SPACES2-SALLnet:

Novel approaches and tools for analysing land use scenarios and risk management strategies for multi-functional landscapes

GEFÖRDERT VOM

Bundesministerium
für Bildung
und Forschung

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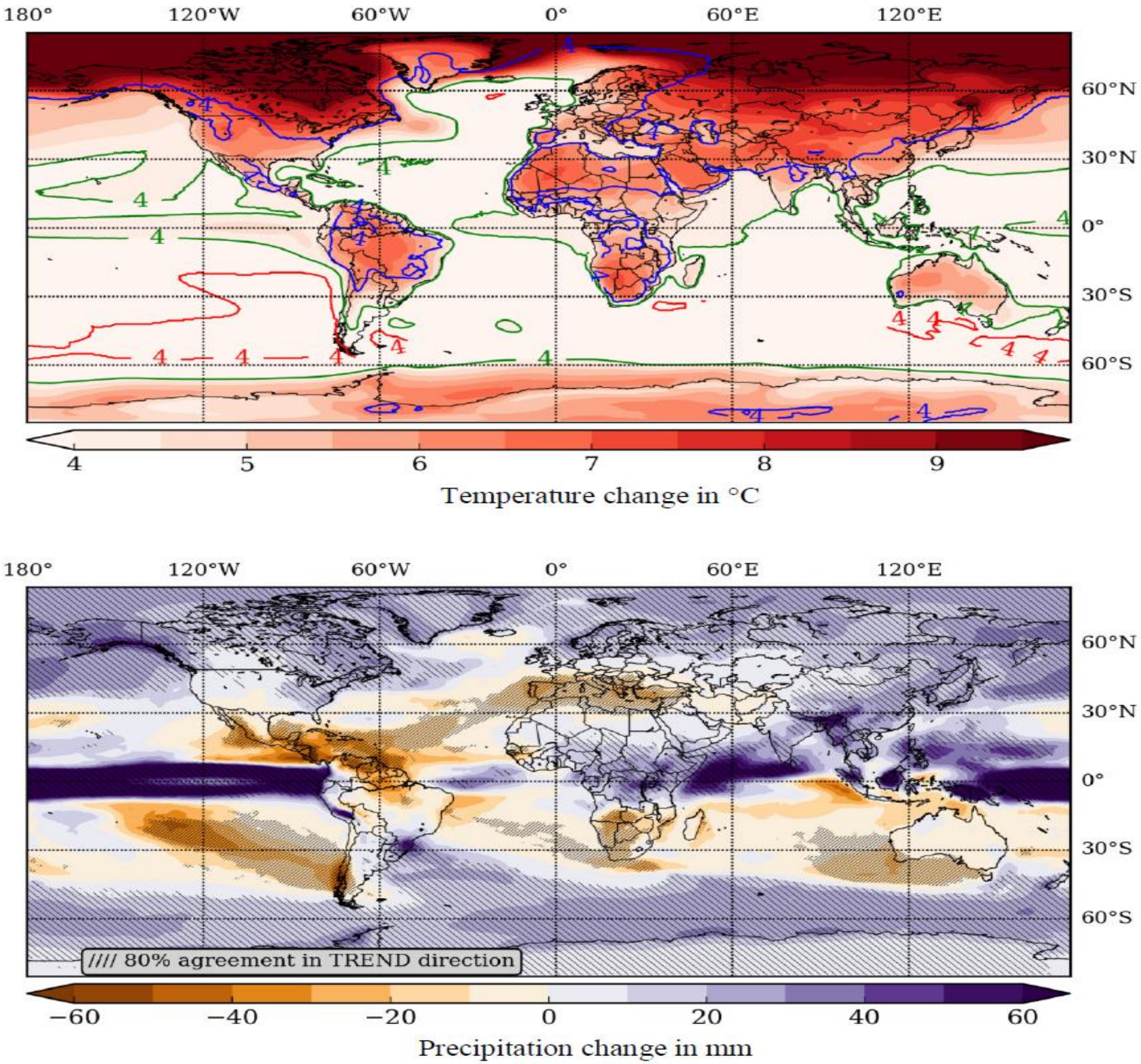


Fig. 1: Projected trends in temperature (top) and precipitation (bottom) under the high-end Representative Concentration Pathway (RCP) with an increase of radiation by 8.5 W/m² by 2100 (RCP 8.5). Both plots show the mean trend of 18 model runs of the Coupled Model Intercomparison Project Phase 5 - Global Circulation Model (CMIP5 GCM) ensembles. The temperature increase is shown in °C and the precipitation change in mm (per year) between 2006 and 2100. The shaded areas show where at least 80% of the climate simulations agree on the trend. The RCP 8.5 represents the high-end, but most-likely scenario under the current emission pathway. The analysis (including this figure) was conducted by Peter Hoffmann (PIK-Potsdam).

