Indicators and data requirement for monitoring sustainable agriculture

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Overview of this module

- Brief introduction
- Which criteria to consider? How to measure them?

  Exercise in groups

Lunch

- Composite indicators for assessing the sustainability of agricultural technologies

Sustainability

What is sustainability?

Why does it matter?

How to assess sustainability?

Concept of weak and strong sustainability

- **Weak sustainability**: substitution of resources is possible. Future generations substitute those resources that are relatively more abundant for resources that have grown scarce. E.g. substitution of human capital for land and labor (Hardaker 2002)
- **Strong sustainability**: human (human-made) capital and natural capital are separate categories that need to be preserved separately for the coming generations (Hansson 2010)

- Mostly the concept of weak sustainability is followed (e.g. FAO definition)

Sustainable agriculture …

- … uses less external off-farm inputs (purchased fertilizers, pesticides, mechanical inputs), uses improved management techniques and practices, employs locally available natural resources and purchased inputs more efficiently, ideally in a complementary and synergistic fashion (Altieri 2002)
- … enhances the recycling of biomass, improves soil conditions, minimizes energy losses, diversifies species and genetic resources, and enhances beneficial biological interactions (Reijntjes 1992)
- BUT: long term sustainability can mean reduced productivity in the short term (Beddington et al. 2011)

Why does it matter?

Millennium Ecosystem Assessment

ECOSYSTEMS AND HUMAN WELL-BEING

Dr. Simone Kathrin Kriesemer
Workshop on Measuring Sustainable Agriculture, Bogor 27.11.2014

Ecosystem services

- … are the benefits provided by ecosystems
  - **provisioning services**: food, water, timber, fiber, and genetic resources
  - **regulating services**: regulation of climate, floods, disease, water quality, waste treatment
  - **cultural services**: recreation, aesthetic enjoyment, and spiritual fulfillment
  - **supporting services**: soil formation, pollination, nutrient cycling, photosynthesis, water cycling

Challenges for sustainability

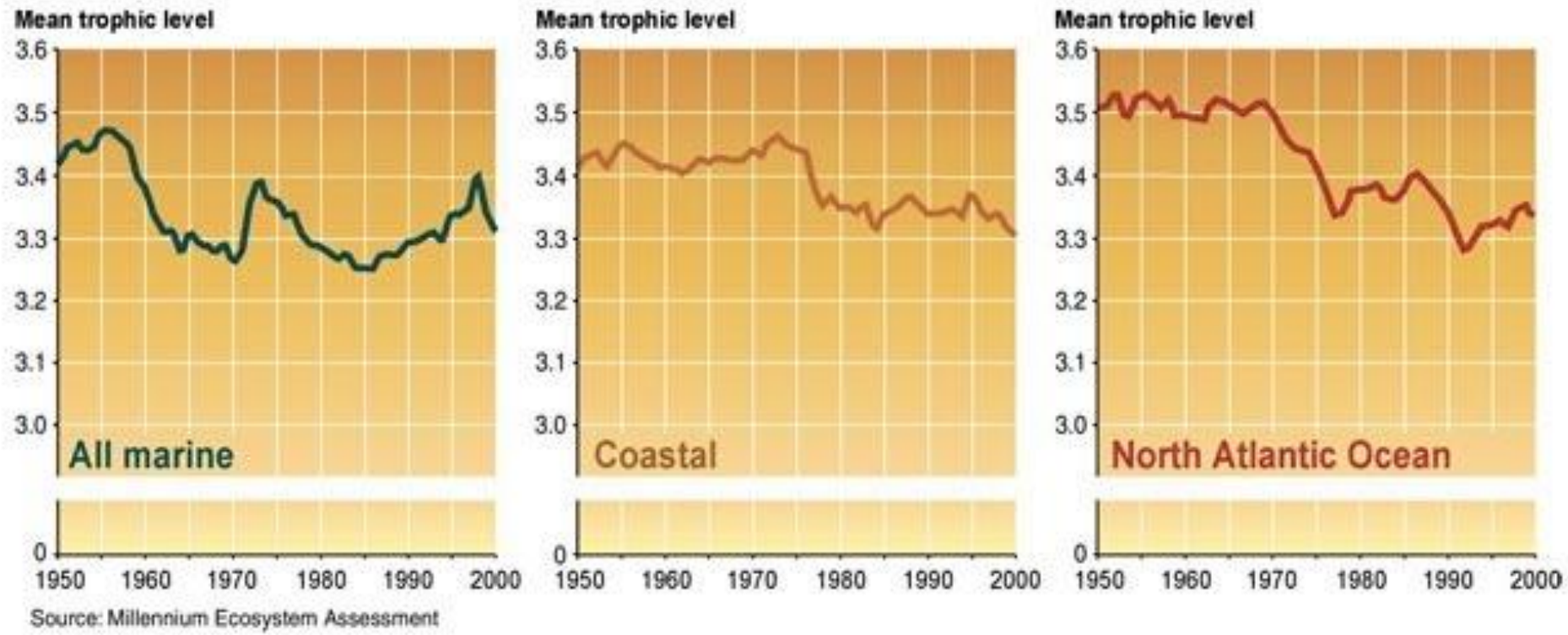
- Human use of all ecosystem services is growing rapidly
- Approximately **60%** (15 out of 24) of the ecosystem services evaluated in MEA are being **degraded** or **used unsustainably** (MEA 2005)
- Stockholm Resilience Centre: Humanity has transgressed three of the environmental planetary boundaries within which we can operate safely:
  - Climate change
  - Biodiversity loss
  - Changes to global nitrogen cycle (Rockström et al. 2009)

Challenges for sustainability (contd)

- Agriculture, forestry and fisheries are major contributor to the ecological footprint of humanity
- 31% of global Greenhouse Gas (GHG) emissions originate from agriculture and forestry (IPCC, 2007)
- Agriculture accounts for 70% of global freshwater withdrawals (FAO, 2011)

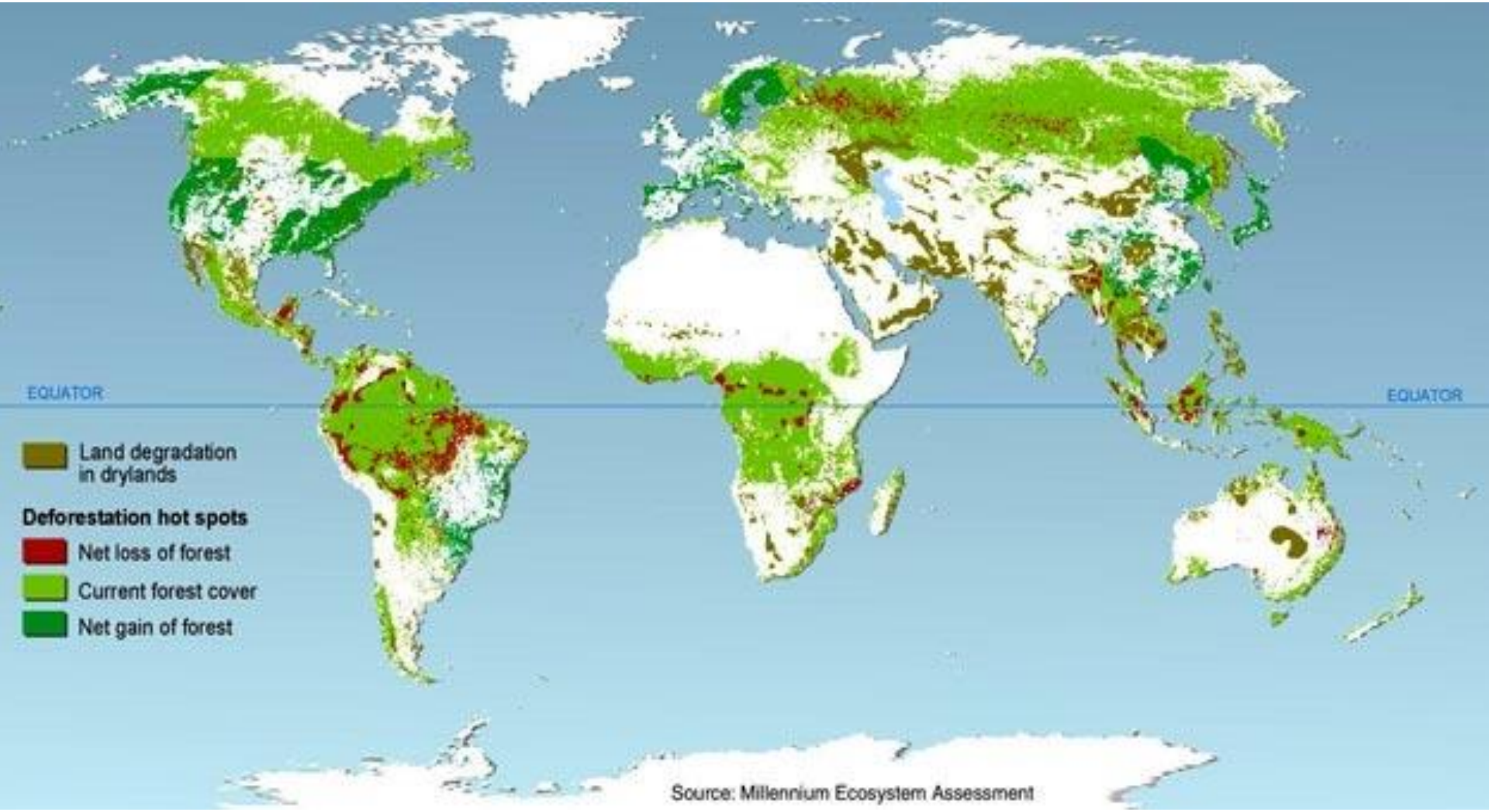
Decline in Trophic Level of Fisheries Catch Since 1950

primary producers (level 1) > herbivores (level 2) > predators (level 3) > carnivores or top carnivores (level 4 or 5)



Source: Millennium Ecosystem Assessment

Land cover change in past few decades



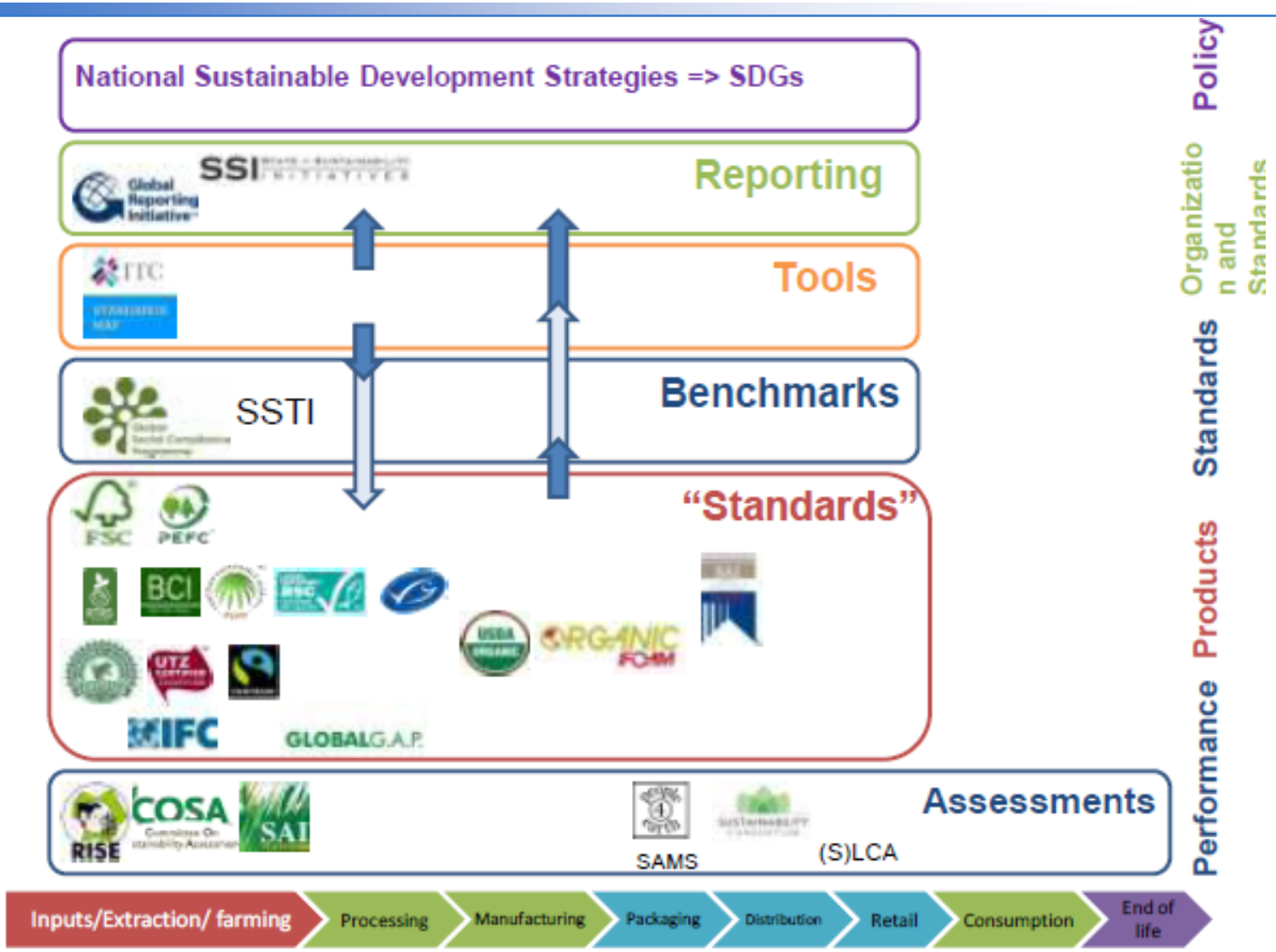
Measuring sustainability?

