TempAg

SCIENCE FEEDING TEMPERATE AGRICULTURE

Temperate Agriculture Collaborative Network (TempAg)

An international research network for Sustainable Agriculture in Temperate regions.

Global Food Security — Sustainable, healthy food for all

INRA SCIENCE & IMPACT

Network's Mission

To facilitate collaboration & alignment of national agriculture research in temperate climates.

Aiming to deliver resilient agricultural production systems at multiple levels across the temperate zone.

TempAg Members Countries

Full Member Countries	
1.	Belgium
2.	Finland
3.	France
4.	Germany
5.	Netherlands
6.	New Zealand
7.	Norway
8.	Sweden
9.	Switzerland
10.	UK
Associate Member Organisations	
1. OECD	

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TempAg Member Organisations

agresearch
Farming, Food and Health. First™

Agroscope

Global Food Security
Sustainable, healthy food for all

INRA
SCIENCE & IMPACT

NIBIO
NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH

SLU
Swedish University of Agricultural Sciences

ILVO
Institute for Agricultural and Fisheries Research

vito

WAGENINGEN UR
For quality of life

THÜNEN

OECD
BETTER POLICIES FOR BETTER LIVES

TempAg Aims

- Increase impact and return on investment of national research programmes
- Bring together national competencies to meet goals of transnational interest
- Enable communication and alignment of existing and new research and technology
- Identify areas of research relevant to science and policy which are currently insufficiently addressed at an international level.

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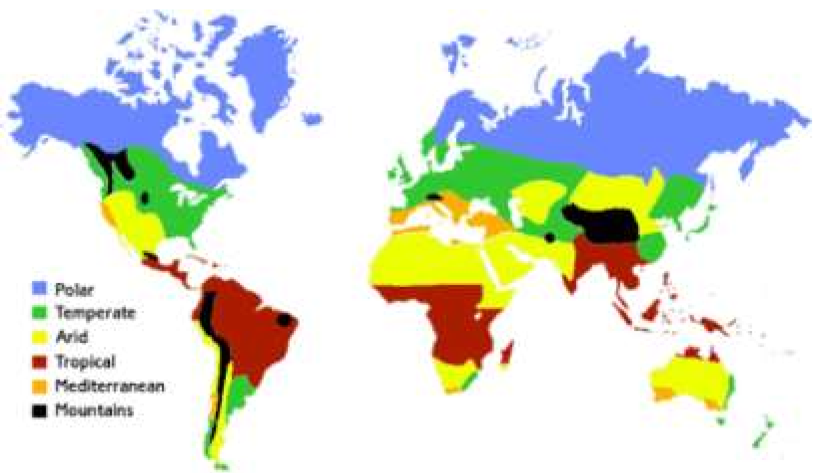
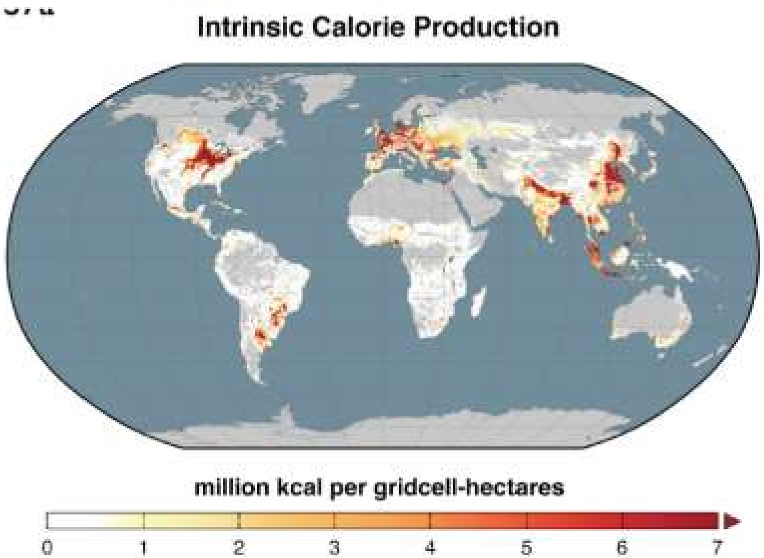
Temperate Agricultural Systems

- Seasonality
- Less weathered soils
- Fertilisers, agrochemicals & mechanisation
- Investment in ‘high-value’ crops
- Very high yields

