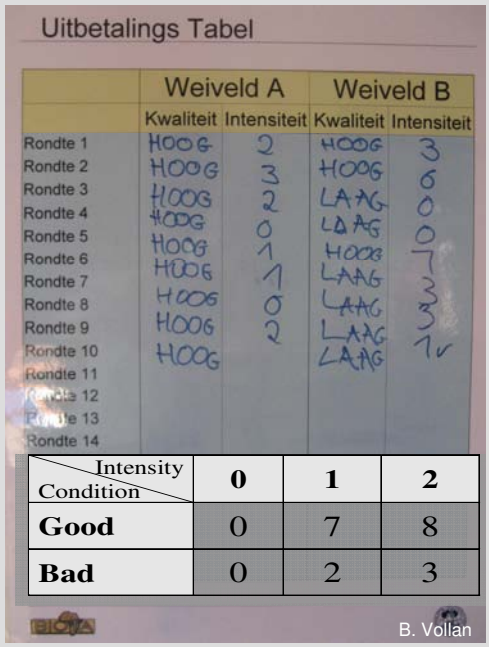
Dependent on the condition [good, bad] people get payoffs according to payoff matrix

10 rounds of decision making

Characteristics

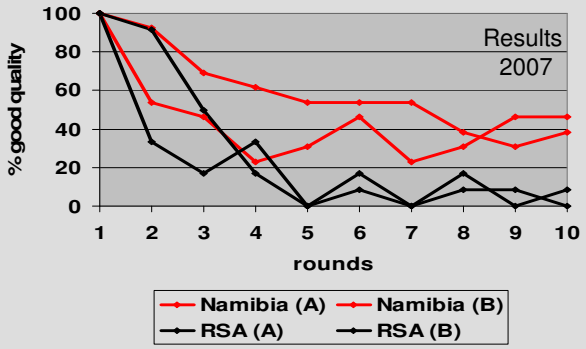
- non-linearity in ecological dynamic

- The game reveals the **internalized norms for resource management** of the community



Based on Janssen et al. Project: http://www.public.asu.edu/~majansse/dor/nsfhsd.htm

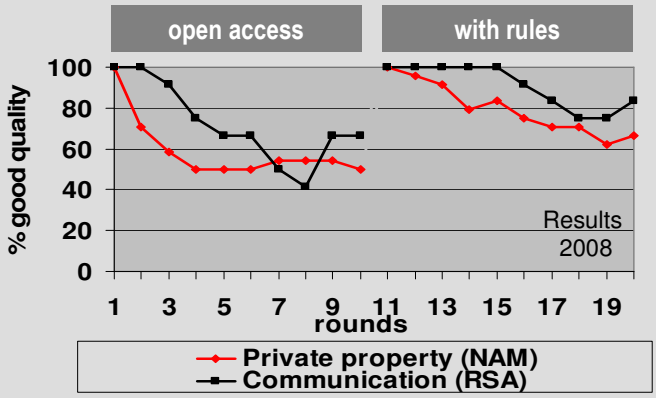
Cooperation for NRM: country differences and introduction of rules



- In Namibia a higher share of the land is maintained in a good condition (42% vs 4% for RSA)
=> Nomadism in the recent past

Vollan & al. in prep.

- The introduction of rules improves rangeland quality, although its efficiency declines slightly over time



Conclusion: towards sustainable management of rangeland

- **Any clarification of property rights (rules) improves cooperative management of rangeland resources**

- **Cultural norms and rules of interaction influence levels of trust.** Understanding them and taking them into account is crucial for the success of implementation of rangeland management institutions

Ex: Functioning cooperation norms/customs in Namibia exist => basis for updated management institutions (e.g. co-management scheme)?

- **Modeling makes apparent for farmers the impact of their knowledge about rainfall on the efficiency of their management**

Reduce uncertainty and reduces degradation risks by:

- Monitoring of rainfall patterns under climate change
- Farmers need to be integrated in the analysis of data generated

Gains

- Integration of disciplines and tools: Field experiments and bio-economic modeling
- With time and cooperation, we have built capacities in interdisciplinary communication, created common vocabulary which enables us to carry better holistic research as time goes by

Perspectives

- Jointly consider economic, ecological and social costs of land use options
- Monitor social capital and cooperation in times of institutional change
- Deepen the link between biodiversity and ecosystem services by considering biodiversity as an element for socio-ecological resilience

Ex: Investigate how biodiversity supports diversification of production on farms (complex grassland systems, integrated bio-diversity production systems)

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