- Metrics are needed to set base-lines against which to measure progress,
  - track and predict socioeconomic, nutritional, and ecological change;
  - understand constraints to sustainable development;
  - work successfully with public, private, and NGO partners;
  - and identify appropriate policy measures

Source: SDSN TG7 (2014)

How to assess sustainability?

Landscape of sustainability initiatives



FAO SAFA (2013)

Do you know these labels?

- Currently the Ecolabel Index (www.ecolabelindex.com) tracks 448 ecolabels in 197 countries and 25 industry sectors

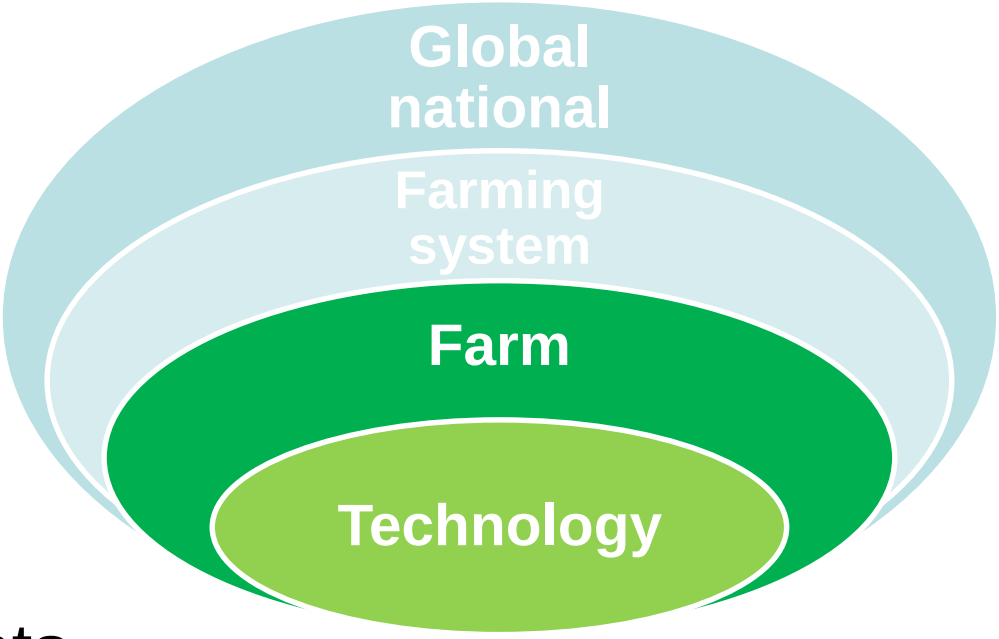
Source: www.ecolabelindex.com/ (2014)

Assessment of sustainability

- Vast literature on sustainability assessment
- At least 41 sustainability indices exist (Singh et al. 2009)
- … of which 12 work at the level of industries or technologies
  - Composite sustainability performance indices for industries
  - Product based sustainability indices
  - Environment indices for industries
  - Energy-based indices (Singh et al. 2009)
- SAFA Framework: Sustainability Assessment of Food and Agriculture Systems (SAFA 2013)

Scientific approaches

- At different levels
- Approaches look at partial aspects of sustainability or not the whole value chain
- Voluntary assessments
- Level of aggregation of end result: visual presentation as polygon vs. composite sustainability indices

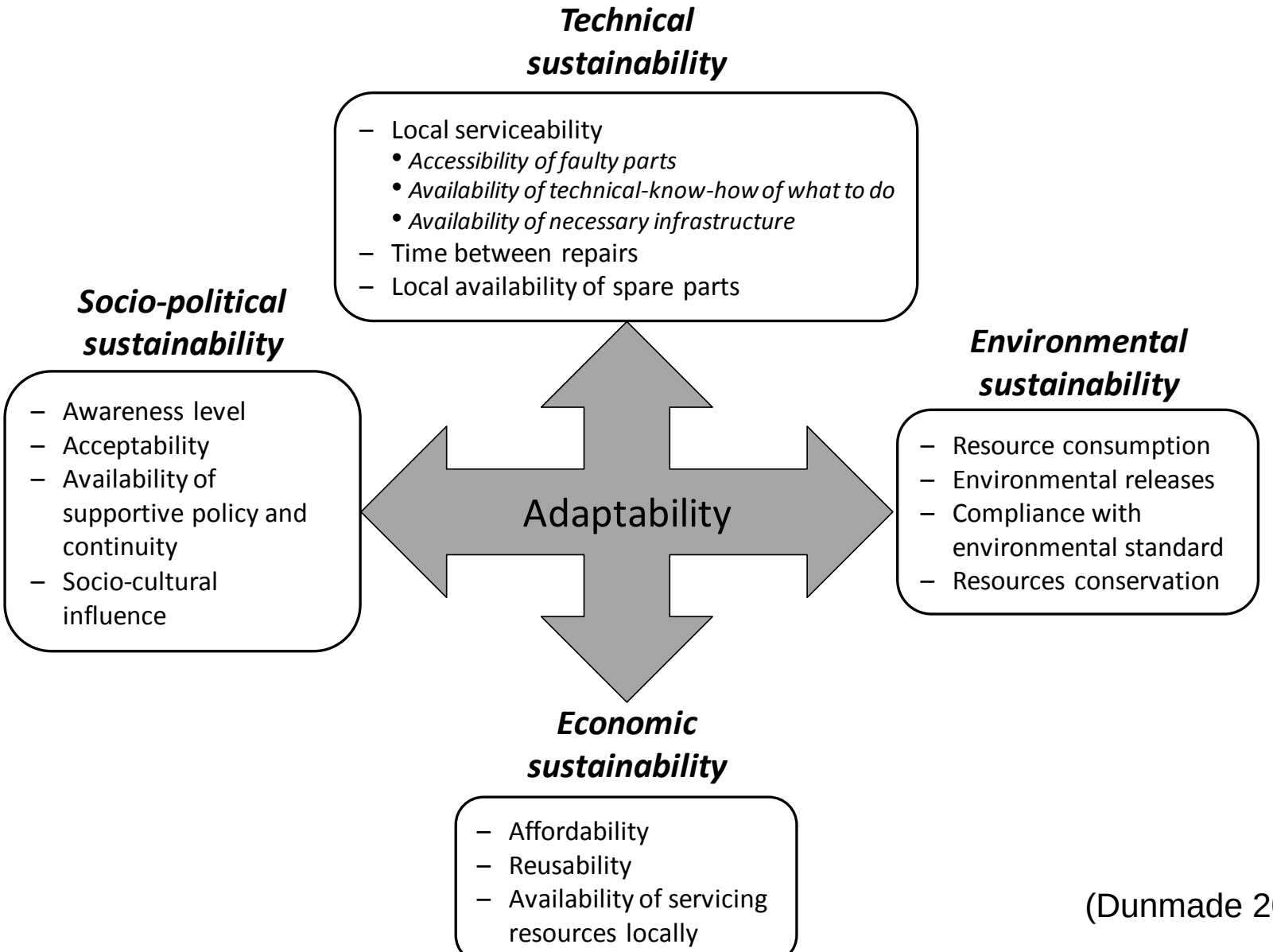


Source: SDSN TG7 (2014)

Dimensions of sustainability

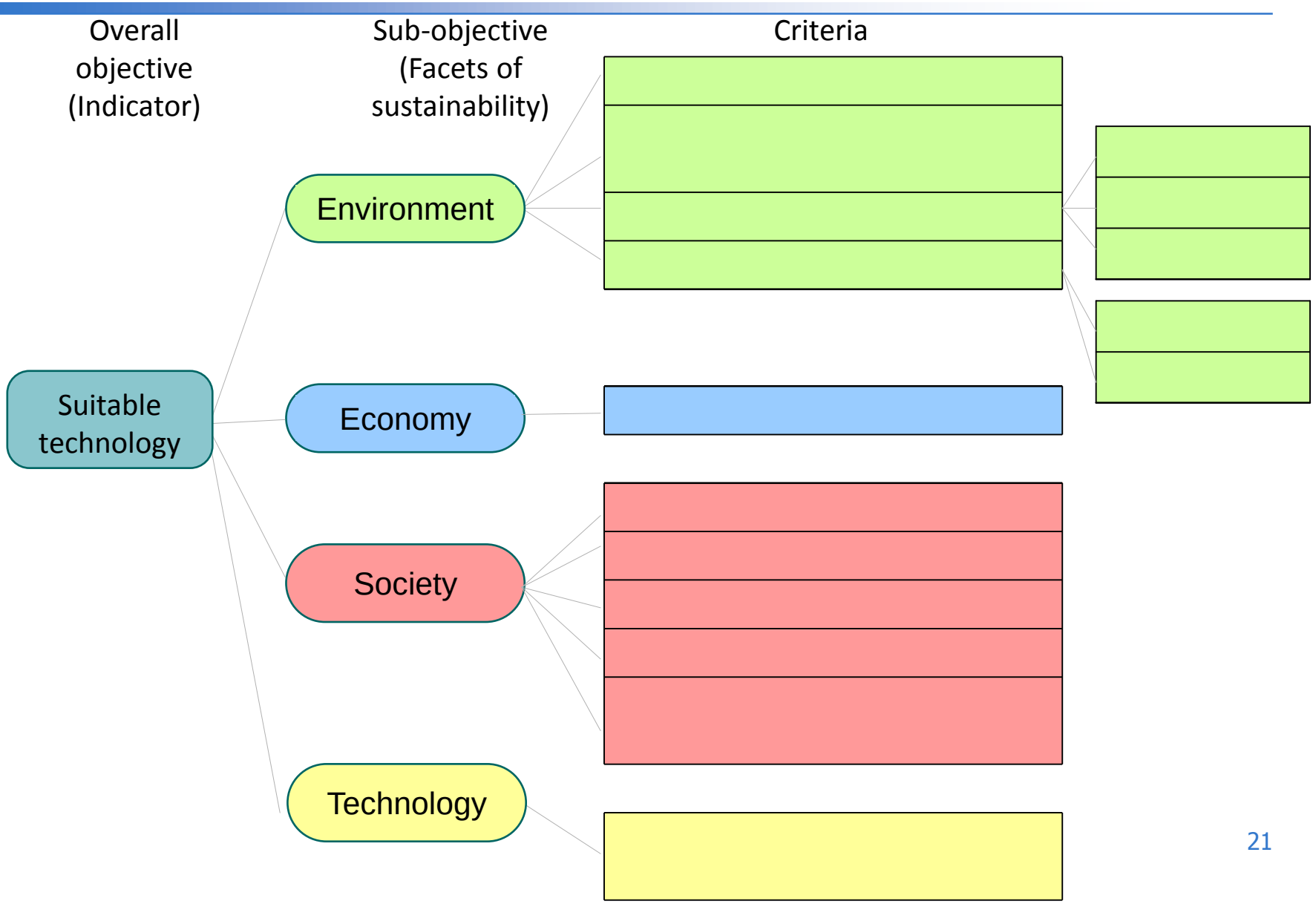
- Usually “three pillars of sustainability” or the “triple bottom line”: economic viability, social acceptability and environmental sustainability
- Other approaches exist:
  - (1) energy and material use (resources); (2) natural environment (sinks); (3) social justice and community development; (4) economic performance; (5) workers; and (6) products (Veleva & Ellenbecker 2001)
  - (1) improved farm-level social and economic sustainability; (2) improved wider social and economic sustainability; and (3) increased yields and reduced losses (Rigby et al. 2001)