Temperate Agricultural Systems

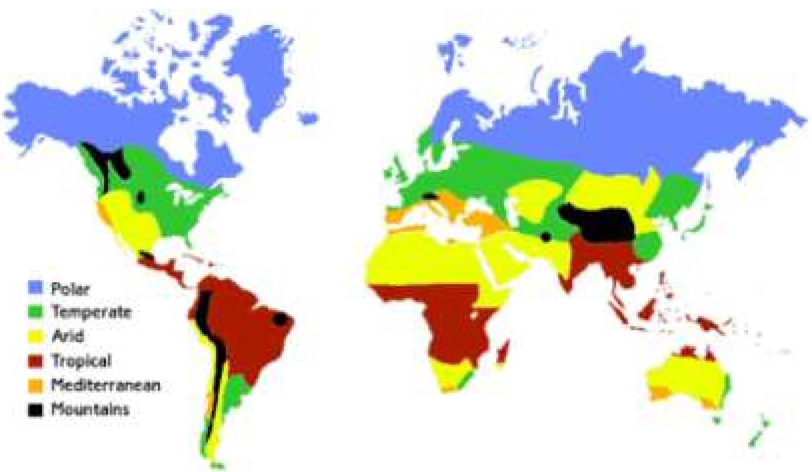


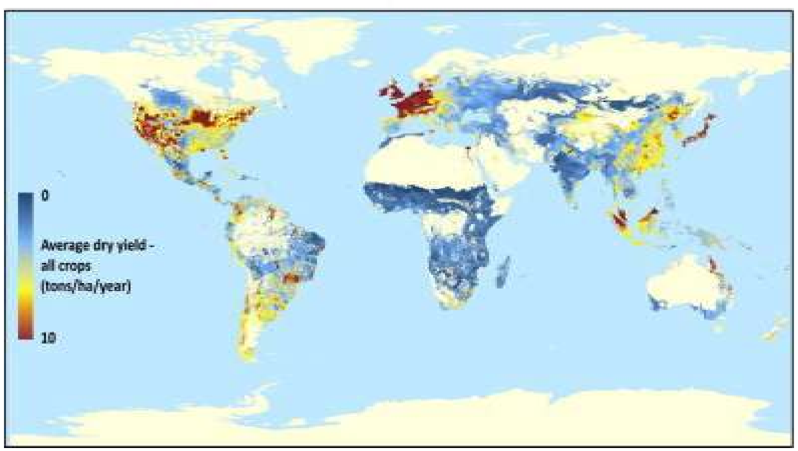


Foley et al 2011

- ✓ A significant proportion of global agricultural production originates from “temperate” (i.e. non-tropical) countries, and this proportion may even increase with climate change.
- ✓ Currently international cooperation in the field of agriculture research is mostly focused on tropical/developing areas.

Temperate Agricultural Systems





West et al 2010

- ✓ A significant proportion of global agricultural production originates from "temperate" (i.e. non-tropical) countries, and this proportion may even increase with climate change.
- ✓ Currently international cooperation in the field of agriculture research is mostly focused on tropical/developing areas.

TempAg Priority Areas and Activities

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Delivering resilient Agricultural Production Systems (Multiple spatio-temporal level)	Optimising land management for food production & other ecosystem services (Landscape level)	Sustainably improving food productivity (Farm/Enterprise level)
New Zealand	France/Sweden	Netherlands
Enhancing sustainability metrics, frameworks and tools for future-proofing agricultural decision making at multiple levels	Optimising synergies between agricultural production and ecosystem services	Addressing yield gaps, resource use efficiencies and environmental impact

Indicators of Sustainability

Delivering resilient agricultural production systems at multiple levels

Enhancing metrics, frameworks and tools for future-proofing agricultural decision making at multiple levels and scales.

- Assessing sustainability frameworks within agriculture
- Weighting criteria for selecting temperate agriculture sustainability indicators


Flanders
TempAg Pilot Activity 1.1.1
Survey of Sustainability Assessment Methods

Wustenberghs, H. et al. 2015


When experts disagree: the need to rethink indicator selection for assessing sustainability of agriculture

De Olde et al. 2016

Synergies between production & ES

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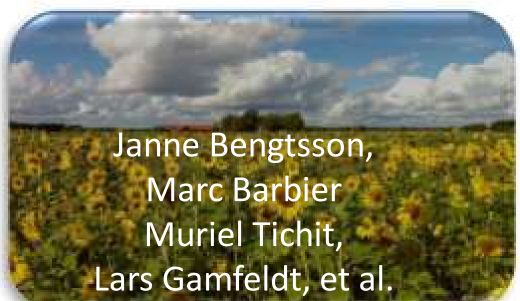
Optimising land management for food production & other ES

Optimising synergies between agricultural production and ecosystem services via an overview of the research landscape.