Global CC projections – implications for climatic risks

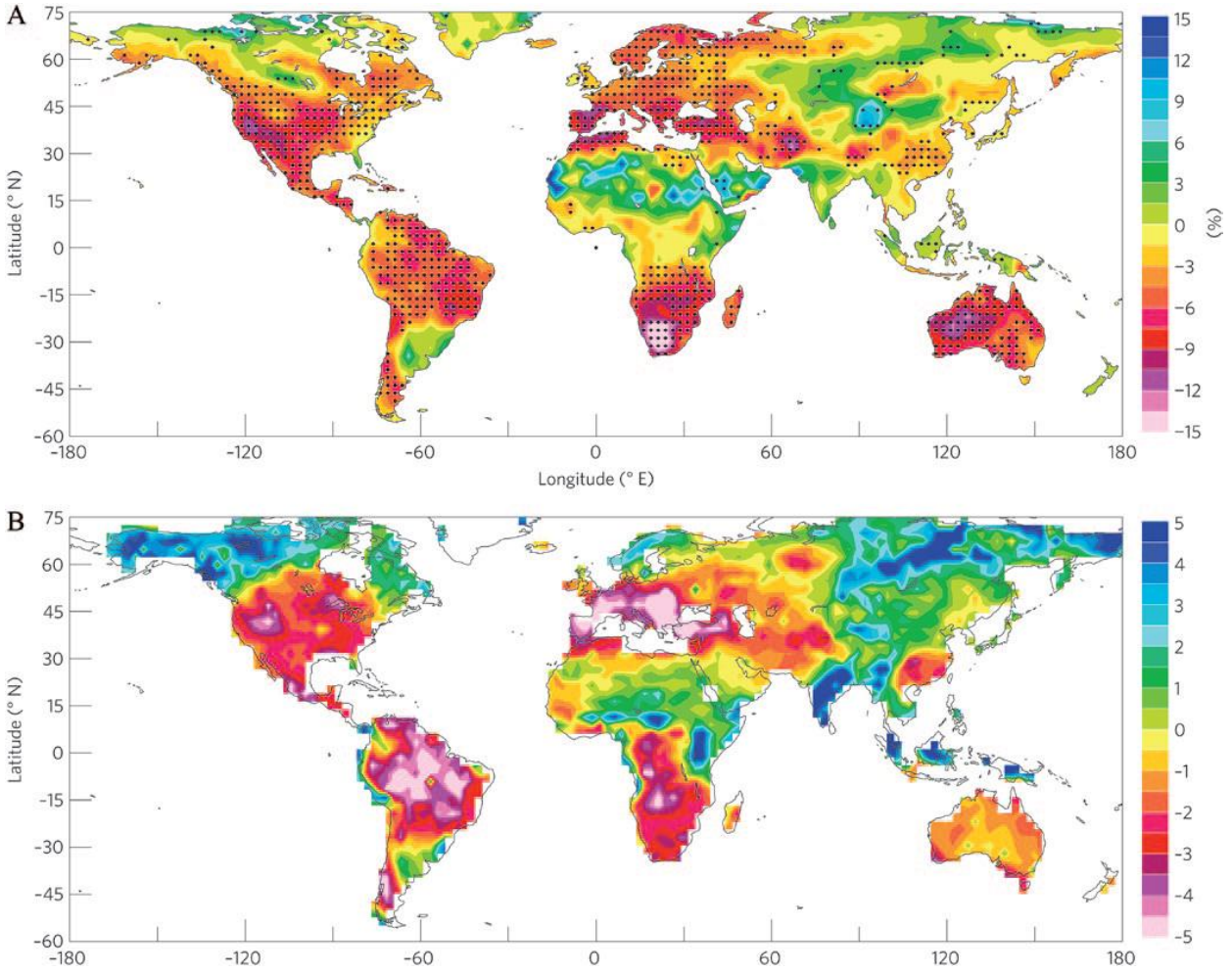


Fig. 3. **Future changes in soil moisture and the self-calibrated Palmer drought severity index (PDSI)** with potential evapotranspiration estimated using the Penman-Monteith equation (sc_PDSI_pm). **(A) Percentage changes from 1980–1999 to 2080–2099 in the multi-model ensemble mean soil-moisture content in the top 10 cm layer (broadly similar for the whole soil layer) simulated by 11 Coupled Model Intercomparison Project Phase 5 (CMIP5) models under the representative concentration pathway 4.5 (RCP4.5) emissions scenario**. Stippling indicates at least 82% (9 out of 11) of the models agree on the sign of change. **(B) Mean sc_PDSI_pm averaged over 2090–2099 computed using the 14-model ensemble mean climate** (including surface air temperature, precipitation, wind speed, specific humidity, and net radiation) **from the CMIP5 simulations under the RCP4.5 scenario.** A sc_PDSI_pm value of −3.0 or below indicates severe to extreme droughts for the present climate, but its quantitative interpretation for future values in B may require modification. From **Dai. 2013**. Increasing drought under global warming in observations and models. ***Nature Climate Change, 3, 54. Reprinted with permission from Macmillan Publishers Ltd: Nature Climate Change, copyright 2013.***

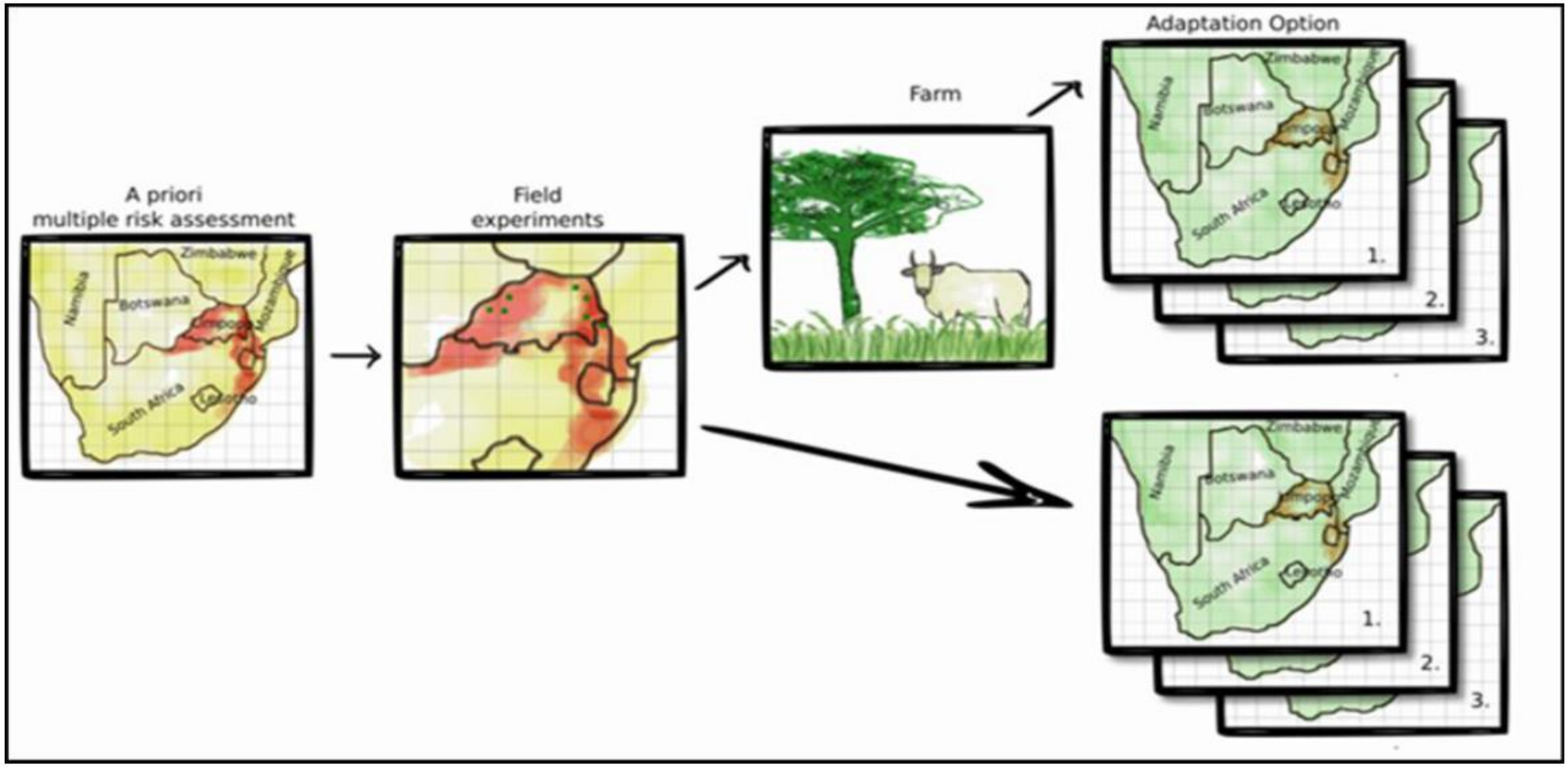
OBJECTIVES, APPROACH AND EXPECTED OUTPUT

Overarching research question :

How and to what extent can the functioning and resilience of the multi-functional landscapes in southern Africa be enhanced under possible alternative futures?