Assessment of technologies for introduction into developing countries

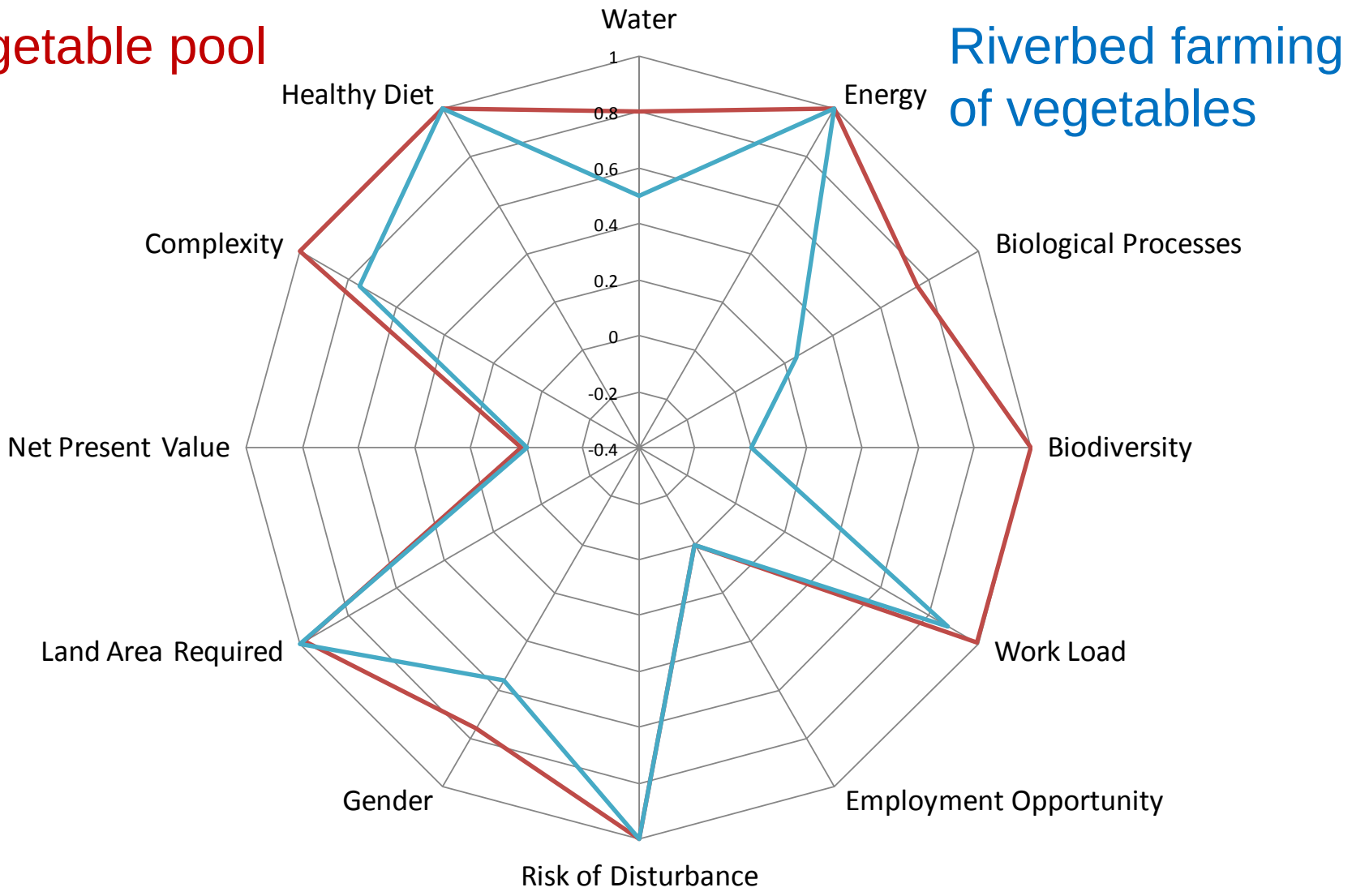


(Dunmade 2002)

SATNET Asia analytical framework

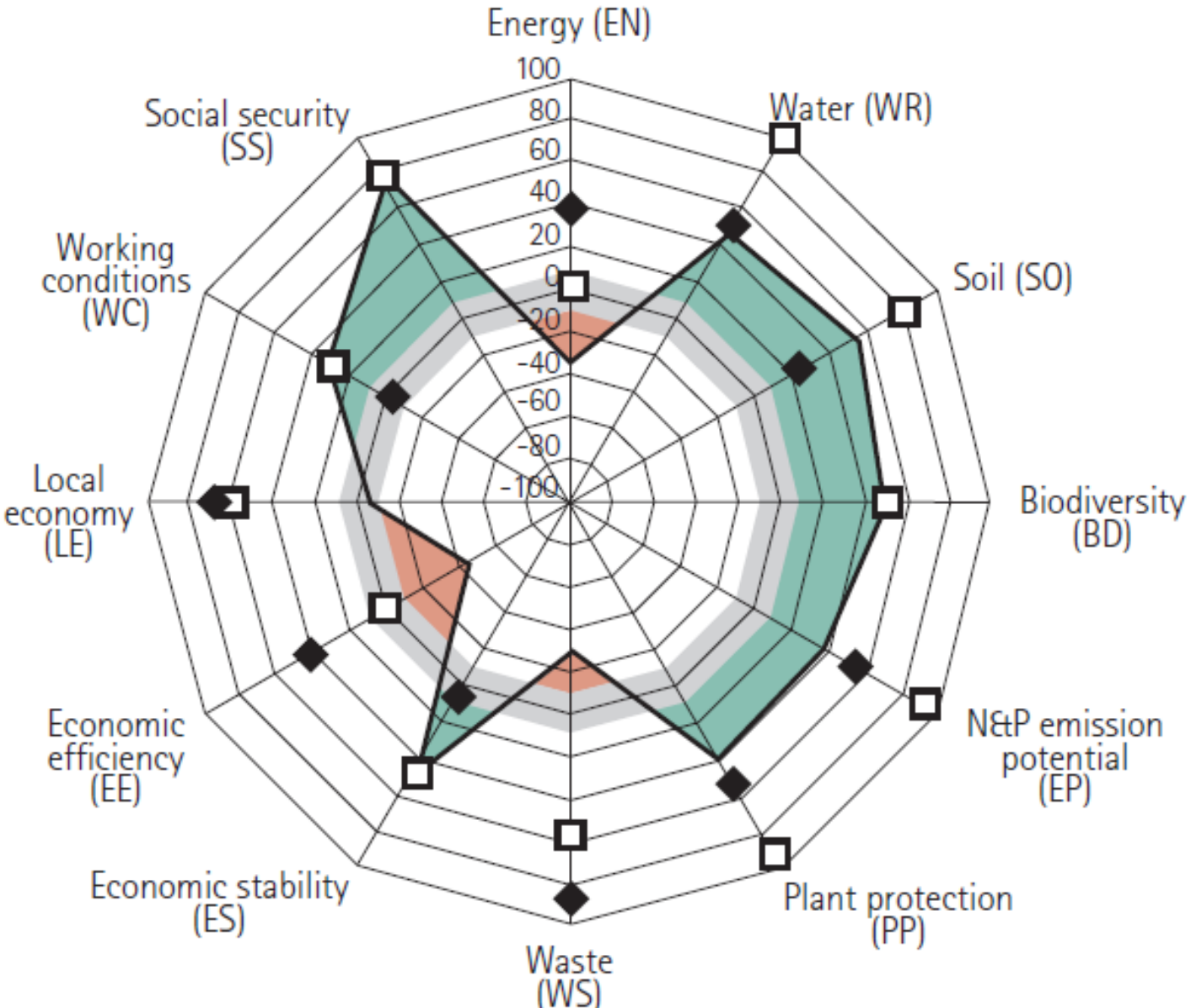


Example of SATNET Asia results



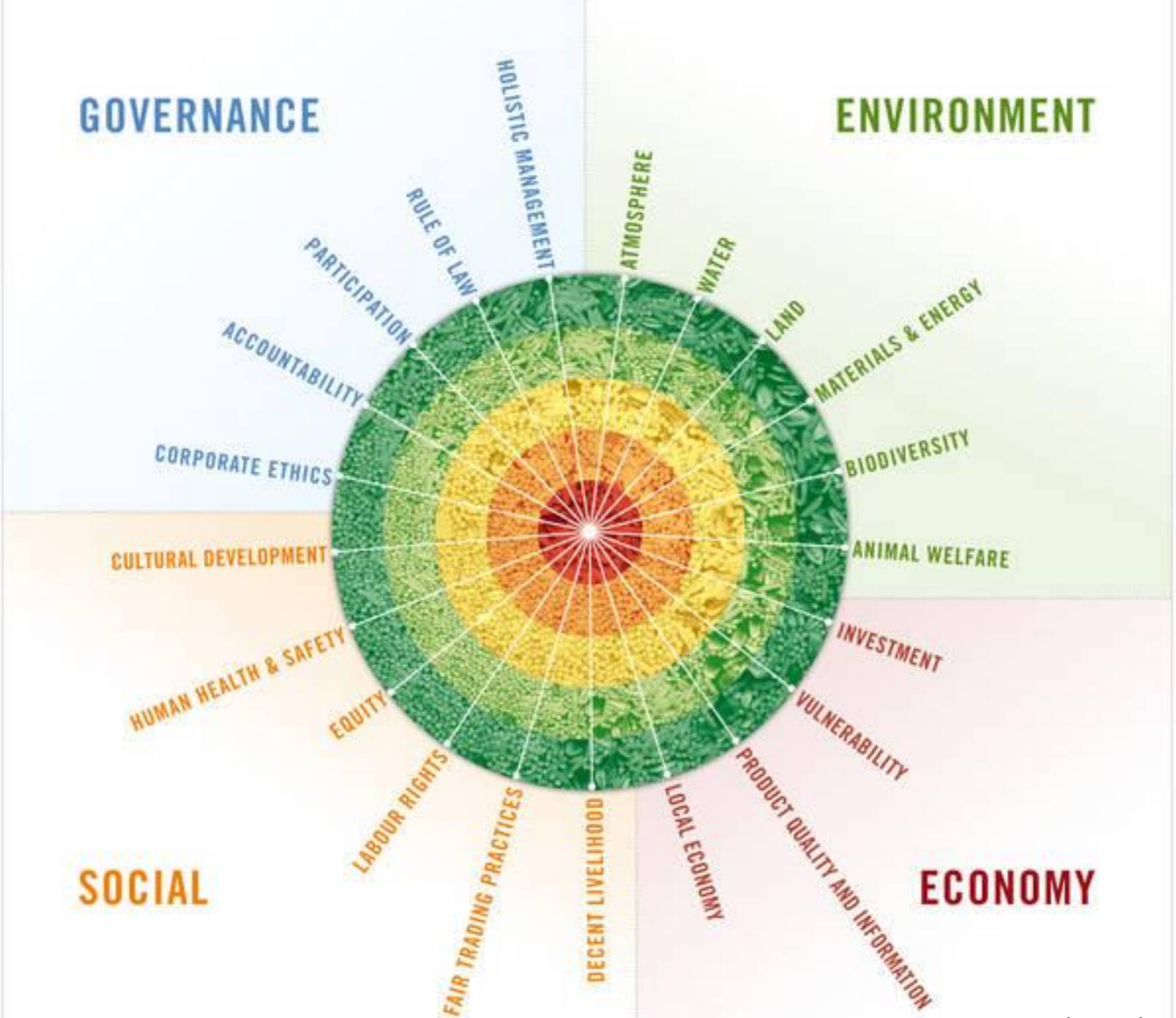
Example of RISE result

Response-Inducing Sustainability Evaluation



SAFA

- Sustainability Assessment of Food and Agriculture systems (SAFA) developed by FAO, completed end of 2013
- Holistic global reference framework for the assessment of sustainability along agriculture, forestry, fisheries, and aquaculture value chains
- Fair playing field for all by presenting a framework adaptable to all contexts and sizes of operation
- Common language for sustainability
- Easy-to-use standardized system, does not require external experts
- Long term objective to transform food systems towards sustainability



FAO SAFA (2013)

