Sustainable intensification indicator framework **for Africa RISING**

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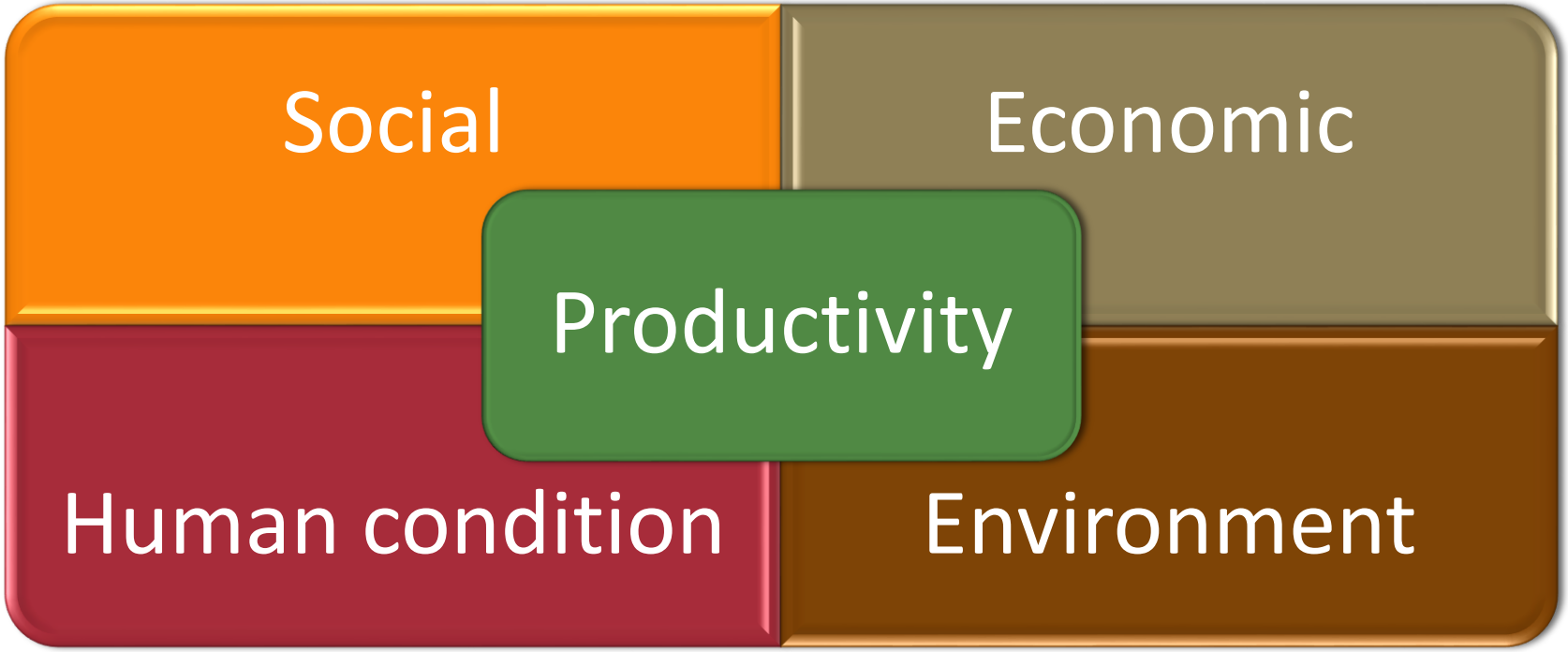
Five domains of Sustainable Intensification



Sustainable Intensification as described in the proposal documents

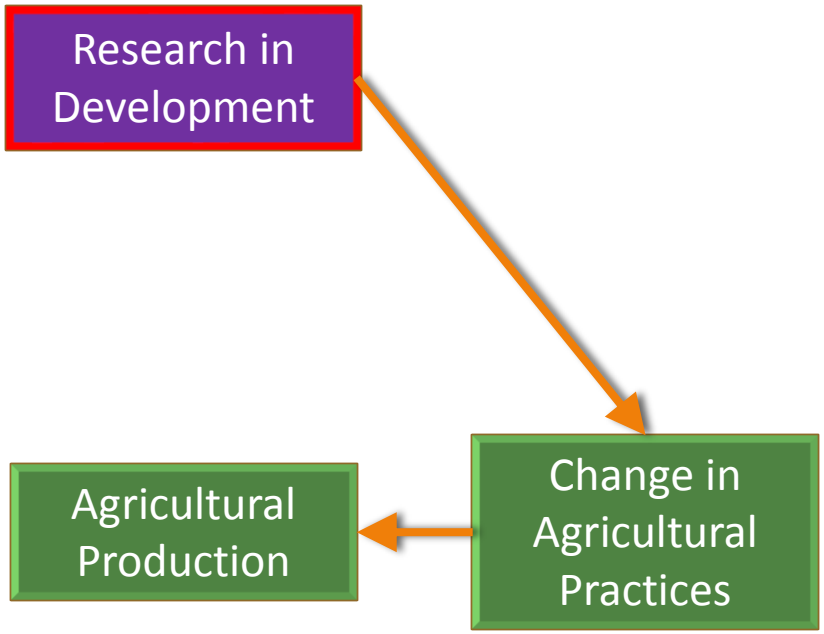
Purpose and theory of change

The purpose of Africa RISING is to provide pathways out of **hunger** and **poverty** for smallholder families through sustainably intensified farming systems that sufficiently improve **food, nutrition, and income security**, particularly for **women** and children, and **conserve or enhance the natural resource base**.

The core focus will continue to be on the sustainable intensification of production from households and systems, with integrated multi-disciplinary research on **food security, nutrition, crops, livestock, water, trees, natural resources and markets** at the heart.

interventions aim to improve **whole farm productivity**, **maintain important ecosystem services**, and enhance the **resilience** of farm households to shocks. (p. iii)

What does it mean for agricultural intensification to be sustainable?