RESEARCH QUESTION AND GENERAL APPROACH

- General approach



SUSTAINABILITY INDICATORS

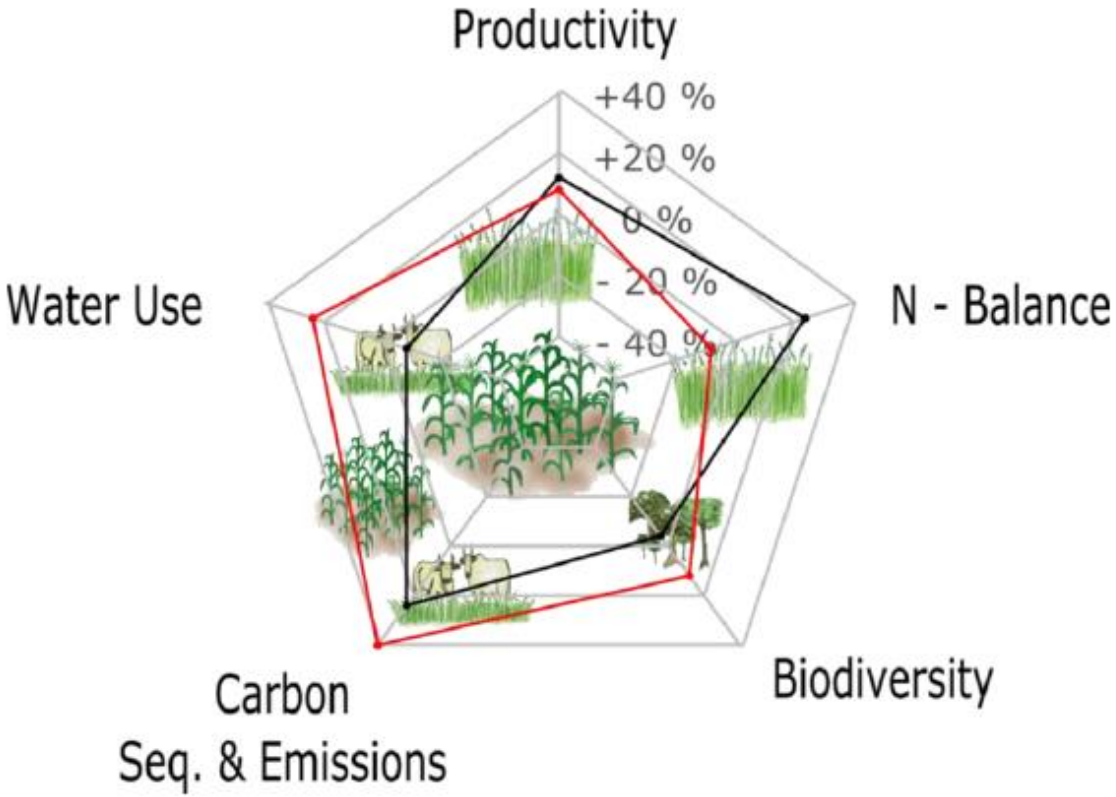


Fig. 8 Spider diagram illustrating potential sustainability indicator groups and their use in comparing different LUM scenarios

METHODS

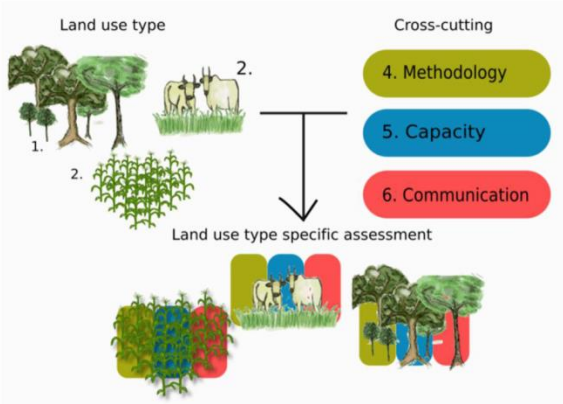


Fig. 2 Research matrix: land use type related research topics (1-3) and associated cross-cutting topics (4-6) leading to specific assessments in the three major land use types in the Limpopo Region (1. arable lands, 2. rangelands and agroforestry systems, and 3. orchards)

WP1: Arable Lands: field experiments on new forage crops; crop modelling;

WP2: Rangelands: field experiments, Rapid Ecosystem Function Assessment (REFA)

WP3: Tree orchards & biodiversity: surveys, cage experiments along altitude gradients

WP4: Economic modelling: farm surveys (n=500); agent-based model with LP; GIS
WP5: Agroecosystems modelling & development of a macadamia model; varr. crop models linked to field experimentation; GIS/remote sensing & using different CC scenario data sets
WP6: Vegetation modelling: DGVM linked to experimentation, GIS/remote sensing; utilizing different CC scenario data sets
WP7: Integration and synthesis: platform for interactive scenario analyses, stakeholder dialogue; web-based user interfaces; sustainability inidcators