SAFA Framework

FAO SAFA (2013)

SAFA Process

STEP 1 MAPPING	STEP 2 CONTEXTUALIZATION	STEP 3 INDICATORS	STEP 4 REPORTING
Description of assessed entities	Sub-themes: review of sub-themes based on boundaries and sustainability objectives	Indicator selection	Polygon at aggregated and broken down level to illustrate sub-theme scores together with contextual issues, including risk areas (hot spot issues), boundaries and data quality, based on Accuracy Score.
Boundaries of assessment (space and time) and visual representation		Irrelevant sub-themes and indicators are not selected	Final report, where all relevant issues and scope are treated and rationale, irrelevant sub-themes and indicators are justified, areas for improvements are identified. See Appendix B: Performance Report Checklist.
What is excluded from SAFA? (cut-off criteria)		Guidance notes for indicators	Critical Review – two levels are outlined – Level 1 for less formal SAFA assessments which involve documenting the results but this is not subject to external 3rd party audit, while Level 2 for more formal applications of SAFA includes a 3rd party audit.
Relationships of different supply chain members	Indicators: review of default (or replacement) indicators in relevant sub-themes and use of data regarding geographical, environmental, social, political and economic context to determine detailed ratings	Determine Accuracy Score for each indicator	
		Documentation of input data and score	
		Rating at indicator level, aggregation of results at sub-theme and theme level	

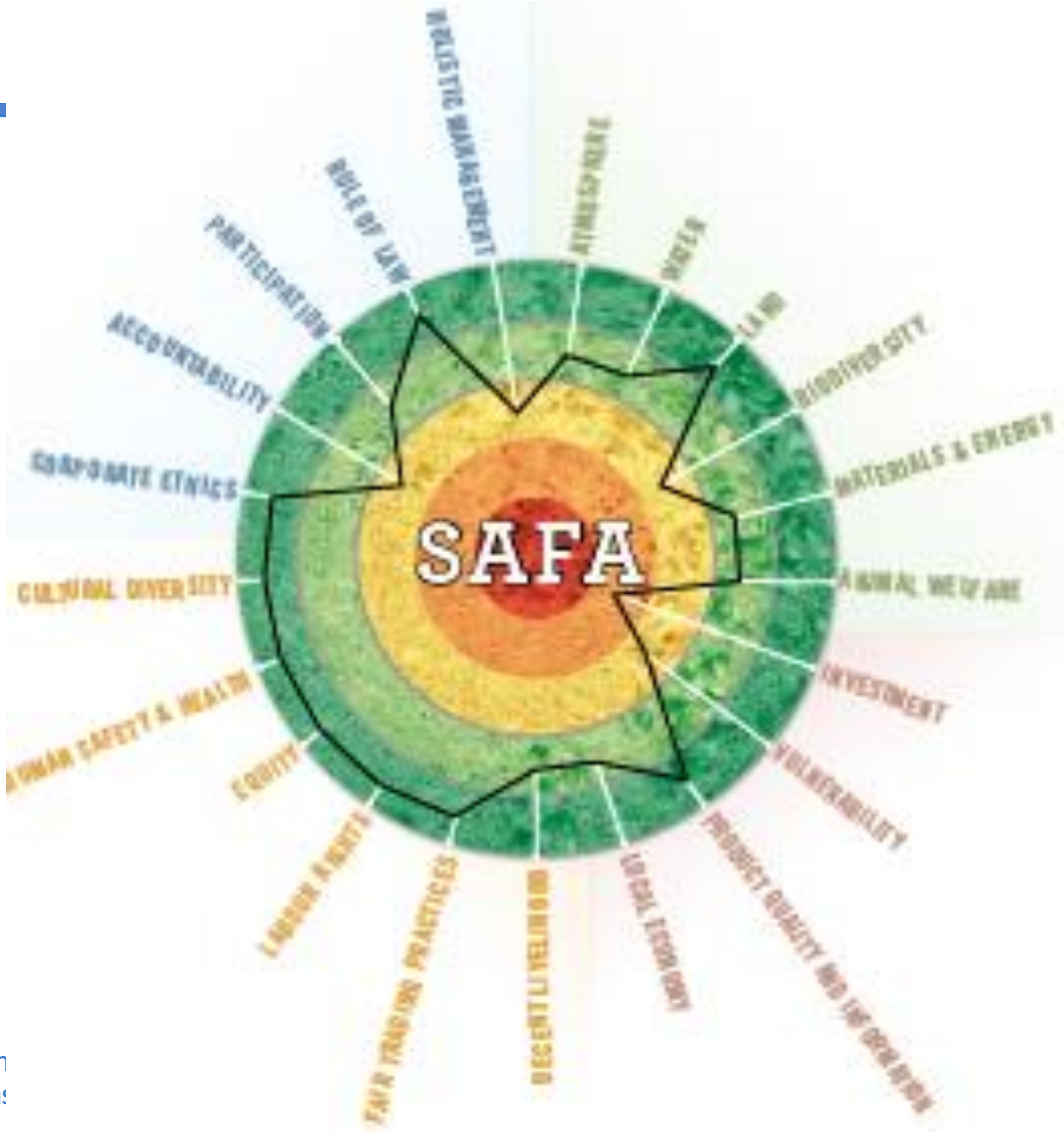
FAO SAFA (2013)

SAFA Process

- 1) Mapping: setting goals and boundaries
  - reasons for doing assessment, intended audience and use of results (self assessment or external assessment for certification?)
  - What is included and what is not included in assessment? Time and space boundaries, describe entities you assess
- 2) Contextualization: review themes and sub-themes, identify the relevant and the irrelevant ones (justify), compile context specific literature and data on relevant indicators, prepare rating of indicators (best, good, moderate, limited, unacceptable)

SAFA Process

- 3) Indicator metrics, accuracy scores, ratings, aggregation of results, interpretation
- 4) Reporting: descriptive and analytical review of sustainability of a particular entity, incl. polygon and disaggregated results


SAFA

SAFA small APP

- FAO announces development of a set of indicator that are both highly relevant and practical to smallholder farmers
- To be completed by November 2014

Exercise:

Assist FAO in the development of the SAFA small App tool for the sustainability assessment of a small scale farm

Exercise

- Form 5 groups
- Look at the list of indicators taken from the “SAFA indicators” document
- **Which of these indicators are relevant for the farm example (video on integrated farming)**
- **How can they be adapted/ modified/ contextualized to better serve the assessment of this farm?**
- **Suggest how adapted indicators can be measured**
- Time: 30 minutes
- Present your group’s result to the plenum (3 minutes each group) followed by discussion

Any questions?

Example of a sustainable food system

- WFD 2013 SPOT: Healthy people depend on healthy food systems

  http://www.youtube.com/watch?v=8cI6YwDZDGA&list=PL0Rrgop7D4QBlSvooO-AsbxEZjHB1mA5N

  http://www.youtube.com/watch?v=6x-XxZe5Ve4

Exercise

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Any questions?

Lessons learned from exercise?

- Text here

Composite sustainability indices

Advantages of composite indices

Pros
Can summarize complex, multi-dimensional realities (such as agricultural sustainability) with a view to supporting decision-makers.
Are easier to interpret than a battery of many separate indicators.
Can assess progress of farms, agricultural systems, regions and countries over time.
Reduce the visible size of a set of indicators without dropping the underlying information base.
Facilitate communication with general public (i.e. citizens, media, etc.) and promote accountability.
Help to construct/underpin narratives for lay and expert audiences.
Enable users to compare complex dimensions effectively.

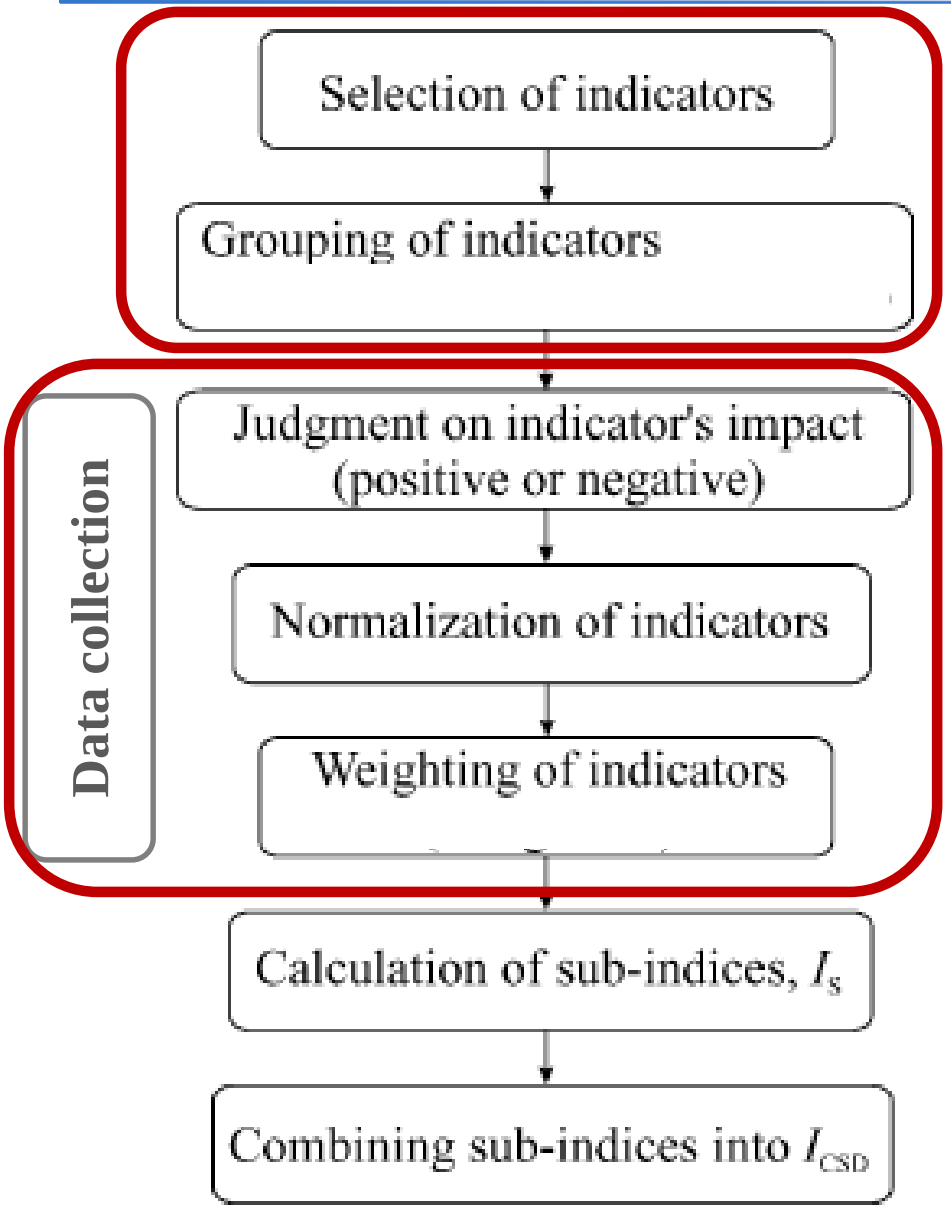
Saisana & Tarantola (2002)

Disadvantages of composite indices

Cons
May send misleading policy messages if poorly constructed or misinterpreted.
May invite simplistic policy conclusions.
May be misused, e.g. to support a desired policy, if the construction process is not transparent and/or lacks sound conceptual (or statistical) principles.
The selection of indicators and weights could be the subject of political dispute.
May disguise serious failings in some dimensions and increase the difficulty of identifying proper remedial action, if the construction process is not transparent.
May lead to inappropriate policies if dimensions of performance that are difficult to measure are ignored.

Saisana & Tarantola (2002)

Process for calculation of Composite Sustainability Indices (CSI)



Choosing the right number of relevant criteria from the pool of possible criteria

Building hierarchy scheme

„Does an increase in value of the criteria have a positive or negative sustainability effect?“

Transforming all criteria values into values between 0 and 1

Different methods to assign weights

(Optional)

Endresult and interpretation

Krajnc and Glavič (2005

Composite Sustainability Indices (CSI)

OECD Statistics Working Papers
2005/03

Handbook on Constructing Composite Indicators

METHODOLOGY AND USER GUIDE

Michela Nardo, Michaela Saisana,
Andrea Saltelli, Stefano Tarantola,
Anders Hoffman, Enrico Giovannini

http://dx.doi.org/10.1787/533411815016

Steps for Composite Indicator Calculation

Step 1. Developing a theoretical framework .....
Step 2. Selecting variables .....
Step 3. Multivariate analysis .....
Step 4. Imputation of missing data .....
Step 5. Normalisation of data .....
Step 6. Weighting and aggregation .....
Step 7. Robustness and sensitivity .....
Step 8. Links to other variables .....
Step 9. Back to the details .....
Step 10. Presentation and dissemination .....