Attributes of Sustainable Systems

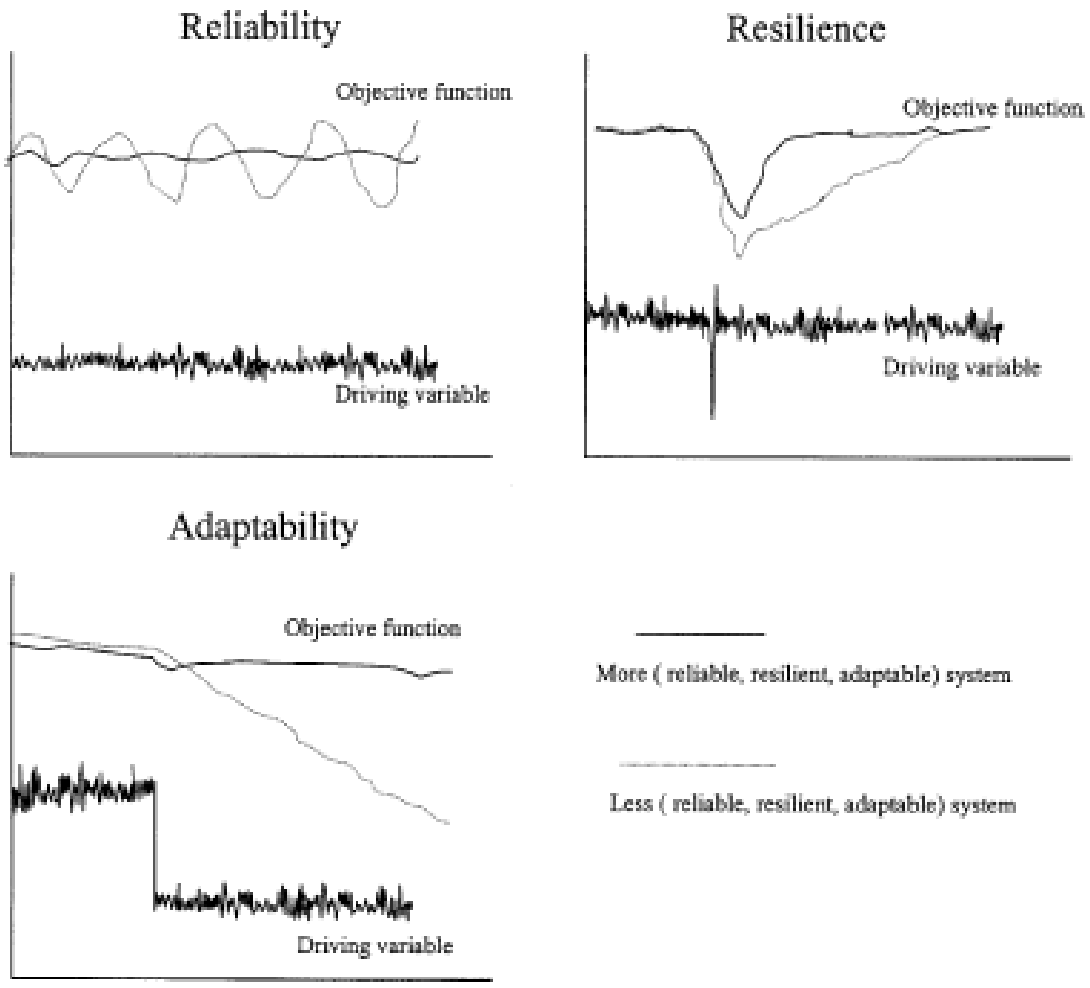


Figure 1. The resilience, reliability and adaptability attributes of sustainable systems.

Lopez-Ridaura et al 2005 Multiscale methodological framework to derive criteria and indicators for sustainability evaluation of peasant NRM systems. *Environment, Development and Sustainability* 7:51–69

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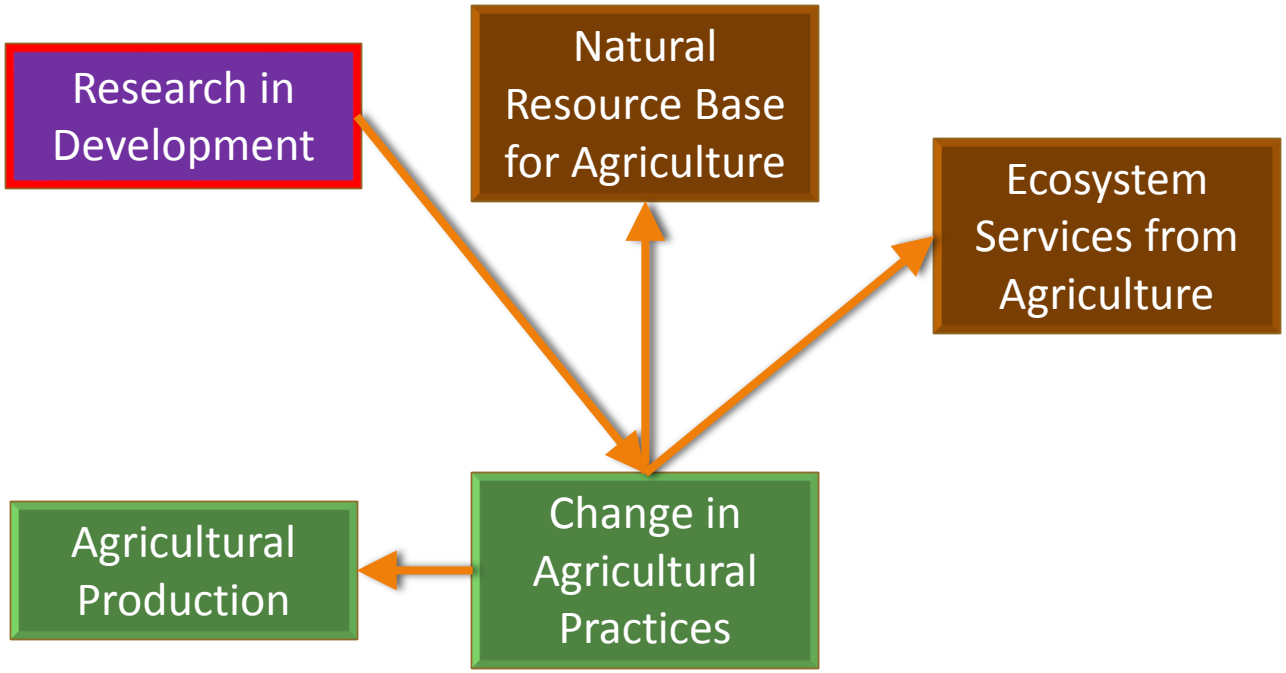

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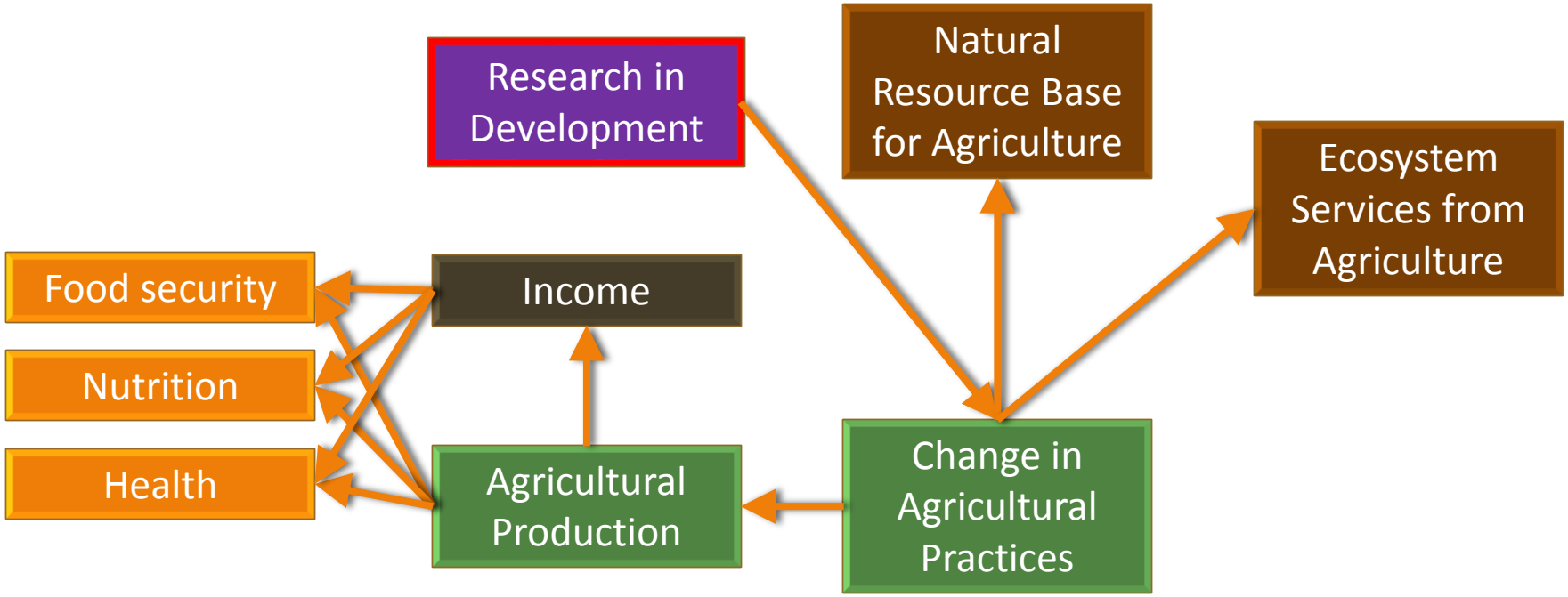