STAKEHOLDER INVOLVEMENT IN SALLNET

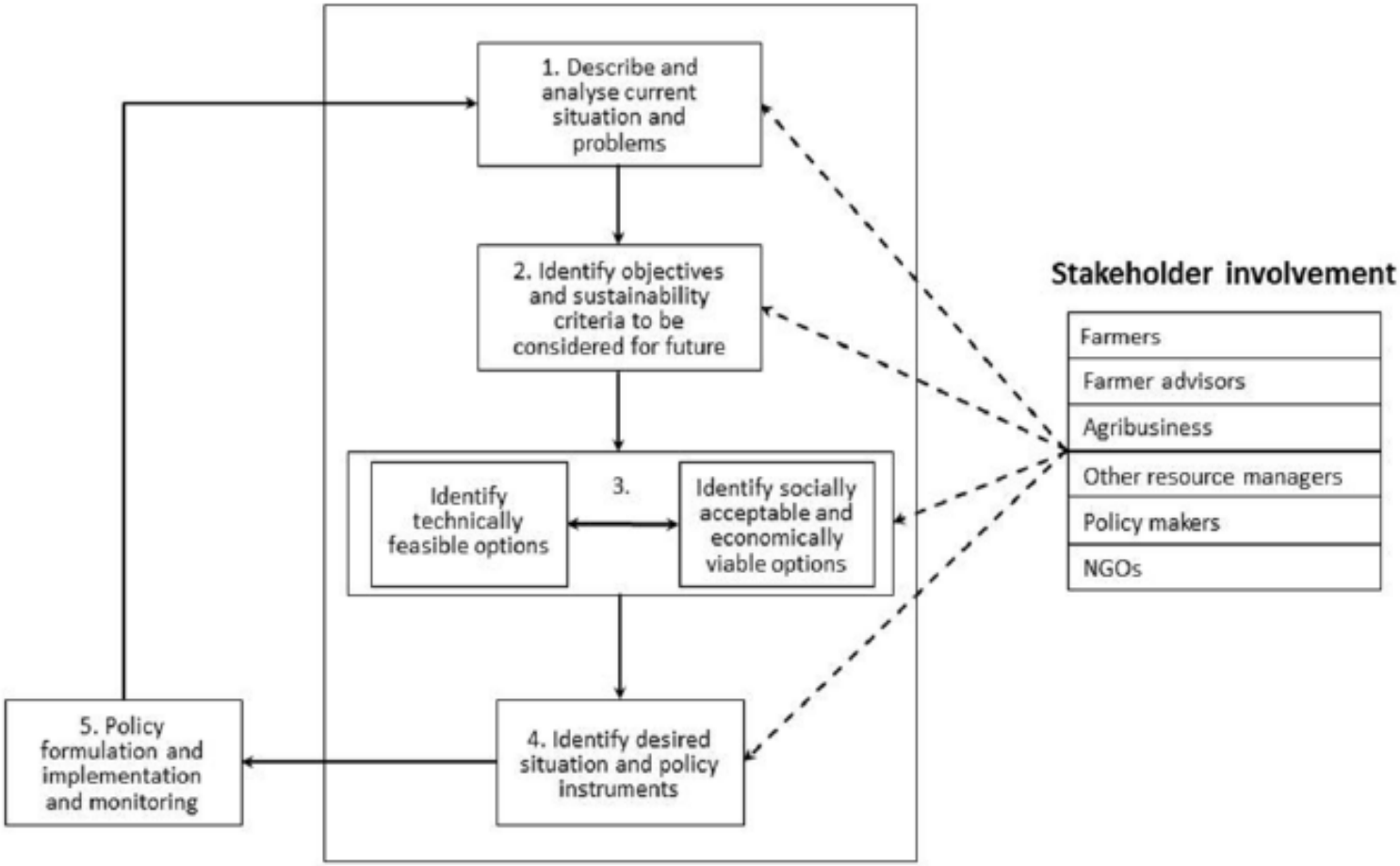
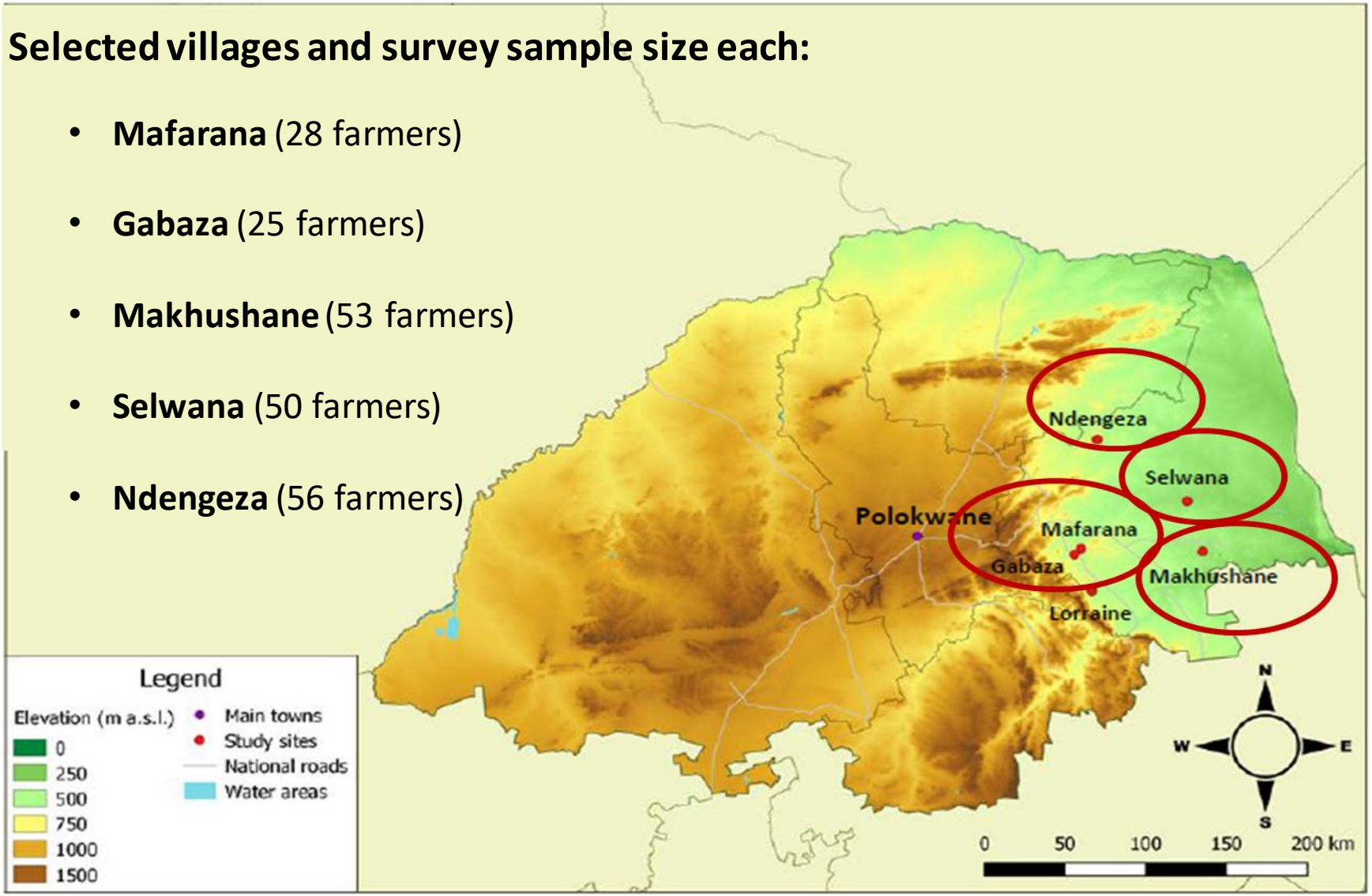