Nardo et al. (2005)

Note on terms used

- Different authors use different terms

Overall goal	**Single items**
Indicator	**Criteria (one criterion)**
Index	Indicators
Objective	Attributes

SAFA terminology				
Sustainability	Dimension	Theme	Sub-theme	Indicator

- A criterion is *measurable* and hence has a specific *unit*

Example for CSI calculation

- The case of SATNET Asia
- Questions:
  - Which technologies to promote for a sustainable future?
  - Which technologies are suitable for poor and vulnerable people AND can contribute to a healthy diet?
  - How to communicate findings?

Objective: identify agricultural technologies that are sustainable, appropriate for poor and vulnerable people, AND that contribute to a healthy nutrition; and to propose a tool for communication

Material and Method

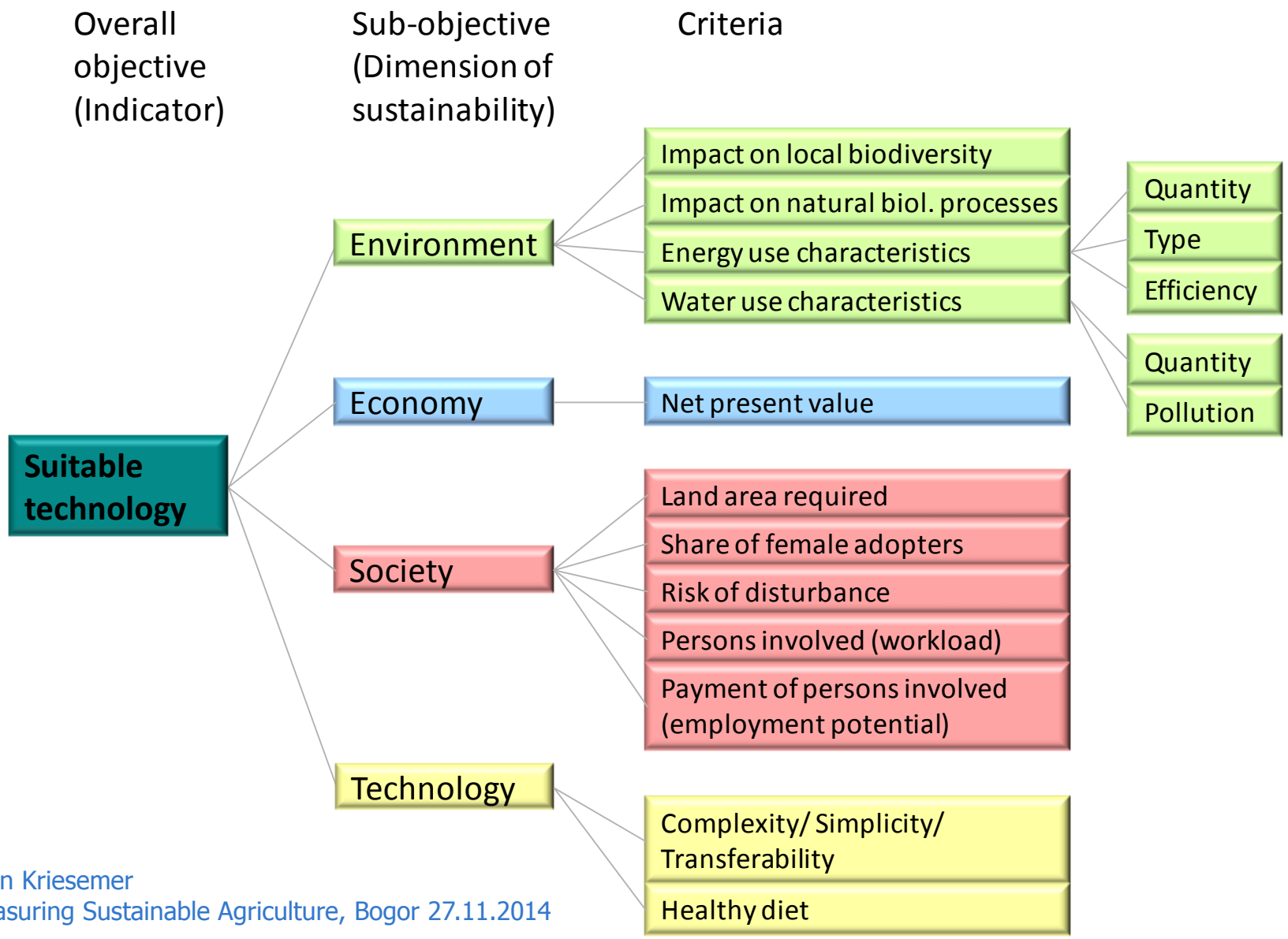
- Data collection through four “calls for application” sent out by email to 300+ contacts and their respective network (Sept 2012 to Sept 2013)
- Data collection on 12 selected criteria in four dimensions
  - Environmental resilience
  - Economic viability
  - Social acceptability
  - Technical appropriateness

  based on the SATNET Asia analytical framework
- The data set comprises 32 technologies

Material and Method, contd.

- Development of one additional criterion: „healthy diet“, included in the dimension on technical appropriateness
  - Valuation of each technology for this criterion based on a set of questions
    - Does this technology produce food? (no = 0, yes = 1)
    - Can its outcome contribute to secure food availability (also indirectly)? (no = 0, yes = 1)
    - Does it improve year round availability of nutrient rich food? (not known = 0, no = 1, yes = 2)
    - Does the outcome of this technology contribute to a healthy diet? (no impact = 0, impact = 1, high impact = 2)
    - Is the produced food free of potential risk to the health of the consumer (food safety)? (risk = 0, very low risk = 1, no risk = 2)
  - Responses were summed up and the sum was normalized

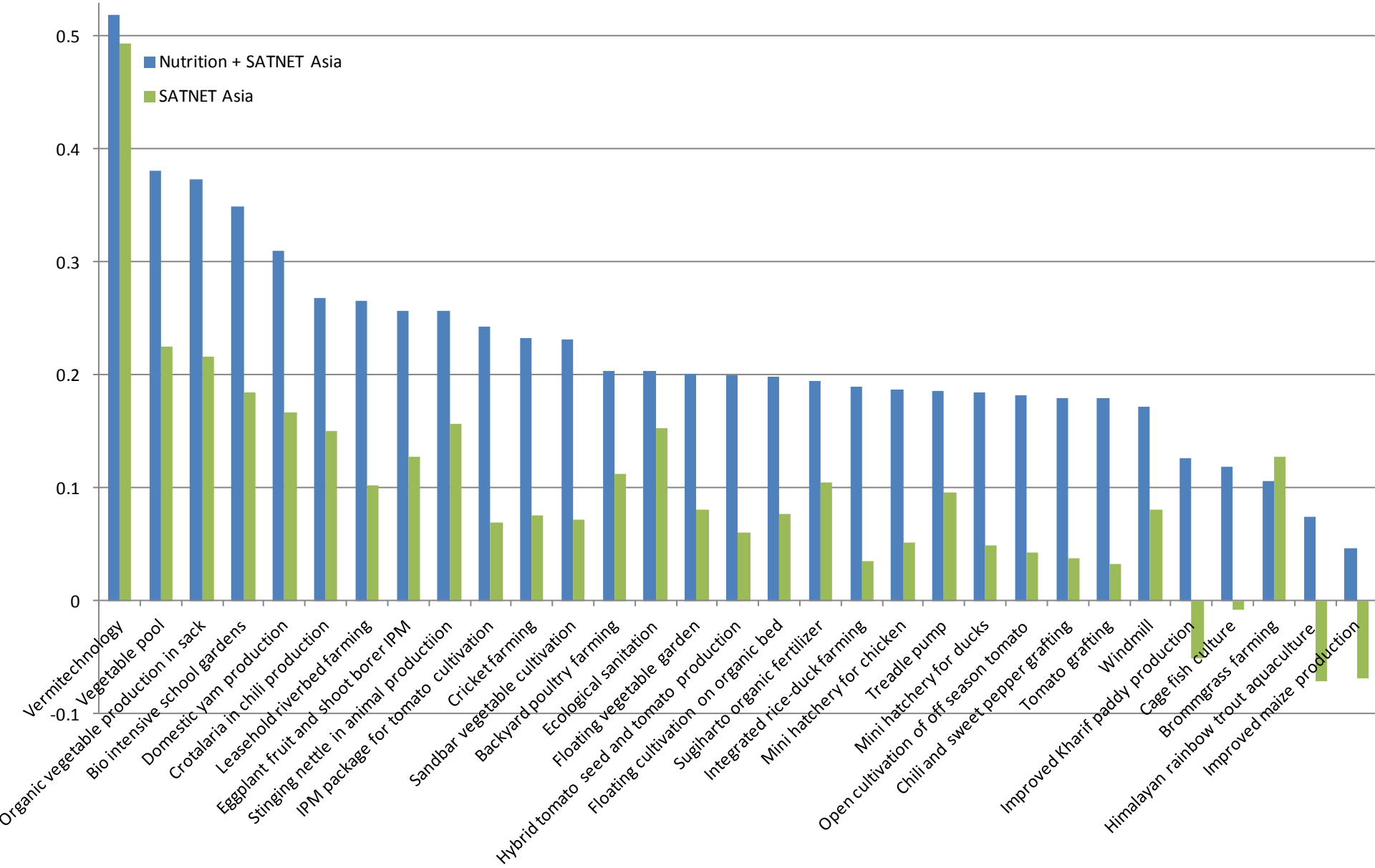
Hierarchy scheme



Criteria weights for indicator calculation

Dimensions and criteria	Weight
Dimension environment	**0.25**
Water consumption	0.35
Quantity of water used	0.5
Pollution of water used	0.5
Energy consumption	0.25
Quantity of energy used	0.3333
Type of energy used	0.3333
Energy use efficiency	0.3333
Impact on natural biological processes	**0.20**
Impact on local biodiversity	**0.20**
Dimension society	**0.25**
Number of persons involved (workload)	0.15
Payment of persons involved (employment potential)	0.15
Risk of disturbance	0.1
Share of female adopters	0.3
Land area required	0.3
Dimension economy	**0.25**
Net present value	1
Dimension technology	**0.25**
Complexity, simplicity, transferability	0.3
Healthy diet	**0.7**

CSI ranking


0.5
0.4
0.3
0.2
0.1
0
-0.1
Nutrition + SATNET Asia
SATNET Asia
Vermitechnology
Vegetable pool
Organic vegetable production in sack
Bio intensive school gardens
Domestic yam production
Crotalaria in chili production
Leasehold riverbed farming
Eggplant fruit and shoot borer IPM
Stinging nettle in animal productiion
IPM package for tomato cultivation
Cricket farming
Sandbar vegetable cultivation
Backyard poultry farming
Ecological sanitation
Floating vegetable garden
Hybrid tomato seed and tomato production
Floating cultivation on organic bed
Sugiharto organic fertilizer
Integrated rice-duck farming
Mini hatchery for chicken
Treadle pump
Mini hatchery for ducks
Open cultivation of off season tomato
Chili and sweet pepper grafting
Tomato grafting
Windmill
Improved Kharif paddy production
Cage fish culture
Brommgrass farming
Himalayan rainbow trout aquaculture
Improved maize production