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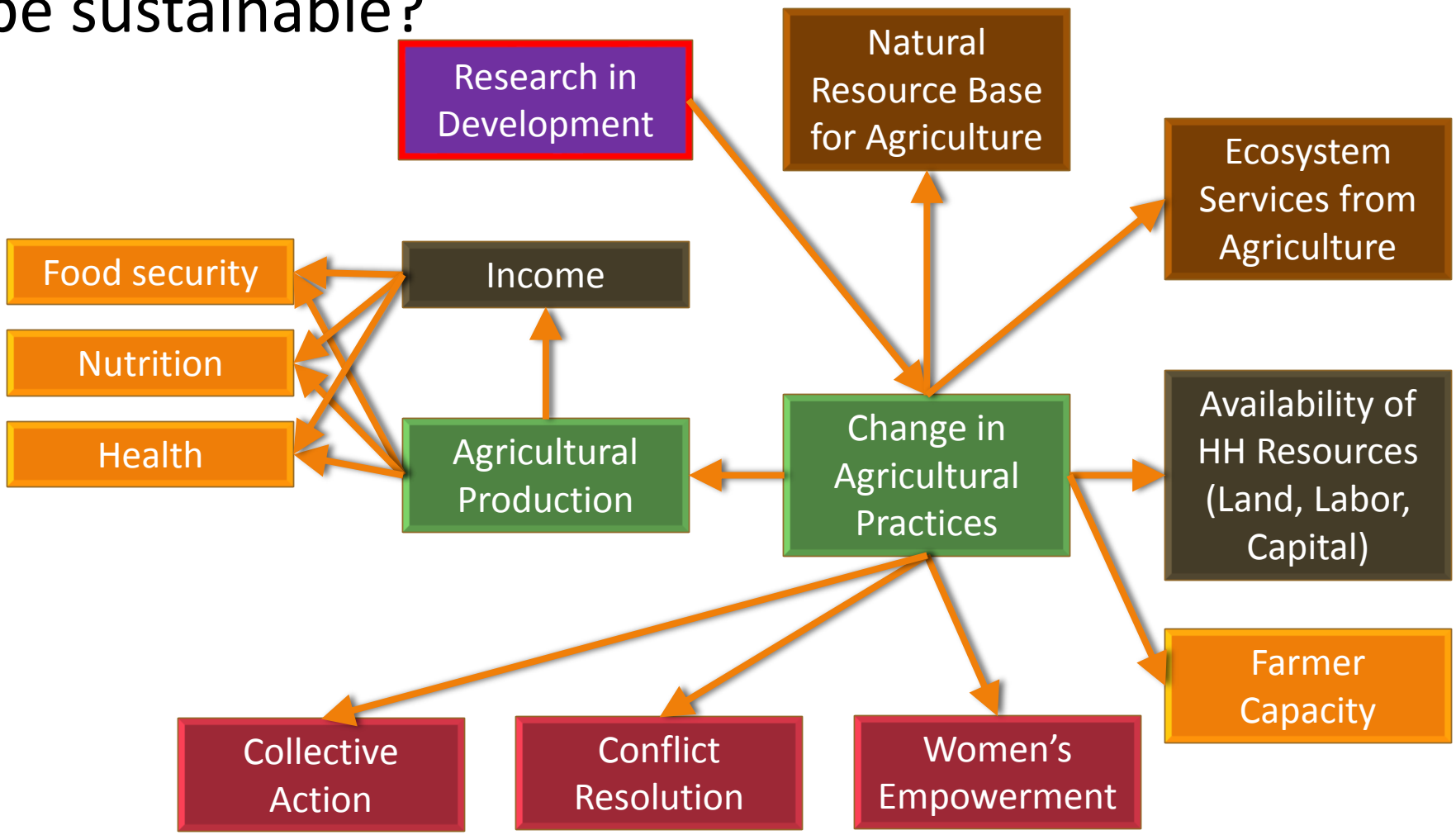
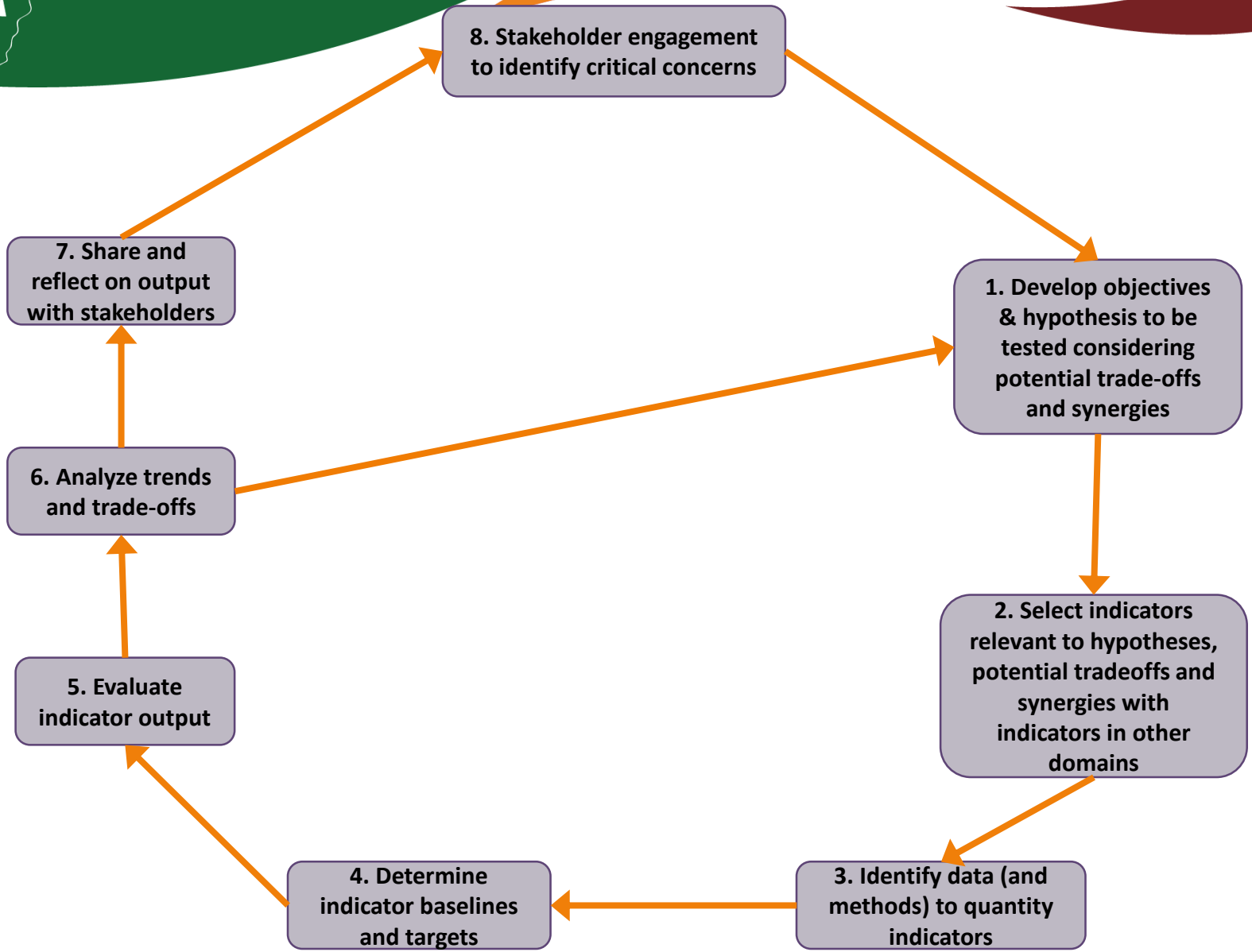