- Assessing which ecosystem services have been most studied (both from and to agriculture)
- What combinations of services have been studied together (addressing multi-functionality & synergies or trade-offs)
- Which agri-ecosystems have been studied with an ecosystem approach?



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SLU Swedish University of Agricultural Sciences

Improving food productivity through addressing yield gaps

Sustainably improving food productivity in a farm/enterprise level

Addressing yield gaps, resource use efficiencies & environmental impact

- **Quantifying yield & water productivity gaps for major cereal crops in TempAg countries using the Global Yield Gap Atlas (GYYA) procedure**
- **Identify underlying drivers and causes of yield gaps**


Explaining yield gaps of cereals in temperate regions using an expert-based survey

Porrero et al. 2016 MSc

Some common policy objectives

- Eco-enhancement of economic competitiveness
- Sustainable production from intensive production systems (sustainable intensification)
- Sustainable production in light of climate impacts, sustainable development, natural resources conservation (land, water, biodiversity)
- Links between production, food, nutrition and health

Some common policy objectives

- Eco-efficiency and agro-ecology including organic production systems (France, Norway, Spain)
- Targets for increasing agricultural production eg. in proportion to increased population (Norway, New Zealand, Sweden)
- Improve marketing and quality of agri-food products (Spain)

TempAg Foresighting Workshop

5-7 October 2016, London

Aims:

- Review current and emerging priorities for policy shaping communities in temperate regions.
- Inform and update the TempAg scientific themes to match current science-policy contexts
- Determine priority activities for TempAg's second phase

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

Theme 1 and Pilot Activity output

Fleur Marchand - ILVO

TempAg Foresight Workshop

5-7 October 2016

The Tower Hotel St Katharines Way, London, E1W 1LD

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

- Theme 1 in general

- PA1 focus
  - CONCEPT OF SUSTAINABILITY
  - GUIDELINES
    - ➢ SURVEY OF SUSTAINABILITY ASSESSMENT TOOL
    - ➢ SURVEY OF CRITERIA FOR SELECTION AND WEIGHTING AMONGST EXPERTS
    - ➢ DEBATE AND DISCUSSION SESSIONS ON IFSA
  - TempAg APPROACH?

- The way forward? Future work?

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

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Theme 1 - Pilot Activity 1

Resilient agricultural production systems at multiple spatial and temporal levels

Scientific questions explored under this theme include:

- How can con… agricultural s…
- How can tem… how can this be managed as one of the causative agents of price volatility?
- What are the … omic and environmental drivers for delivering sustainable intensification?
- How can poli… gricultural systems that … nge, economic an…
- What are the … uction systems, and…

Conceptual frameworks?

Reduce production variability?

Effects of changing drivers?

Policy and strategies?

Trade-offs between production systems?

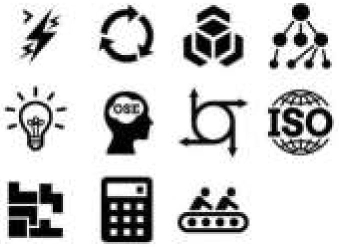
CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

Theme 1 - Pilot Activity 1

1

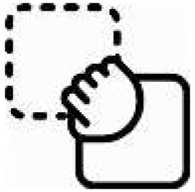
Review/survey the current concepts of agriculture sustainability in member countries

2



Develop technical guidelines to evaluate agriculture sustainability and recommendations on the limitations, translation of metrics and appropriate use of each approach

3



Assess which systems can be made sustainable across spatial scales and those that may need to relocate or transform to do so.

4

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Recommend a TempAg approach to translate ‘sustainability’ metrics between countries that is rapid, robust and real.

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

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Theme 1 - Pilot Activity 1

1

Review/survey the current concepts of agriculture sustainability in member countries

- Define ‘sustainability’ too tightly will undermine rather than enhance our resilience
- It’s normative and context-specific : involvement of stakeholders is required
- many definitions, good well taught!

- No need to re-define sustainability in a temperate agriculture way

sustainable pathways

Normative

Context specific

Analysis Paralysis

over-analyzing (or over-thinking) a situation so that a decision or action is never taken.