Vegetable pool

Riverbed farming of vegetables

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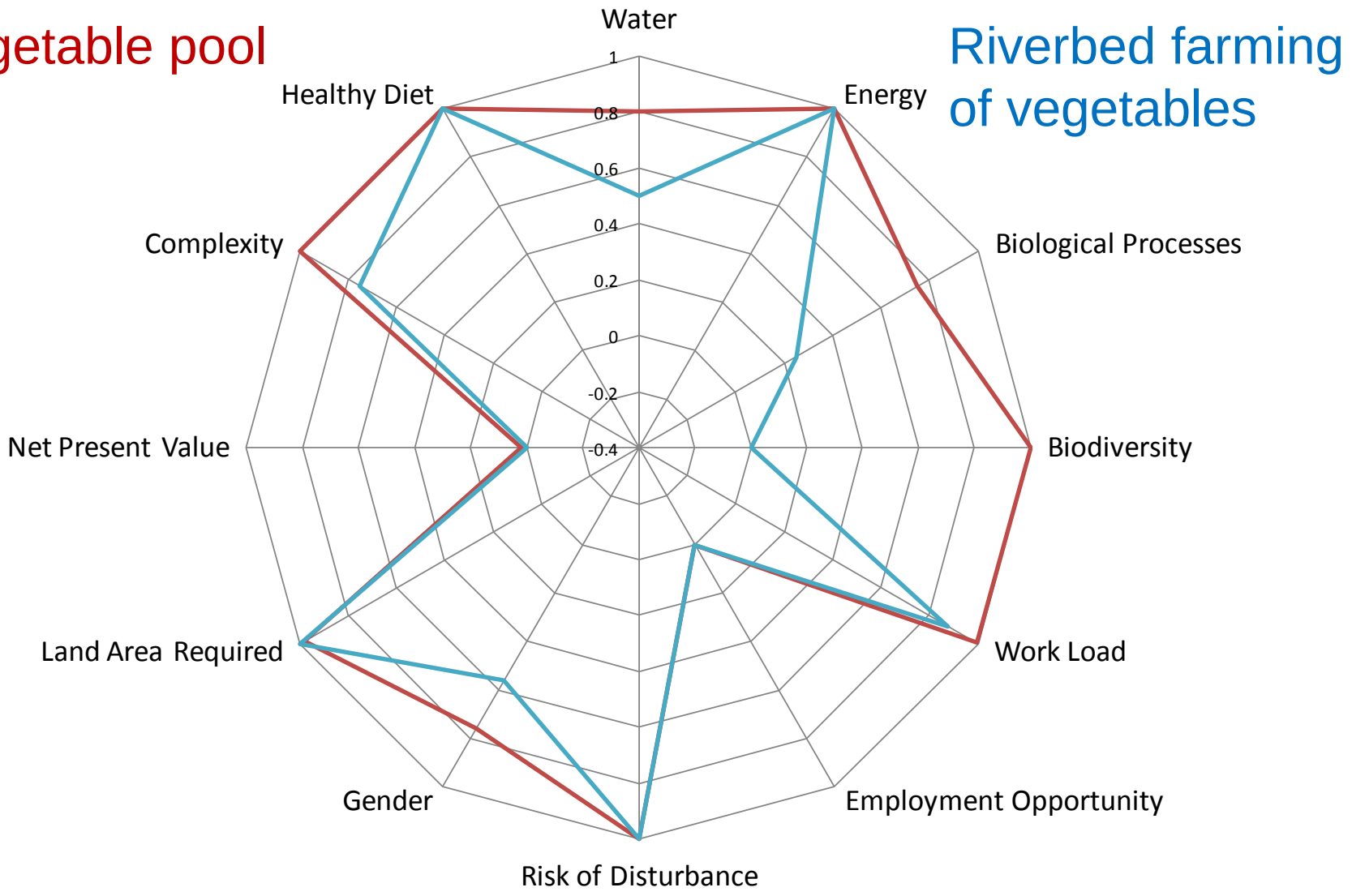
Workshop on Measuring Sustainable Agriculture, Bogor 27.11.2014

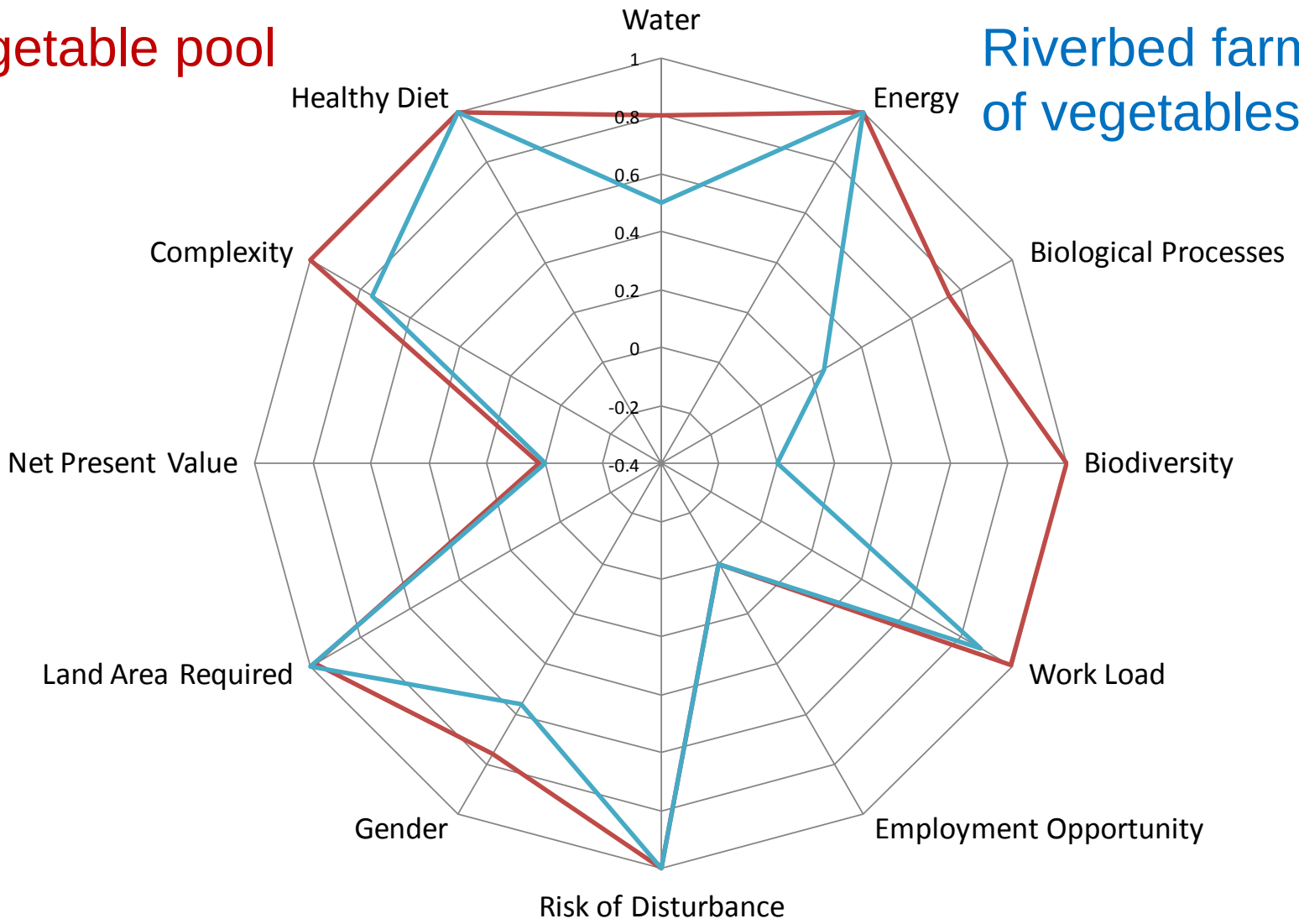
Sustainability polygon: Food producing technologies



Maize production

Broomgrass farming

Sustainability polygon: Non-food technologies



Any questions?

What are the remaining challenges?

- Data on many indicators is not readily available, particularly in developing countries' contexts
- Defining thresholds for rating of indicators: best, good, moderate, limited, unacceptable
- Simplified tools are needed for small scale farming contexts (➔ SAFA small app)
- Communication about sustainability to reach a common understanding that leads to both policy and individual action toward more sustainable decision making and behavior

What can I do as producer?

- Improve sustainability performance by taking measures to use natural resources more efficiently, team-up with peers and share resources
- Communicate your sustainability performance to your buyers
- Engage in SAFA assessments and other sustainability initiatives

FAO (2013)

What can I do as consumer?

- Seek information about the products to purchase
- Choose items that clearly contribute to enhanced environmental and socioeconomic performance
- Ask food retailers and companies to provide information (data) on their socioeconomic and environmental performances

FAO (2013)

What can I do as food industry?

- Publicly commit to improved sustainability targets
- Provide incentives for suppliers to improve their sustainability performance
- Develop partnerships to enhance sustainability performance

FAO (2013)

What can I do as policy maker?

- Promote full-cost pricing of environmental and socio-economic externalities
- Include, in the national sustainable development strategies, commitments and targets for sustainable food and agriculture and allocate the corresponding capacity-building budget
- Require that food companies and their suppliers regularly publish data on social, economic, environmental and governance performance

FAO (2013)

Thank you for your attention and participation

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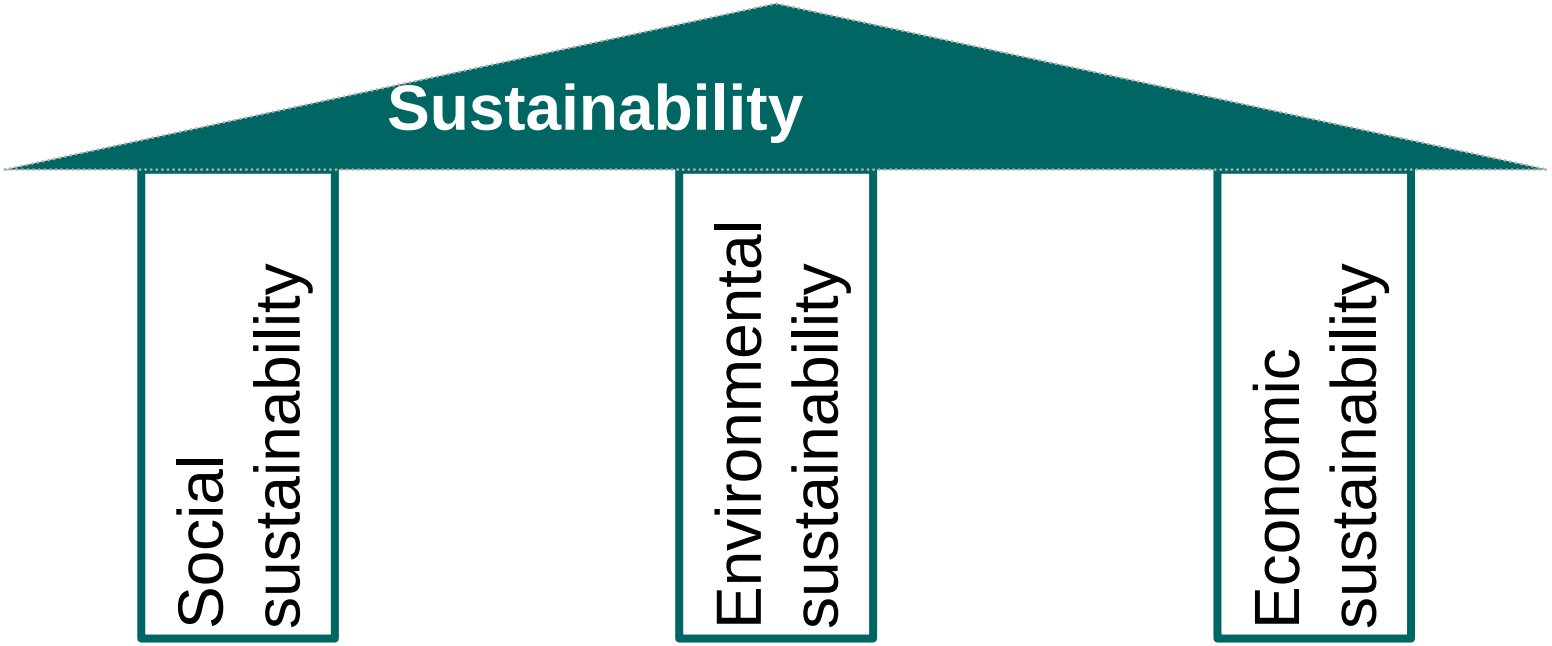
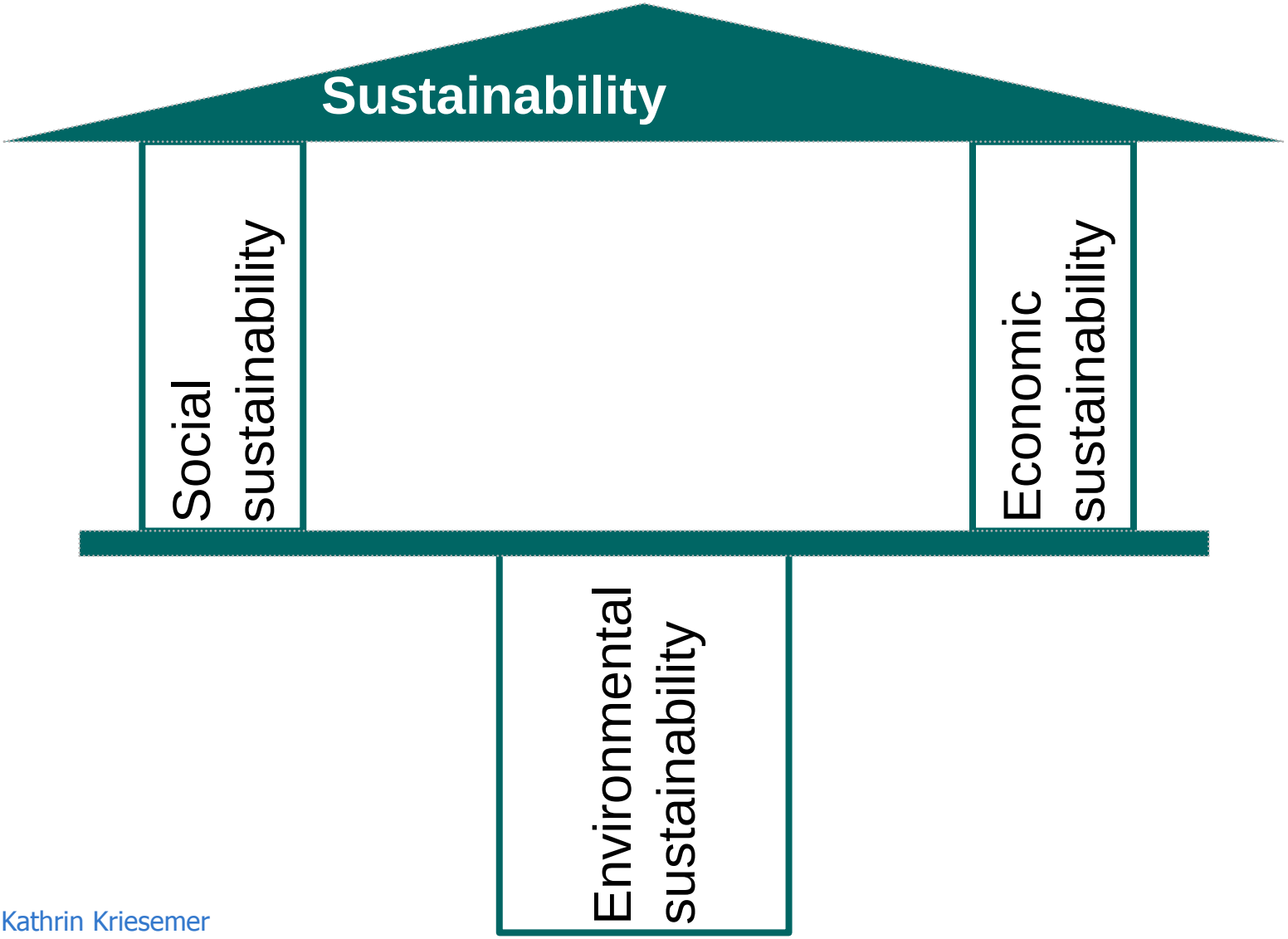
Optional slides