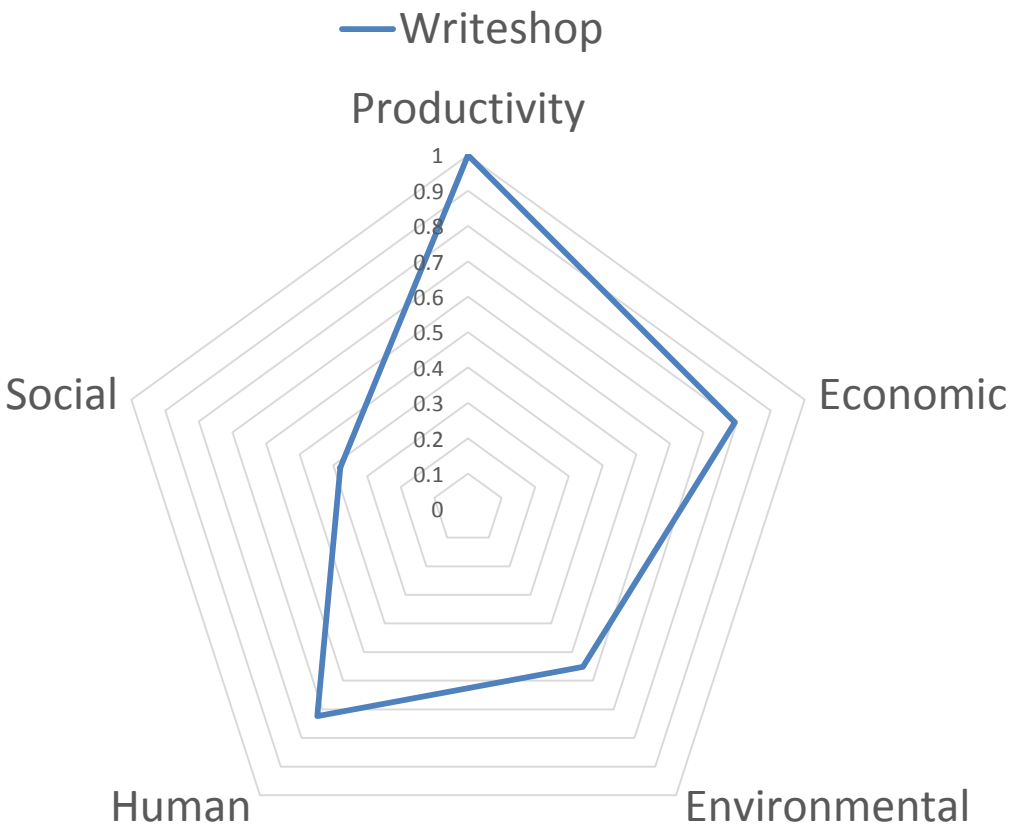
How do we know if we are achieving this?

- You can't know what you don't measure!
- SI indicator framework
  - List of indicators with various metrics organized by scale
  - Exercise for identifying tradeoffs and synergies
  - Guide for selecting indicators and metrics
  - Support for visualizing the results

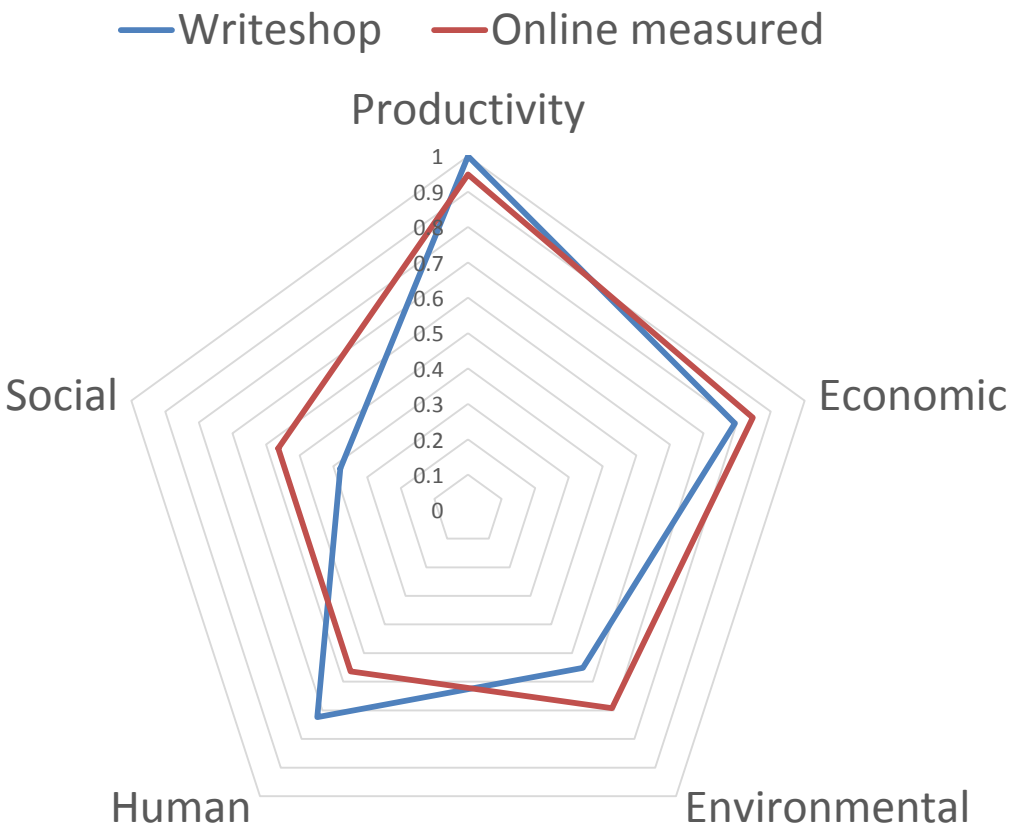


Adaptation from -- Kline, K. 2014; Stoorvogel et al. 2004

ESA Writeshop studies (29)



Writeshop (29) vs. On-line survey (39)



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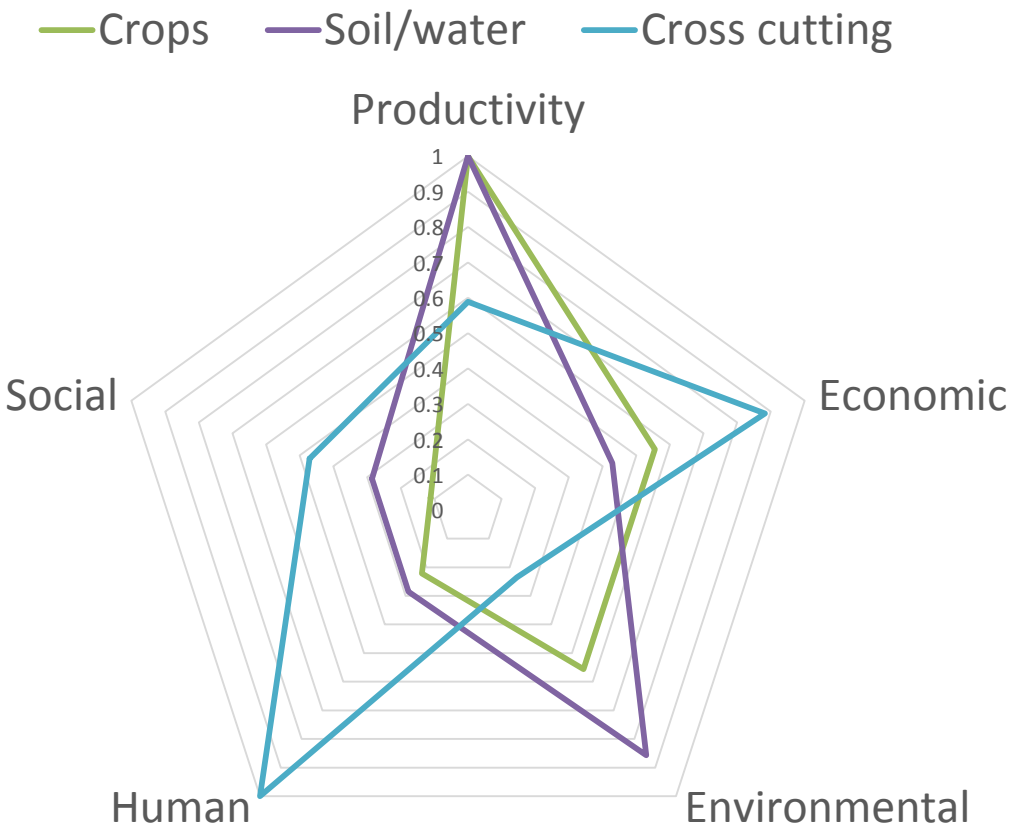
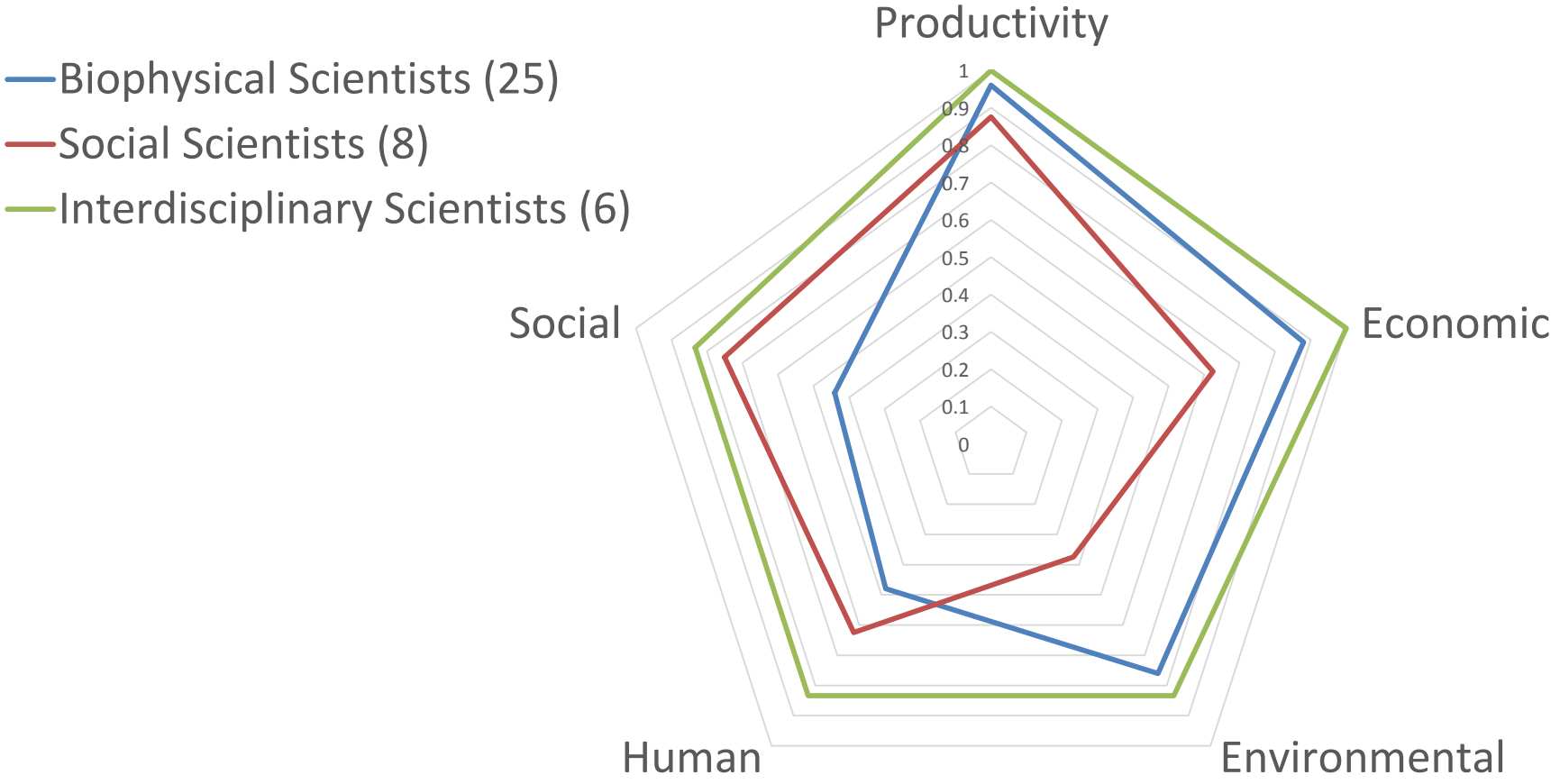