Fig. 9 Schematic of analyzing land use management and policy scenarios based on interactive modelling and synthesis jointly with stakeholders (modified from: Rötter et al., 2016)

LIMPOPO SMALL SCALE FARMER SURVEY

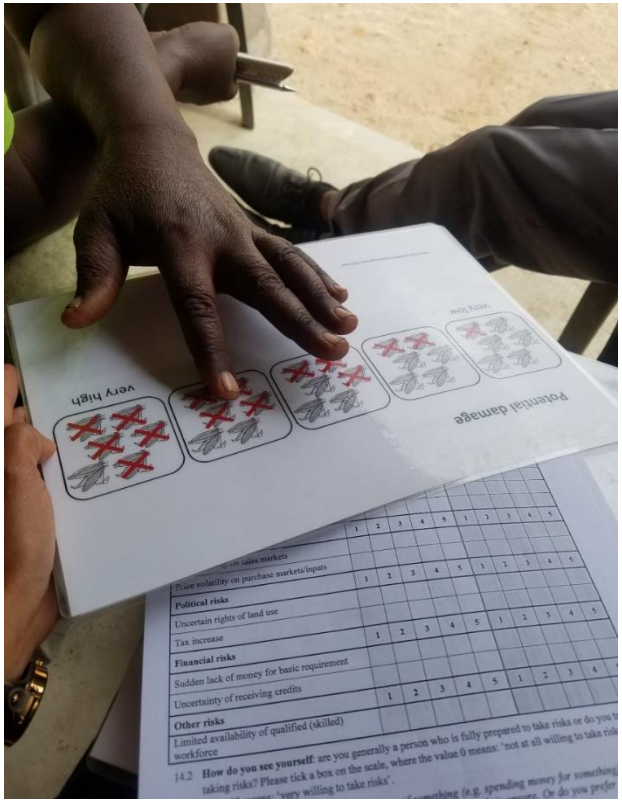
Selected villages and survey sample size each:

- **Mafarana** (28 farmers)
- **Gabaza** (25 farmers)
- **Makhushane** (53 farmers)
- **Selwana** (50 farmers)
- **Ndengeza** (56 farmers)



IDENTIFICATION AND ASSESSMENT OF AGRICULTURAL RISKS ON BASIS OF SMALL-SCALE FARMER SURVEY

- Probability of occurrence of unfavorable events
- Potential damage of unfavorable event on farm operation (risk exposure)



IDENTIFICATION AND ASSESSMENT OF AGRICULTURAL RISKS ON BASIS OF SMALL-SCALE FARMER SURVEY (TENTATIVE)

Possibility of occurrence

1. Pest and disease
2. Drought
3. Uncertainty of receiving credits
4. Capital constraint
5. Storm/ wind

X

Damage on Farm business

1. Drought
2. Pest and disease
3. Storm/ wind
4. Flood
5. Theft (livestock)

Risk Score

1. Drought
2. Pest and disease
3. Storm/ wind
4. Theft (livestock)
5. Capital constraint

IDENTIFICATION AND ASSESSMENT OF AGRICULTURAL RISKS ON BASIS OF SMALL-SCALE FARMER SURVEY (TENTATIVE)