Three pillars of sustainability



Three pillars of sustainability



Examples of sustainable agriculture II

- Land-use and climate change interactions in the Vu Gia Thu Bo

  http://modul-a.nachhaltiges-landmanagement.de/en/media-centre-module-a/video-portal/lucci/

How to get started?

- When a problem is complex and stakes are high: **Multi Criteria Decision Making**:
  - Decompose the big problem into smaller aspects, structure the problem well
  - Look at multiple criteria of the problem and evaluate them separately
- Leads to more informed and better decisions

Recommendations

… for criteria selection

- Measurable!
- Appropriateness to the task of assessing sustainability
- Including a manageable number of criteria
- Yet, addressing all aspects of sustainability
- Simple, yet meaningful criteria
- Based on available and accurate data
- Using both quantitative and qualitative criteria
- Verifiable
- Allowing comparison among companies/ farms/ technologies

(adapted from Veleva & Ellenbecker 2001)

What concrete examples of unsustainable development do you know?
… in the agricultural sector?
…in other sectors?

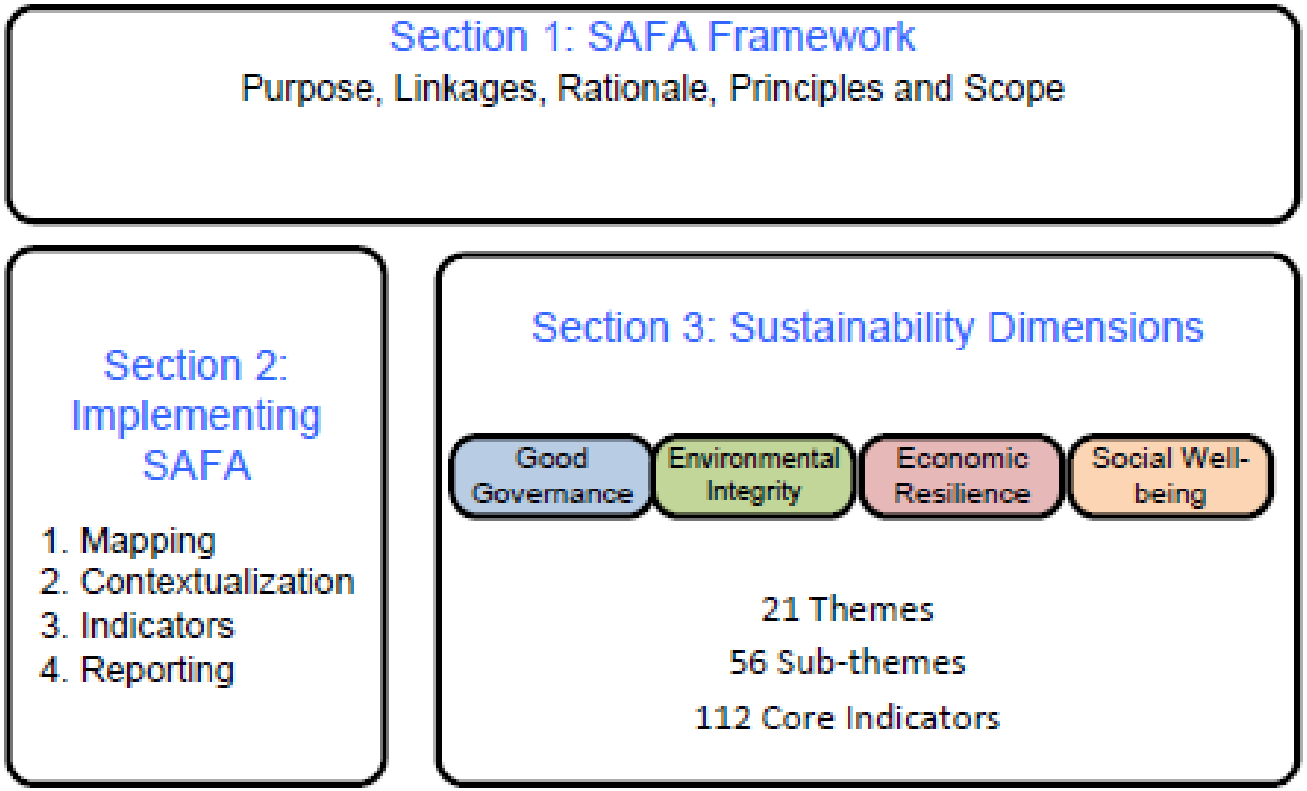
Examples of sustainable agriculture I

- Sustainable rubber cultivation in the Mekong Region

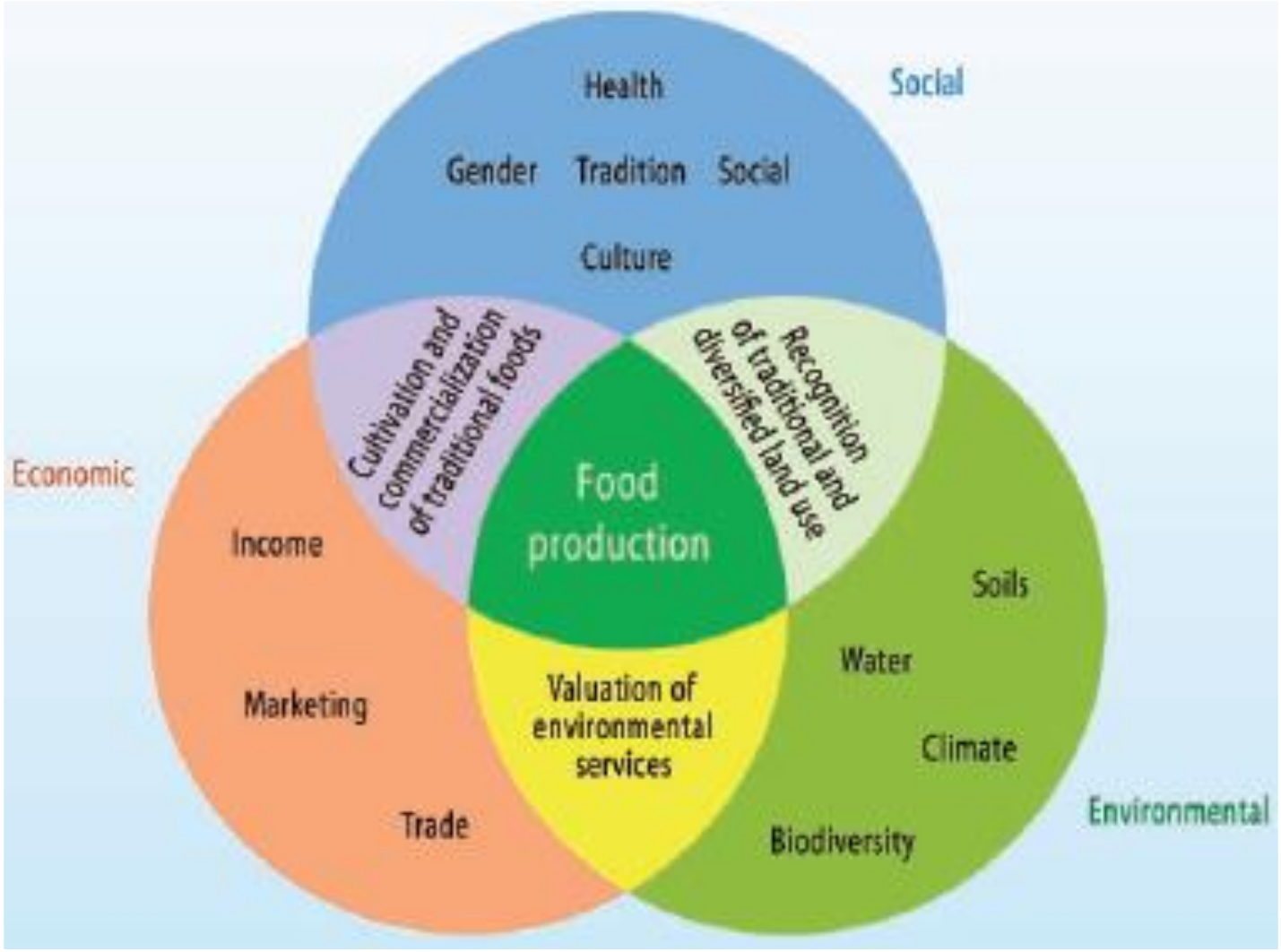
  http://modul-a.nachhaltiges-landmanagement.de/en/media-centre-module-a/video-portal/surumer/