On-line survey results (39 scientists)



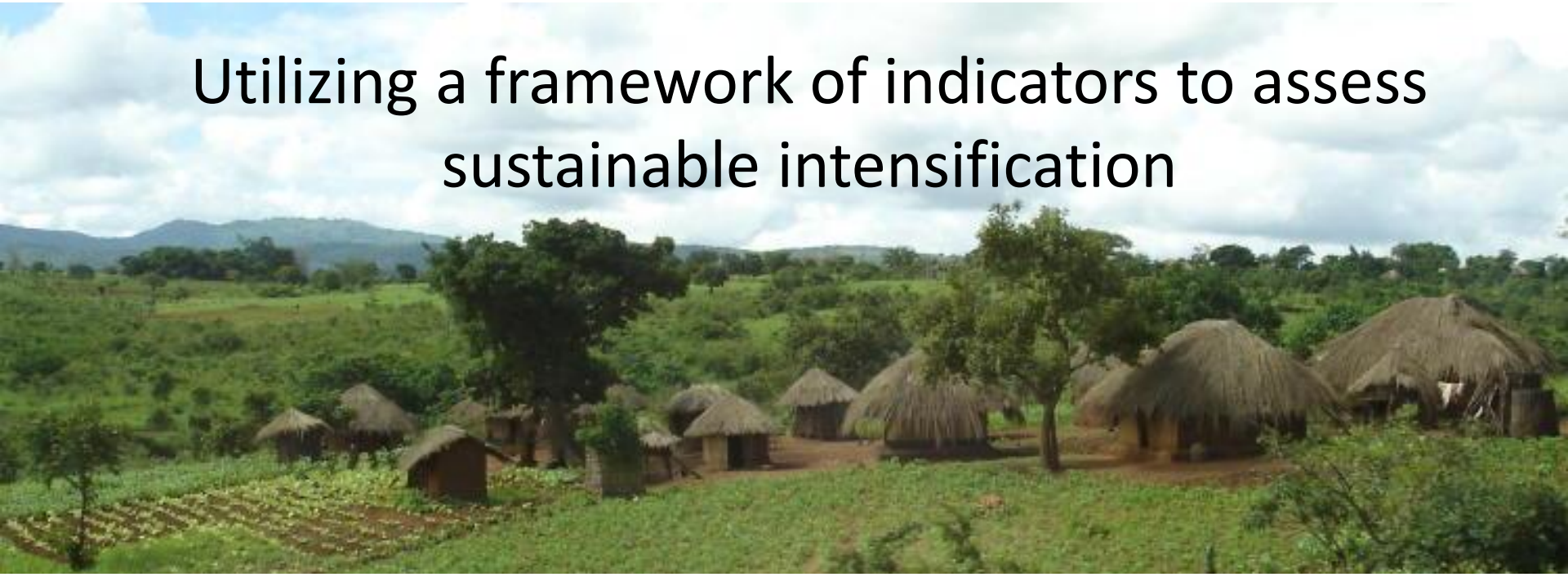
Challenges to reliably collecting data on all important SI indicators

Limitation	Percent mentioning
Data quality (accuracy and precision)	50%
High costs of data collection	45%
Lack of expertise training/collecting data	36%
Time required	32%
Other (e.g. scale aggregation)	23%
Lack of expertise training/collecting data	36%