2

Develop technical guidelines to evaluate agriculture sustainability and recommendations on the limitations, translation of metrics and appropriate use of each approach

Existing frameworks and initiatives – not specific on Agriculture or Food

ISO International Organization for Standardization

OECD BETTER POLICIES FOR BETTER LIVES

UNEP United Nations Environment Programme

Global Reporting Initiative™

The 8 Millennium Development Goals

THE SUSTAINABILITY CONSORTIUM

ITC | STANDARDS MAP

MILLENNIUM ECOSYSTEM ASSESSMENT

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

TempAg

vity 1

2

Existing frameworks and initiatives – specific on Agriculture

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RISE

SAI PLATFORM

The New Zealand Sustainability Dashboard

Field to Market

BioBio

Sustainable Agriculture Network

SAFA

FLINT

GLOBALG.A.P.

COSA
Committee On Sustainability Assessment

THE SUSTAINABILITY CONSORTIUM

leap
LIVESTOCK ENVIRONMENTAL ASSESSMENT AND PERFORMANCE PARTNERSHIP

FSC
www.fsc.org
The mark of responsible forestry

RAINFOREST ALLIANCE CERTIFIED

Food and Agriculture Organization of the United Nations

SUSTAINABLE NEW ZEALAND WINEGROWING

IFOAM
INTERNATIONAL FEDERATION OF ORGANIC AGRICULTURE MOVEMENTS

ENVIFOOD Protocol

DECLARATION OF ABU DHABI

2

Existing frameworks and initiatives – specific on Agriculture – from consumers / supermarkets requirements

It's the Waitrose way

coles
Save everyday

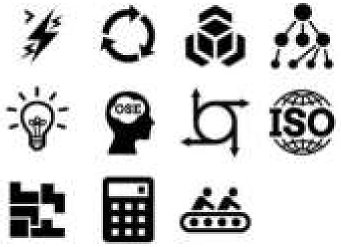
WHOLE FOODS MARKET

Walmart
Save money. Live better.

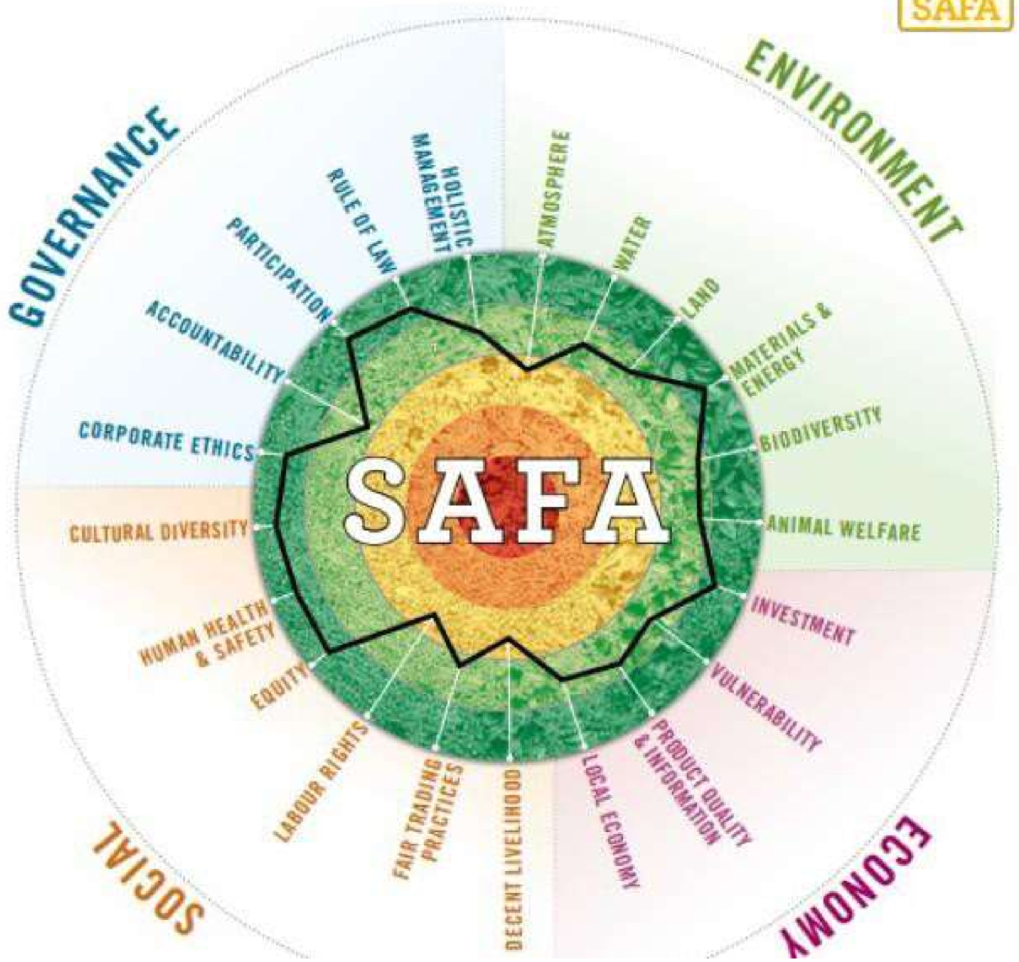
Unilever
Sustainable agriculture code
Implementation guides