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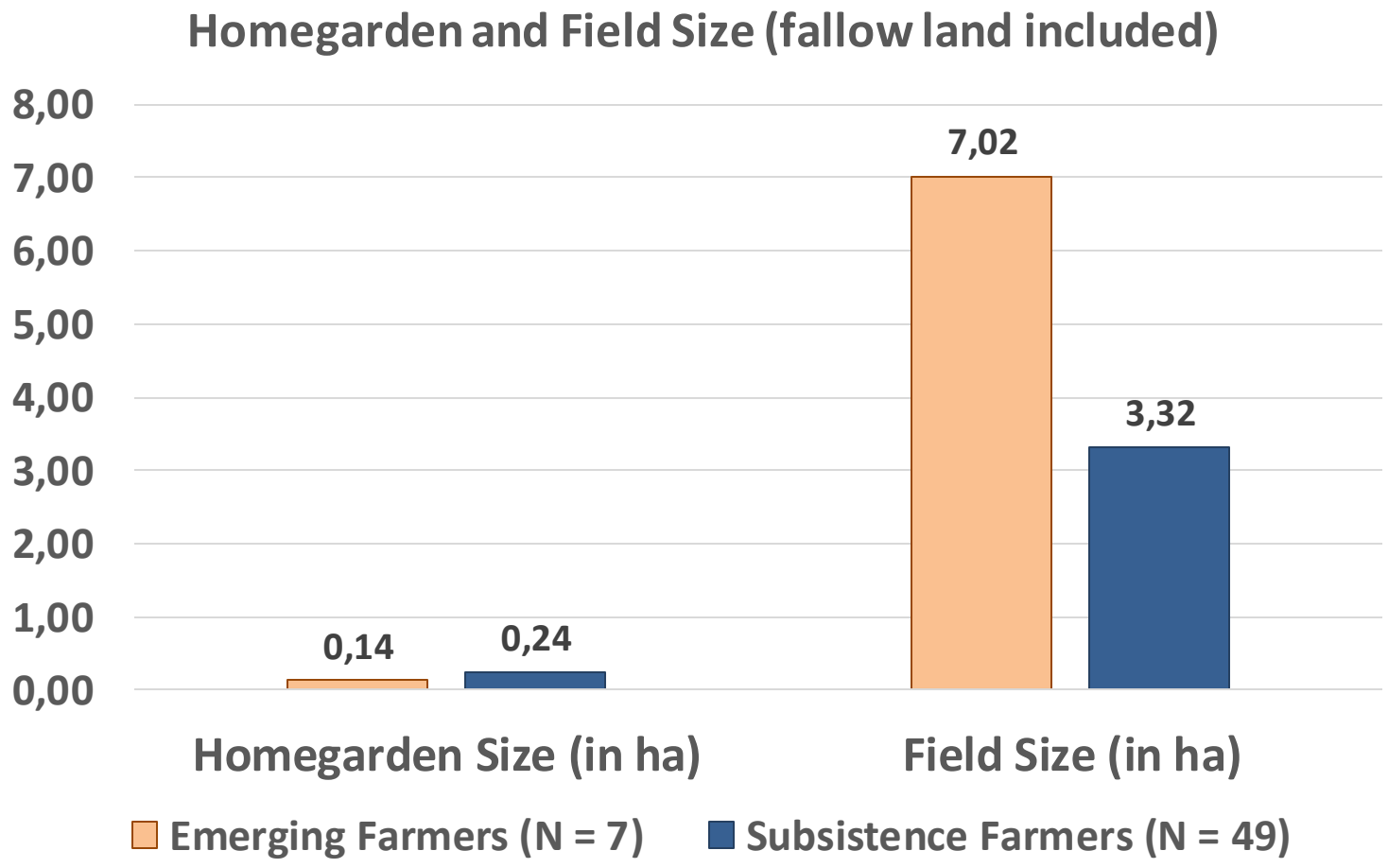
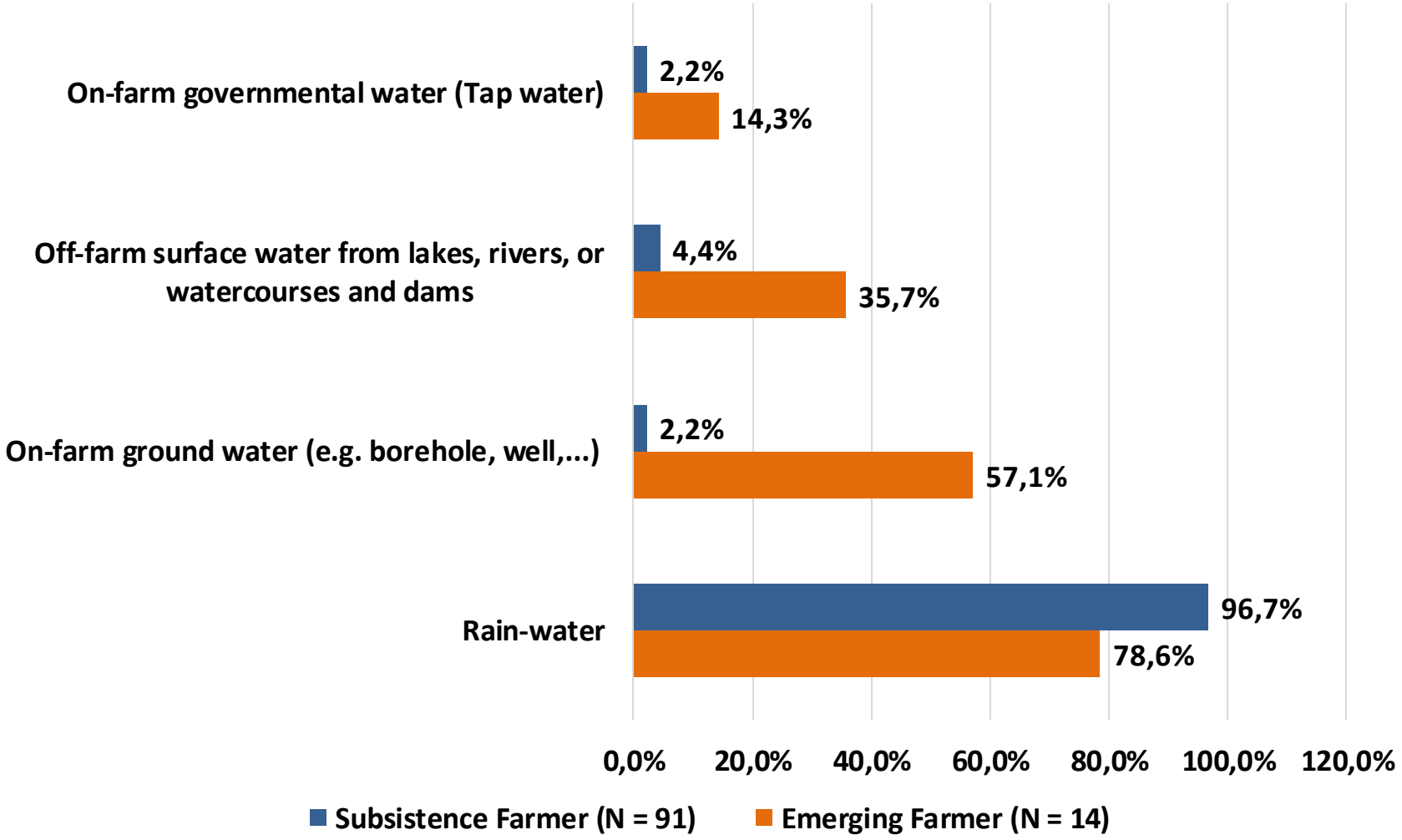
TYPOLOGY OF FARMERS IN COMMUNITIES (TENTATIVE)

	Subsistence	Emerging
Purpose	**crops grown mainly for self-consumption**	**crops grown mainly for marketing purposes**
Technology	Labor intensive	Relatively capital intensive
Acreage	small area	larger area
Irrigation	**fully rain-dependent**	**using irrigation methods**
Cultivation	Predominantly traditional methods (muscle power)	Mechanized by a notable proportion