Primary uses of the SI indicator framework

1. Assessing technologies
2. Identifying tradeoffs and synergies
3. Monitoring and Evaluation of Community-wide impact

Utilizing a framework of indicators to assess sustainable intensification



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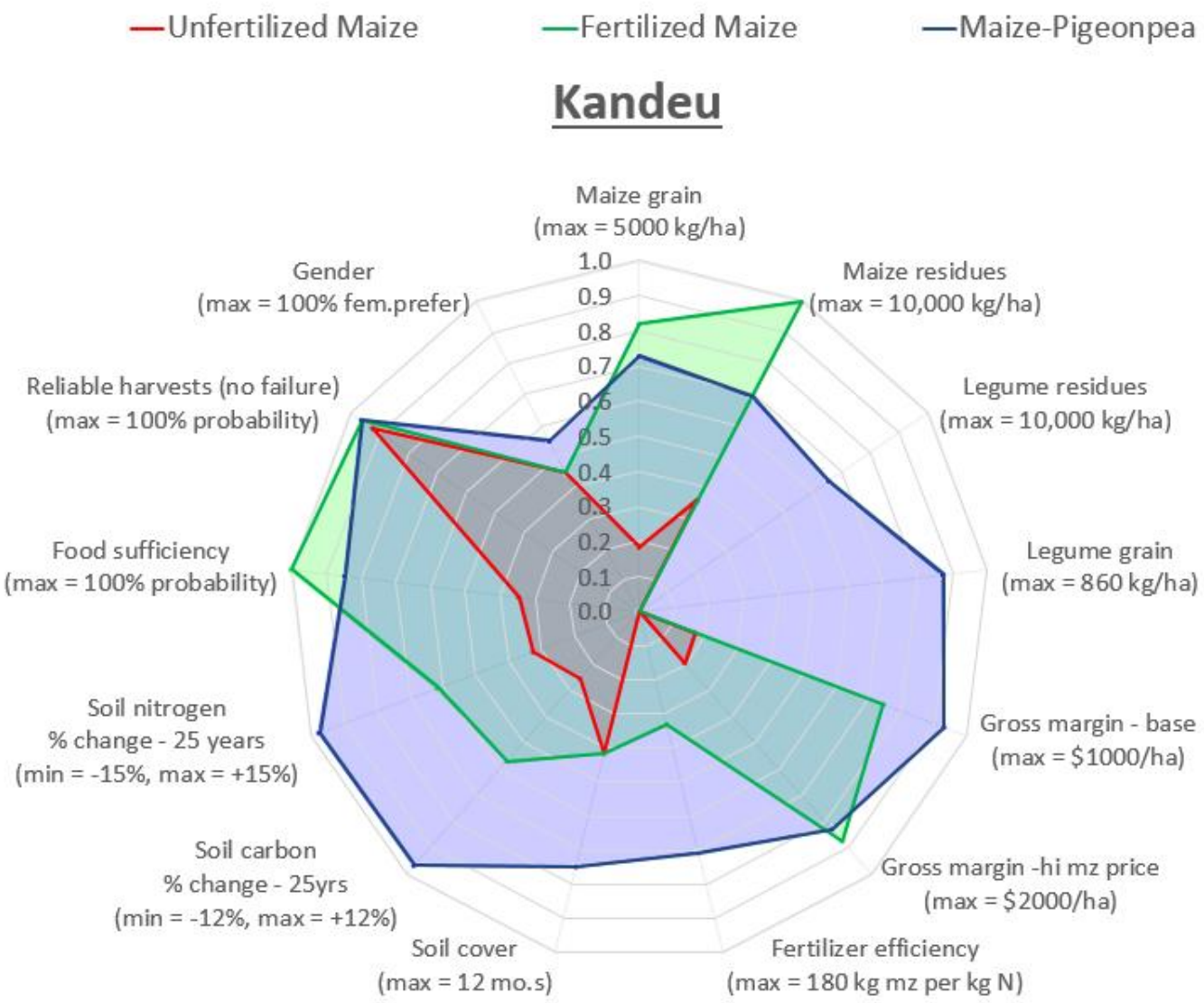
Evaluating relative sustainability of legume systems in Malawi

Systems compared:

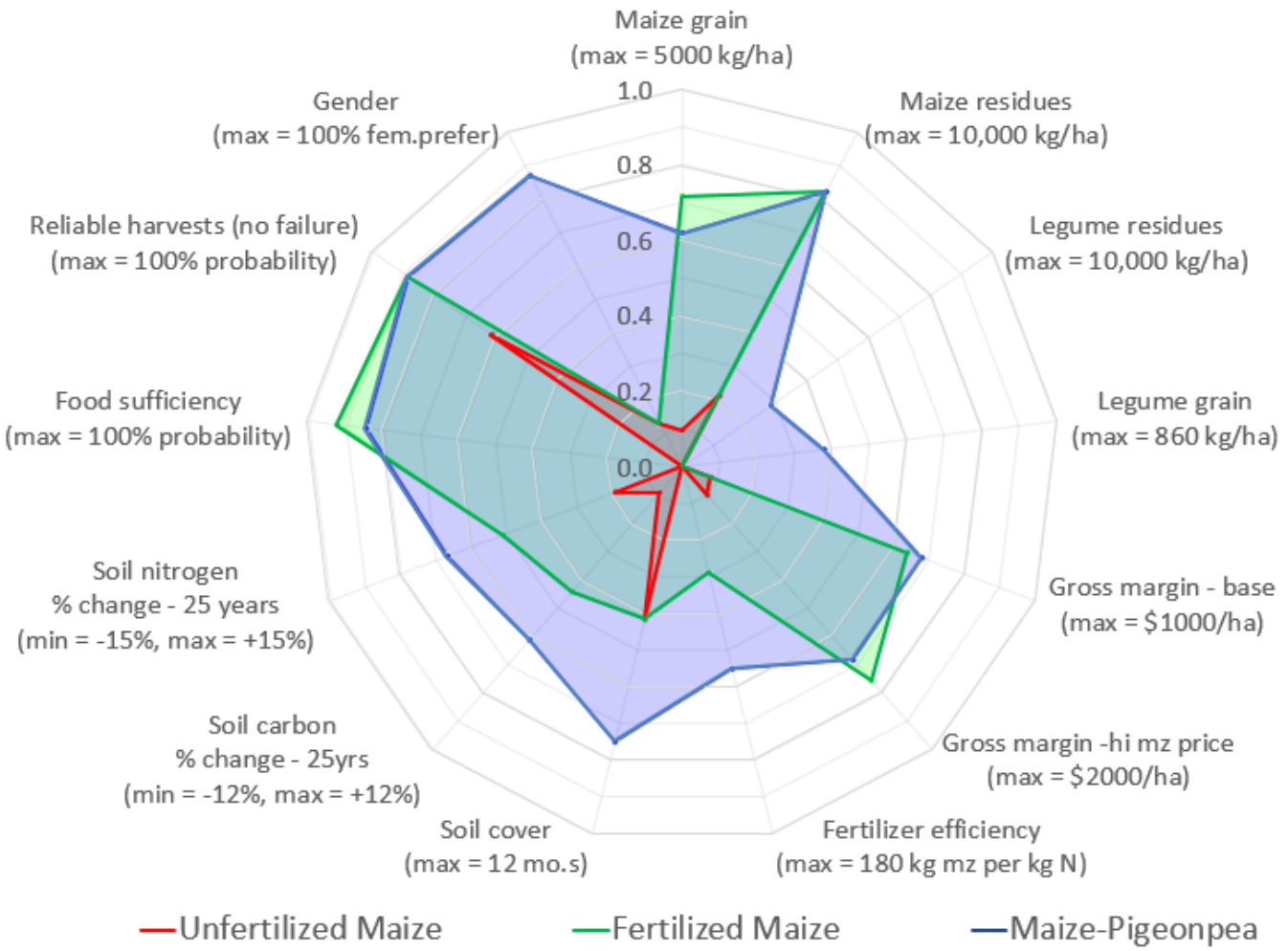
- Mz0 – Continuous sole maize – no fertilizer
- MzNPK – Continuous sole maize with 69 kg N/ha fertilizer
- PpMz – Maize-Pigeonpea intercrop with 35 kg N/ha fertilizer
- GnPp-Mz – Groundnut-Pigeonpea intercrop rotated with maize (35 kg N/ha fertilizer in maize phase)

Data sources:

1) Mother trials – yield and biomass (2-3 seasons)
2) APSIM modeling results – yield variability, long-term soil changes
3) Survey data (baseline for prices + hh composition; baby trials survey for pairwise ranking of technologies


Unfertilized Maize
Fertilized Maize
Maize-Pigeonpea
Kandeu
Maize grain
(max = 5000 kg/ha)
Maize residues
(max = 10,000 kg/ha)
Legume residues
(max = 10,000 kg/ha)
Legume grain
(max = 860 kg/ha)
Gross margin - base
(max = $1000/ha)
Gross margin -hi mz price
(max = $2000/ha)
Fertilizer efficiency
(max = 180 kg mz per kg N)
Soil cover
(max = 12 mo.s)
Soil carbon
% change - 25yrs
(min = -12%, max = +12%)
Soil nitrogen
% change - 25 years
(min = -15%, max = +15%)
Food sufficiency
(max = 100% probability)
Reliable harvests (no failure)
(max = 100% probability)
Gender
(max = 100% fem.prefer)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0

Golomoti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Fertilized Maize
Maize-Pigeonpea

Conclusion

- The SI indicator framework facilitated holistic analysis of legume systems and the identification of important data gaps
- A transdisciplinary approach (interdisciplinary research collaboratively engaging with farmers) is needed to develop and assess management practices for sustainable intensification

Preliminary results from Mbola		
Table 1. Describes the indicators selected		
Indicators	**Basic Indicator**	**Domain**
Maize yield in ton per ha	Crop yield	Productivity
Chemical fertilizer use per ha	Input use intensity	Economic
% total land allocated to maize	Crop diversification'	Economic
% of household selling maize to the market	Market Participation	Economic
% households with no incidence of water insecurity	Water Insecutiry	Environmental
% households with no incidence of food insecurity	Food Insecurity	Human condition

Questions?