FAO – SAFA (Sustainability Assessment of Food and Agriculture systems)

2



- <u>A holistic framework built mainly on existing schemes</u>
- Developed for assessing the impact of food and agriculture operation on the environment and people.
- Framework that is adaptable to all contexts and sizes of operations
- Encourages continuous improvement



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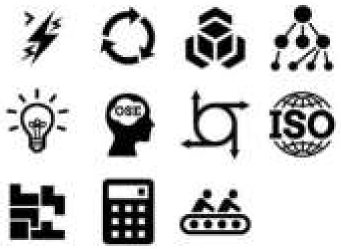


Develop guidelines => Co-opt SAFA

SAFA is the best interim framework for TempAg :

- growing acceptance
- recent and sound development process
- it's flexibility to embrace diversity

However:

- testing and refinement at different scales and production systems clarification and standardization of the framework

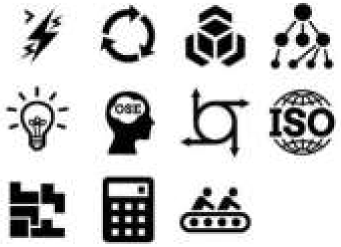
Limit of SAFA is on Indicators & measures: the real work of PA1?

- SAFA indicators and metrics not well developed or tested
- Better selection and weighting of indicators and their metrics needed