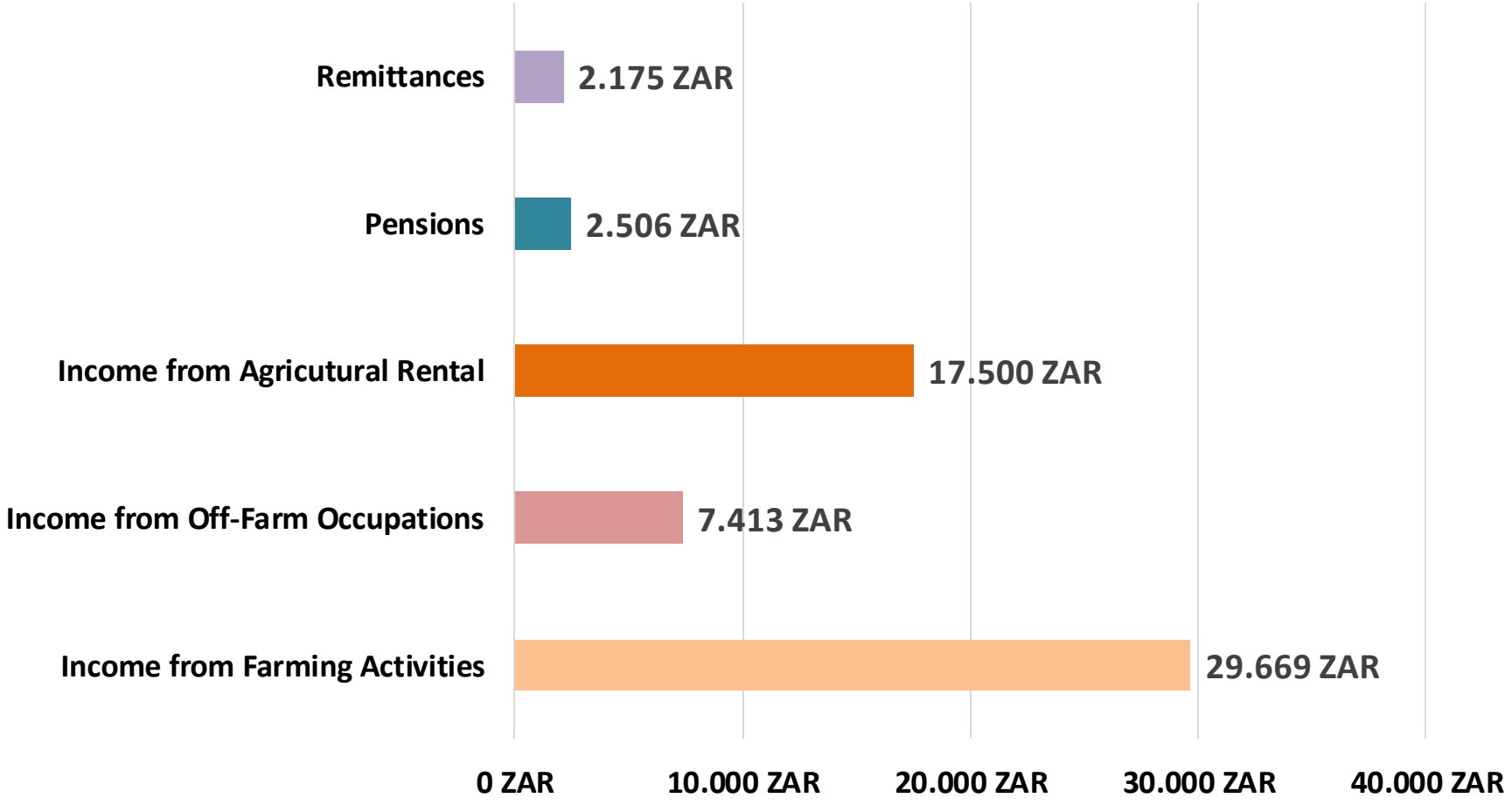
Comparing farm size of emerging vs. subsistence (example of Ndengeza, N = 56)



Different sources of irrigation (Ndengeza and Selwana, N = 105)



Average Household Income (in ZAR) generated from different sources (Ndengeza and Selwana, N = 105)



Next steps

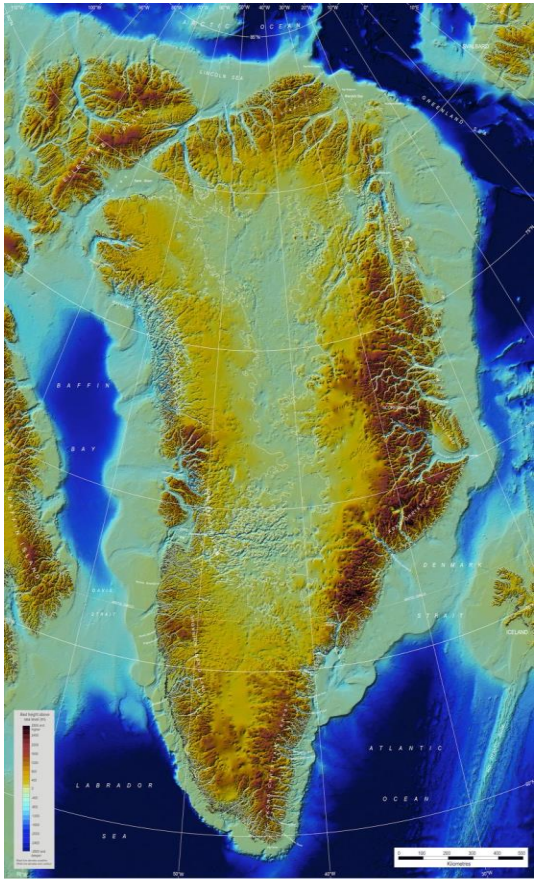
- Analyzing status quo of Limpopo agriculture regarding different farm types, land-use options and agri-relevant risks
- Efficiency measurement of different farm types and respective gap analysis
- Development and assessment of risk management options under different land use management scenarios
- Modeling long-term development paths of different farm types for different sets of land use management and policy scenarios

Thank you for your kind attention and looking forward to mutual exchange!

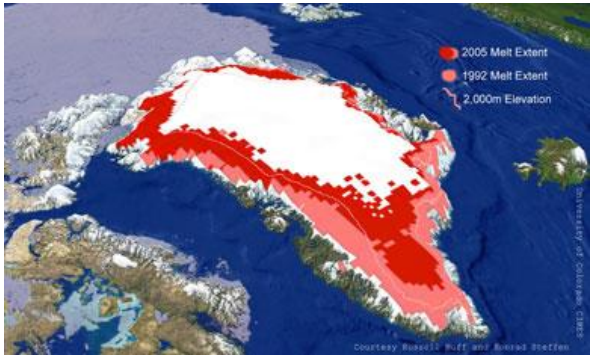
Visit our SALLnet project website:

https://www.uni-goettingen.de/de/592566.html

MELTING ARCTIC TRIGGERS CHANGES IN CIRCULATION PATTERNS



New map of Greenland



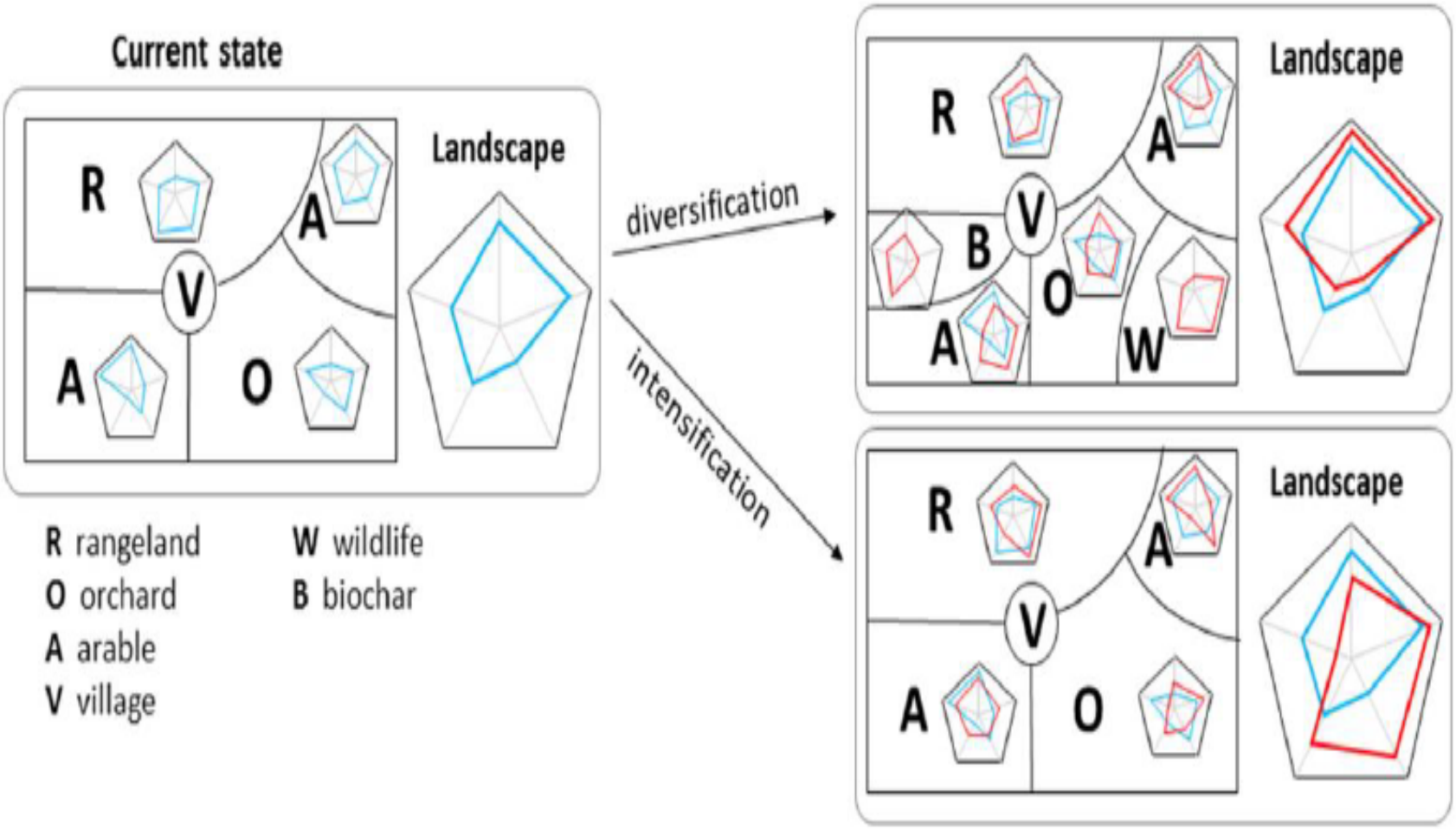
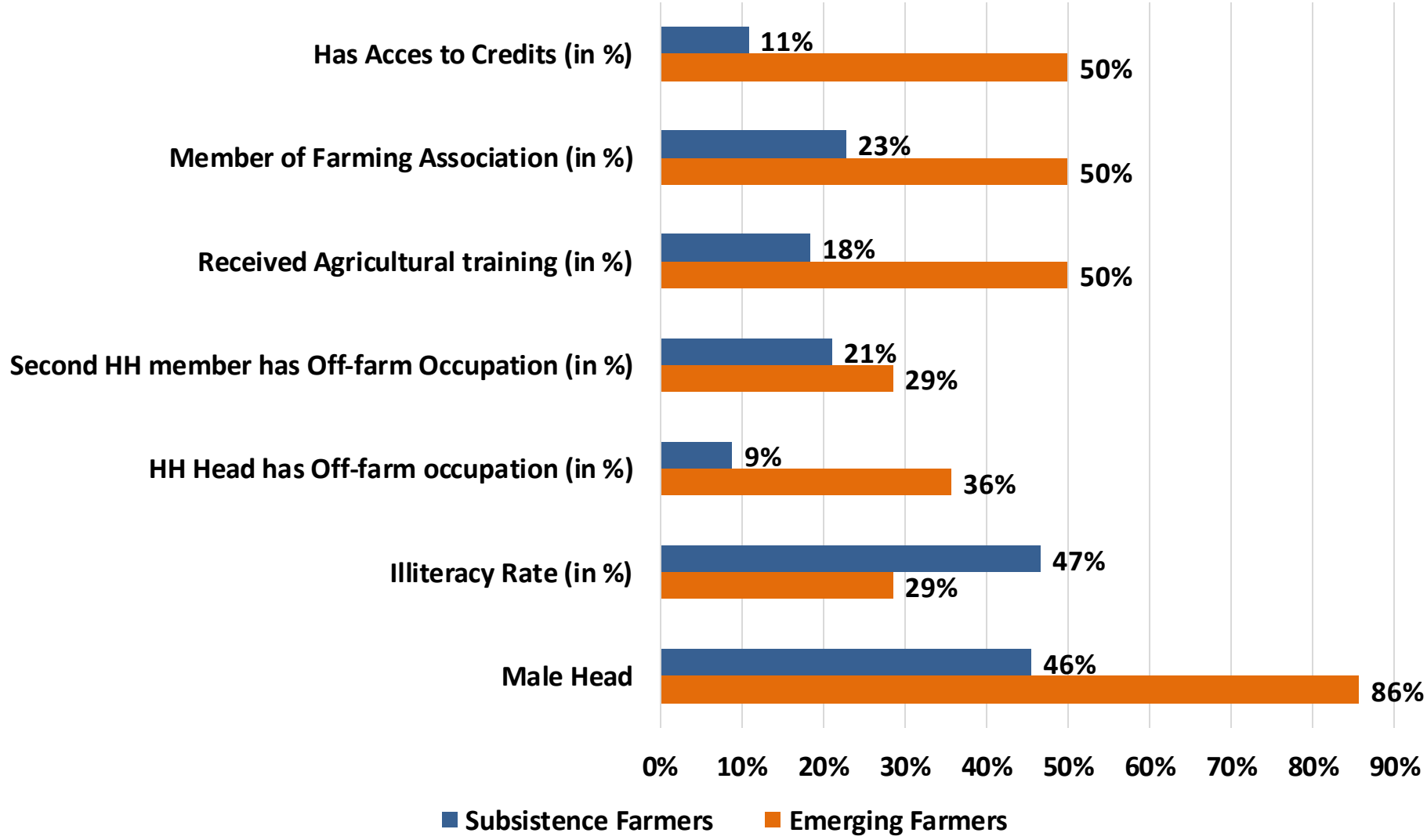


Fig. 7 Illustration of integrated ecosystem service assessment. The left panel shows how the landscape is split into different land use forms and the spider diagrams (see also Fig. 8)

Household head characteristics (Ndengeza and Selwana, N = 106)



Relative proportion of farmers owning or renting (Ndengeza and Selwana, N = 106)