Primary uses of the SI indicator framework

1. Assessing technologies
2. Identifying tradeoffs and synergies
3. Monitoring and Evaluation of Community-wide impact

Name: _____

Focus: _____

_____

_____

Productivity

Crop production

Fodder production

Animal production

Variability in production

Environment

Vegetative cover

Plant biodiversity

Fuel availability

Water availability

Water quality

Soil erosion

Soil carbon

Soil acidity

Soil salinity

Nutrient partial balance

Greenhouse gas emissions

Pesticide use

Social

Gender equity

Age equity

Equity of marginalized groups

Level of social cohesion

Level of collective action

Conflicts over resources

Human condition

Nutritional status

Nutrition awareness

Food security

Capacity to experiment

Human health

Economic

Profitability

Variability of profitability

Income diversification

Input use efficiency

Returns to land, labor and capital

Poverty rates

Market participation

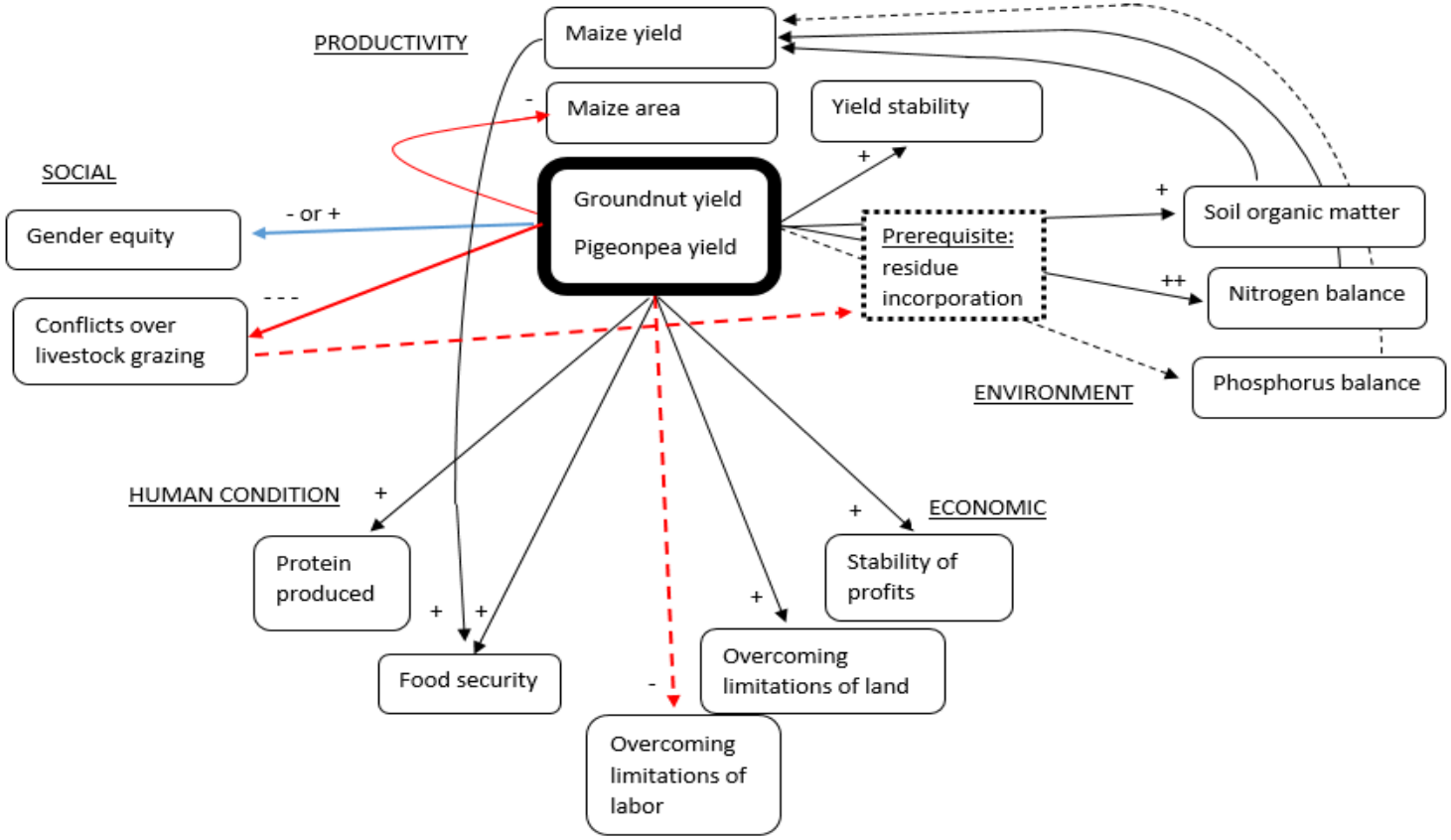
Market orientation

Draw arrows for connections ---------->

Use +, ++, or +++ to show synergies

Use -, --, or --- to show tradeoffs

Malawi – Africa RISING example



Summary of indicators and metrics

Domain		Indicators		Measurement methods		Proxies
				Popular measurement	Approximate measure	
1. Productivity – grain, biomass and animal products per unit of land per unit time		Crop production kg/ha/yr.		Crop cuts	Farmer recall	NPP
		Animal yield		Livestock surveys	Farmer recall	Regional sales
		Fodder productivity		Survey	Crop cuts or measures	
		Variability of production		Data over time	Farmer ranking	Modeled data
2. Economic – incentives, constraints and efficiency		Profitability		Survey/diary of inputs + outputs	Gross margin	
		Variability of profitability		Profits over time	Modeled profits	
		Poverty rates		Survey consumption, expenditure and assets		
		Market participation		Survey		Regional sales
		Income diversification		Survey		
		Input use efficiency		Experiments	Recall	
		Input use intensity		Survey		
3. Environment	Part 1: local natural resource base for agriculture	Soil attributes	Carbon	Soil test	Biomass inputs	
			Water	Soil moisture	Visual estimate	
			Nutrients	Soil nutrient tests	Crop performance	
			Erosion	Runoff measure	Visual estimates	Sediment load
		Vegetative cover		Quadrats	Remote sensing	
	Part 2: impacts on ecosystem services	Habitat or biodiversity loss		Transects	Remote sensing	
		Water quality		Various		
		Pesticide use		Observed application	Recall, sales	
		Greenhouse gas emissions		Measured fluxes	Inputs and practices	
4. Human condition – impacts on individuals		Food security		Survey - production consumption and expenditure	Consumption	Production
		Nutrition		Anthropometric measures	Dietary diversity	Prod. diversity
		Capacity to experiment		Independent experiments	Testing out practices	
5. Social – impacts on relationships		Gender equity		Gender equity impact analysis	Farmer ratings by gender	
		Social capital		Collective action	# conflicts	

Example of -- Economic domain

Indicator	Field/plot	Farm	Household	Landscape or Administrative Unit	Measurement method
Market participation	N/A	% of production sold (by crop, animal product)[1]	-see farm	% households selling an agricultural product[1]	[1]Household survey
Market orientation	N/A	% of land allocated to cash crops[1]	% of production sold (by crop, animal product)[1] % of land allocated to cash crops[1] *(Market orientation index)*		[1]Household survey

Choose indicators for an intervention or technology

1. Be specific about the intervention
2. What are the potential direct and indirect effects?
3. How can those be feasibly measured?