SAFA Guidelines

- Sustainability Assessment of Food and Agriculture systems



The roles and functions of agriculture



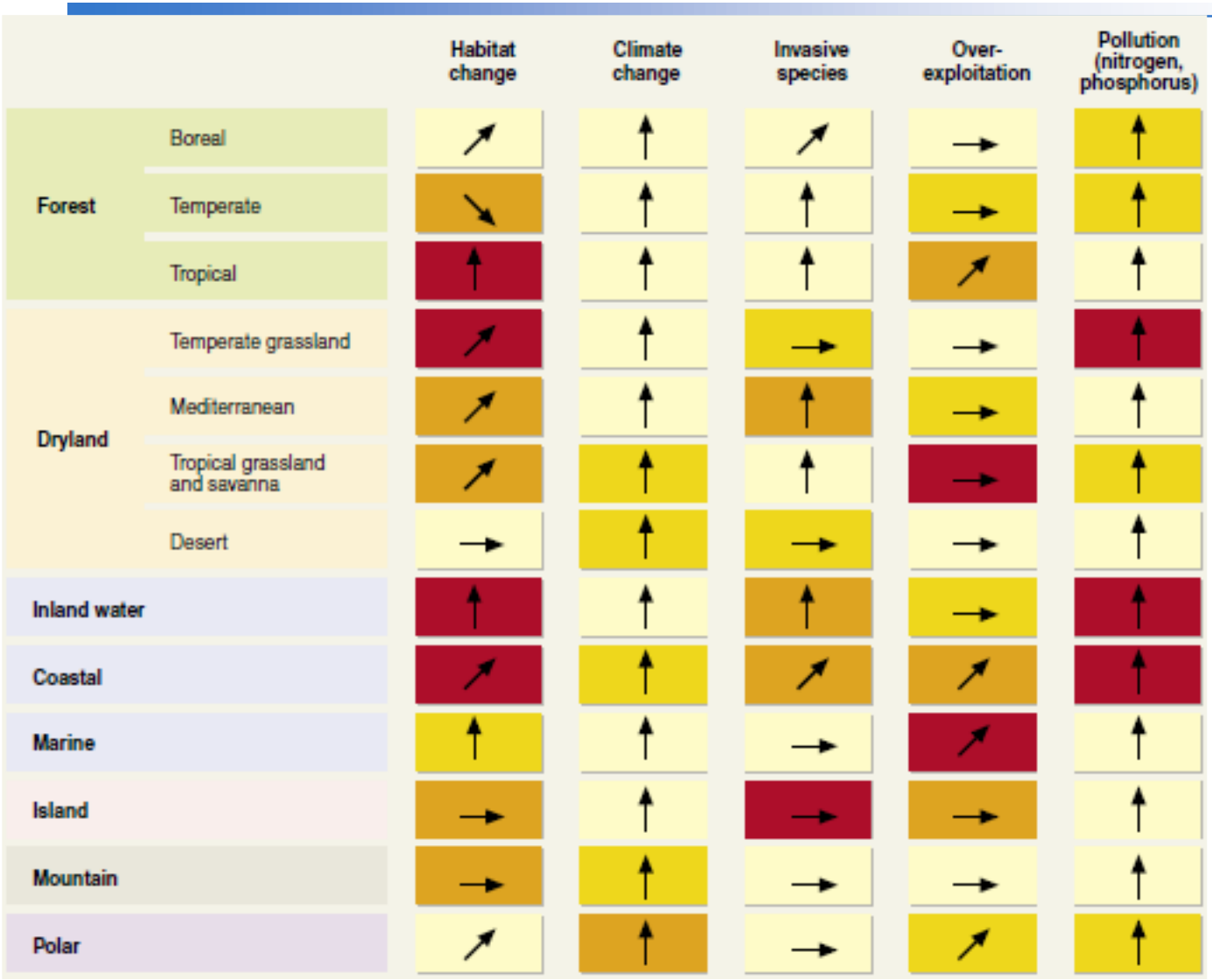
Use of ecosystem provisioning services

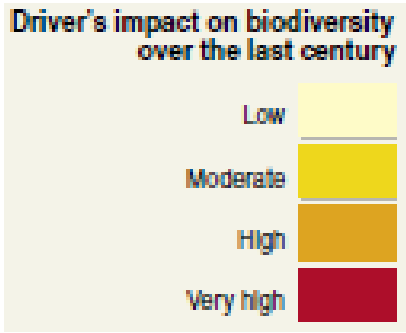
Service	Sub-category	Human Use	Enhanced or Degraded
Food	Crops	↑	↑
	Livestock	↑	↑
	Capture Fisheries	↓	↓
	Aquaculture	↑	↑
	Wild plants and animal foods	NA	↓
Fiber	Timber	↑	+/-
	Cotton, hemp, silk	+/-	+/-
	Wood fuel	+/-	↓
Genetic resources		↑	↓
Biochemicals, natural medicines, and pharmaceuticals		↑	↓
Freshwater		↑	↓

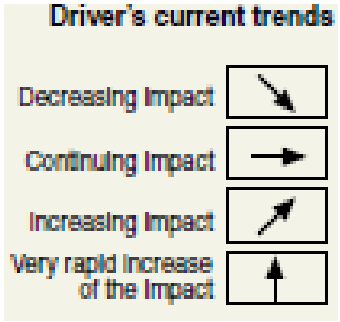
Use of ecosystem regulating services

Service	Sub-category	Human Use	Enhanced or Degraded
Air quality regulation		↑	↓
Climate regulation	Global	↑	↑
	Regional and Local	↑	↓
Water regulation		↑	+/-
Erosion regulation		↑	↓
Water purification and waste treatment		↑	↓
Disease regulation		↑	+/-
Pest regulation		↑	↓
Pollination		↑	↓
Natural hazard regulation		↑	↓

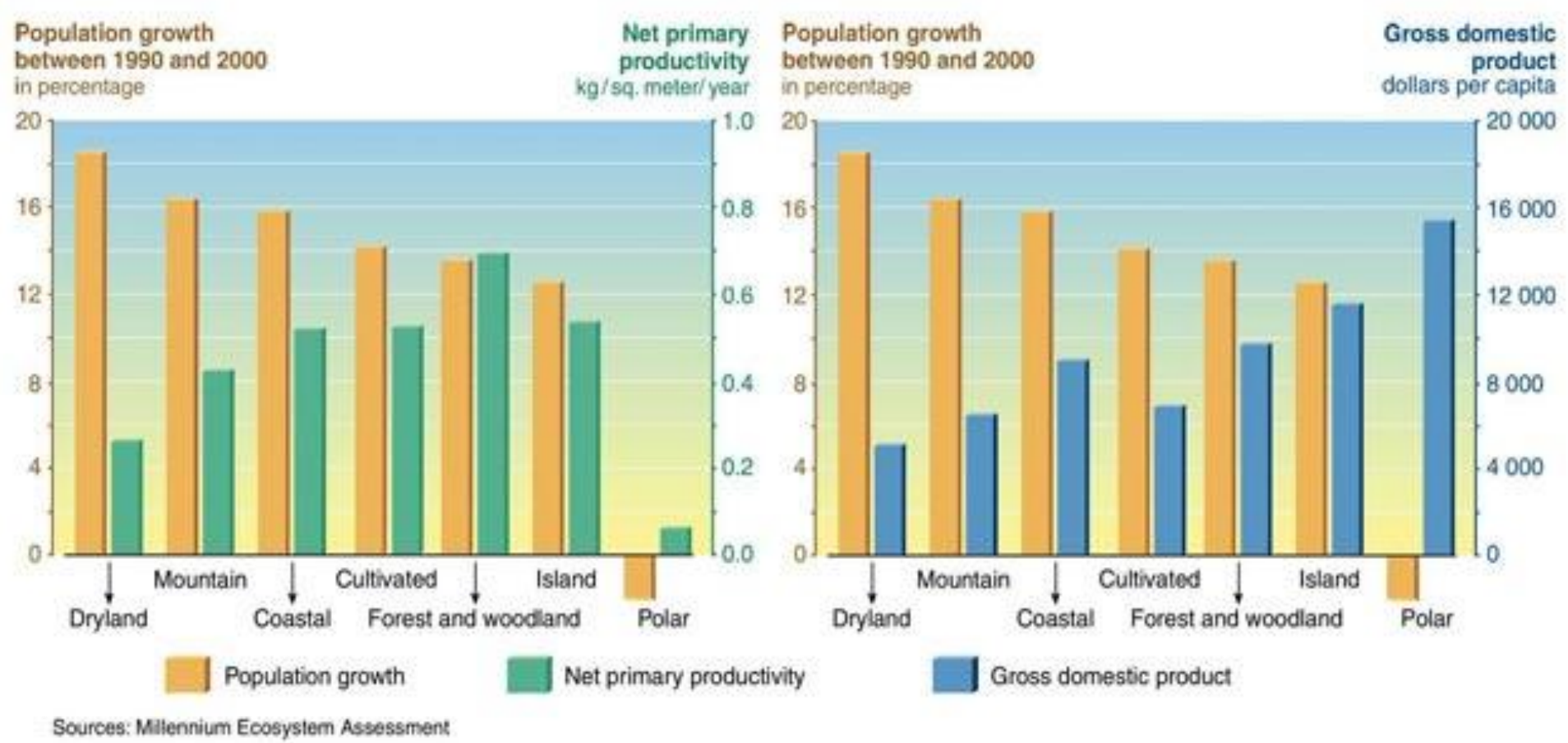
Drivers of change in biodiversity







Population Growth, GDP/Capita and Biological Productivity



Sources: Millennium Ecosystem Assessment

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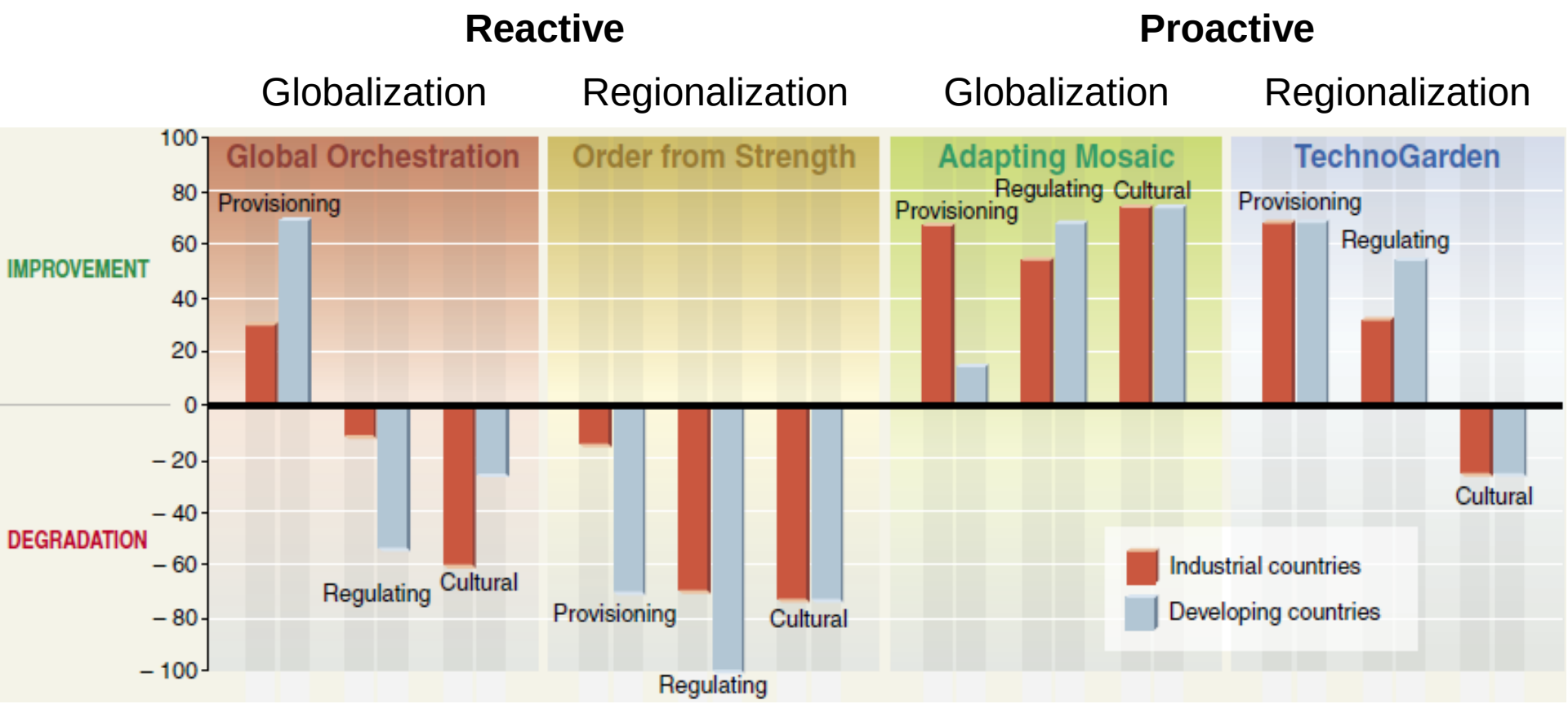
Changes in ecosystem services (%)



Selecting criteria

- A literature review in 2012 revealed more than 100 criteria in use for sustainability assessments
- Problem of data availability for some of the criteria
- Not all criteria are relevant for the assessment of sustainability at all levels