Indicator selection guide

Indicators for Productivity Domain	**Direct effect (X if yes)**	**Indirect effect (X if yes)**	**Likelihood of indirect effect *rate from 1 (very unlikely) to 5 (very likely)***	**Magnitude of effect (+ or -) *rate from 1 (weak) to 5 (very strong)***	**Justification if the indicator will not be measured**
Yield					
Crop harvest 1:					
Crop residue 1:					
Fodder production considering quality					
Animal productivity					
Species 1:					
Species 2:					

Discussion questions

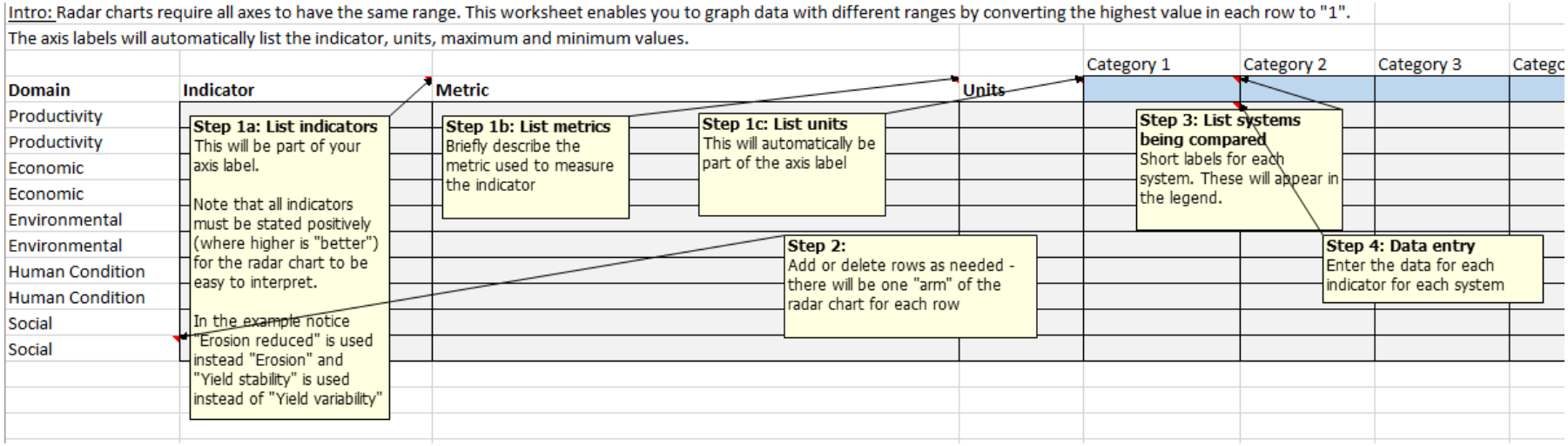
1. What indicators have you measured in Africa RISING already?
2. What indicators are of interest for Phase II? Why?
3. What concerns do you have about measuring those indicators effectively?

Presentation of results

- Radar charts allow for transparency
- Readers can value each indicator as they see fit
- A computed index (e.g. per domain) tends to hide too much and provides little benefit
- Developing targets and threshold values would be useful, but challenging

Radar chart generator in excel

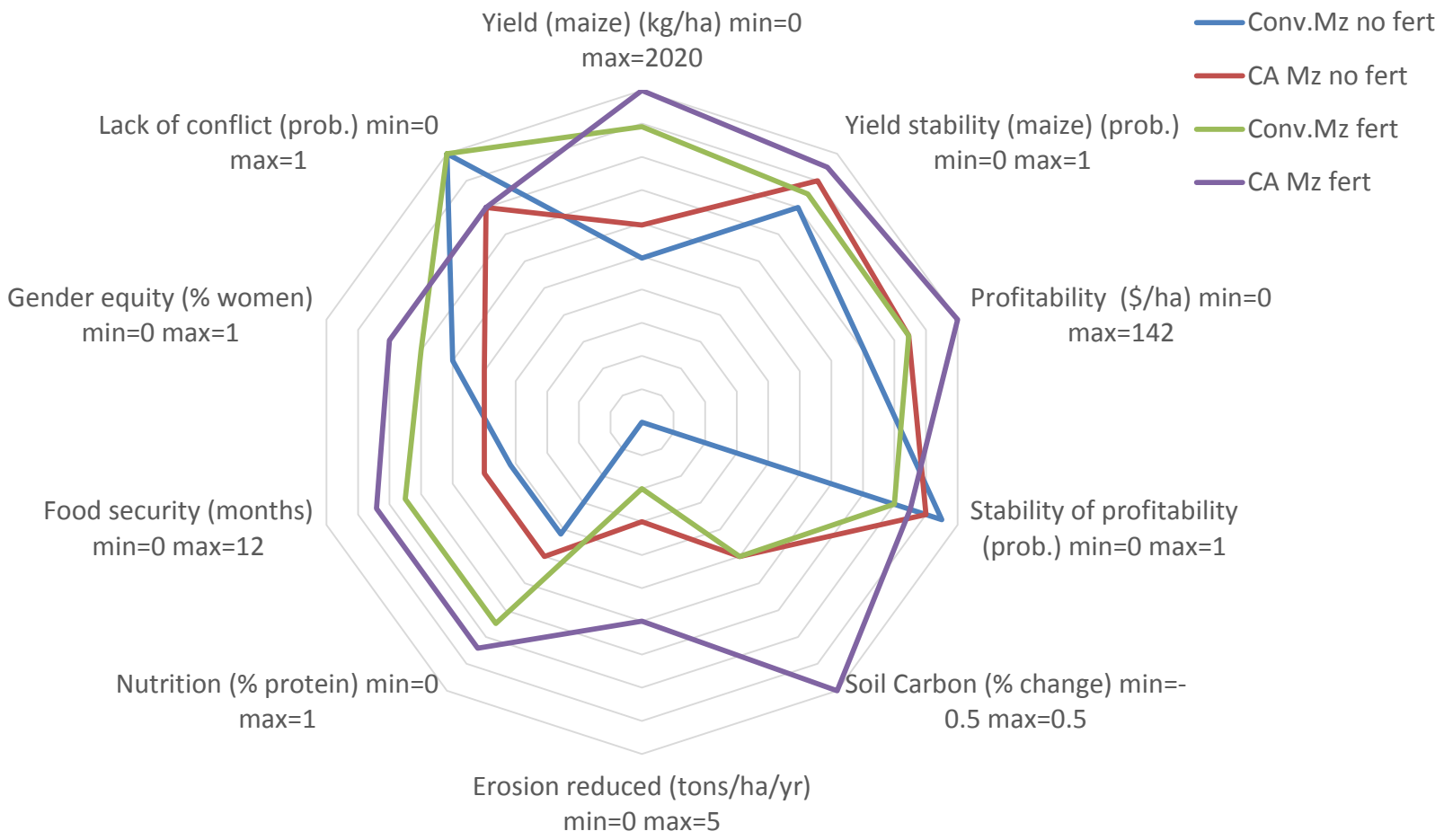
- Instructions for how to enter information
- All indicators must be stated positively!
- For example – erosion reduced



Mock example provided

Domain	Indicator	Units	Conv.Mz no fert	CA Mz no fert	Conv.Mz fert	CA Mz fert
Productivity	Yield (maize)	kg/ha	1000	1200	1800	2020
Productivity	Yield stability (maize)	prob.	0.8	0.9	0.85	0.95
Economic	Profitability	$/ha	$100	$120	$120	$142
Economic	Stability of profitability	prob.	0.95	0.9	0.8	0.85
Environmental	Soil Carbon	% change	-50.00%	0%	0%	50%
Environmental	Erosion reduced	tons/ha/yr	0	1.5	1	3
Human Condition	Nutrition	% protein	0.416666667	0.5	0.75	0.841666667
Human Condition	Food security	months	5	6	9	10.1
Social	Gender equity	% women	60%	50%	70%	80%
Social	Lack of conflict	prob.	100%	80%	100%	80%

Output generated by mock example



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Approach to refining indicator list

- Synthesis of literature and stakeholder expertise to obtain list of indicators, metrics and methods at the four scales and identify gaps.
- Engage scientists and project managers involved in SI to curate the list of indicators and methods.
  - Meeting and field visit in Mali (October 2015)
    - Discussion and meeting with steering committee and Africa RISING scientist.
    - Field visit to Africa RISING sites and MV site
  - Ethiopia visit in November 2015 (Africa RISING)
    - Visit to Africa RISING sites
    - Interaction with project partners and scientist
    - Update the framework indicators and protocol (metric methods) list
  - Rwanda (CIALCA) (February and March 2016)
  - Online survey of scientist working in sustainable intensification research projects (May – July 2016)

Thank You

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