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

Theme 1 - Pilot Activity 1

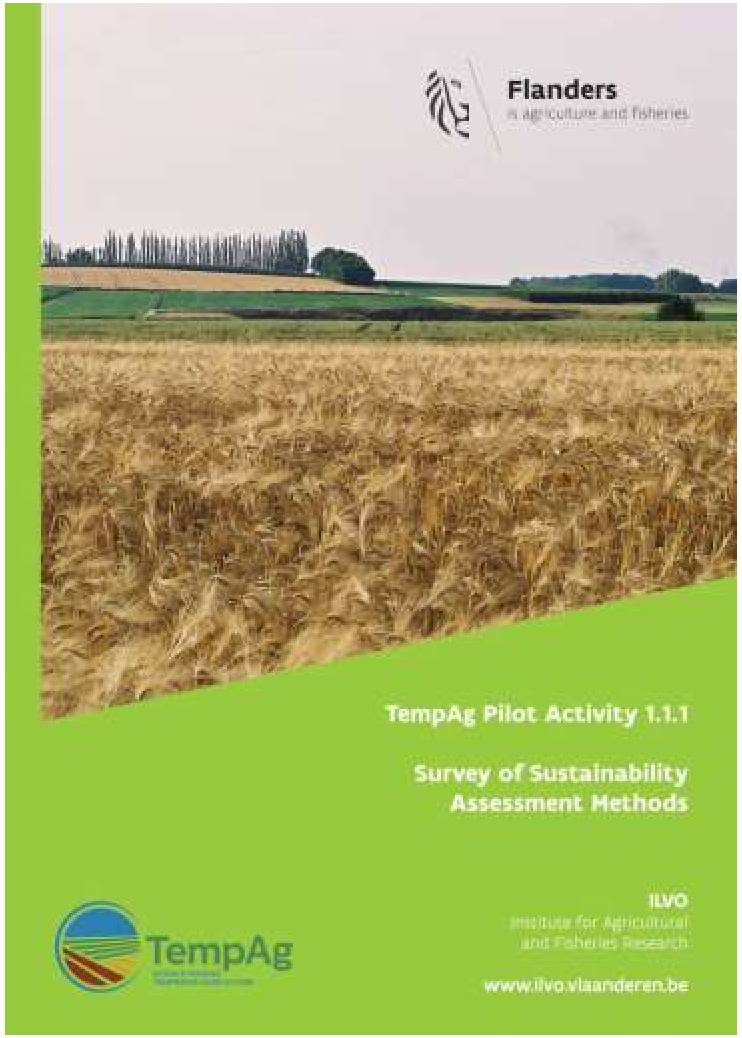
2

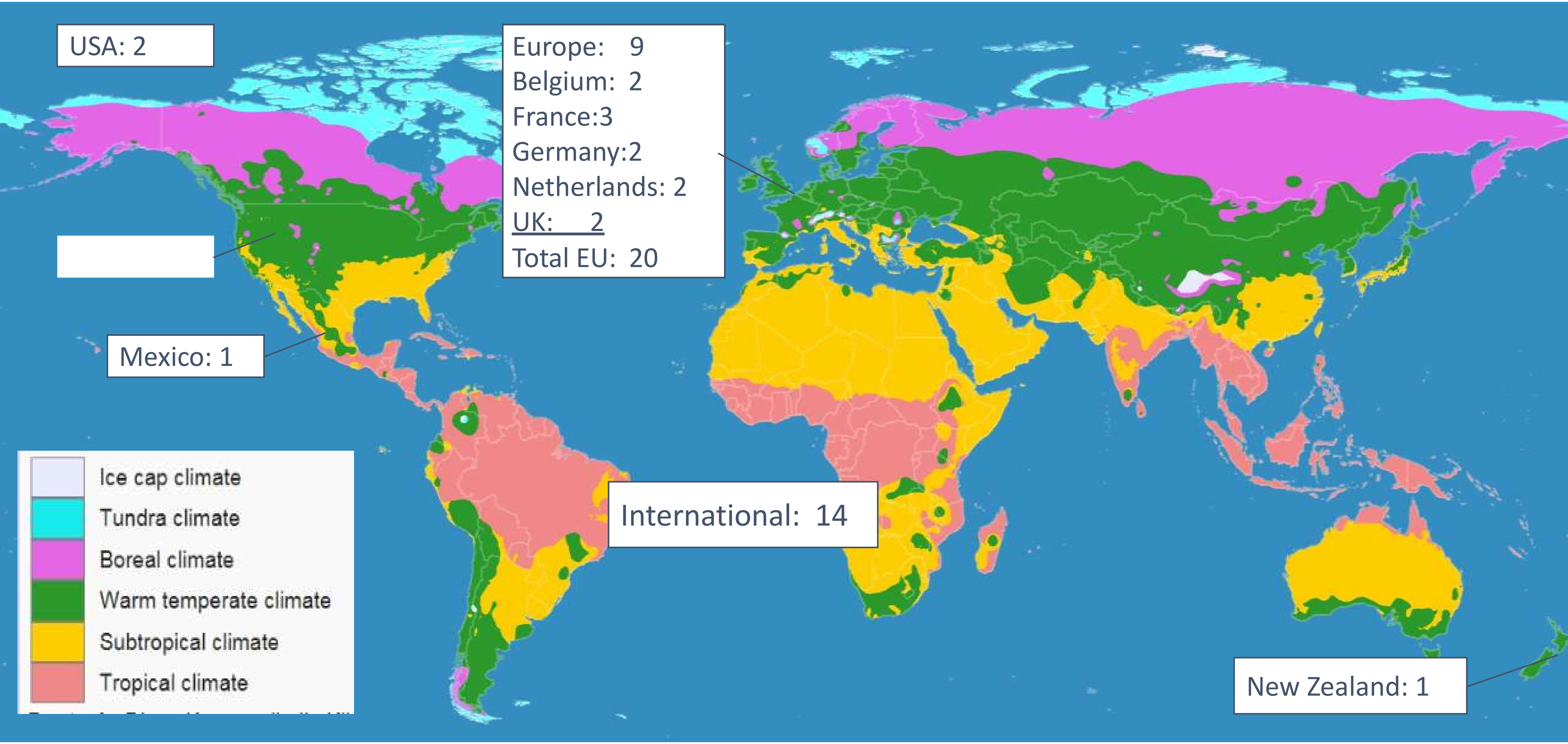


Survey of sustainability assessment methods:

→ inventory lists 170 frameworks, metrics and tools

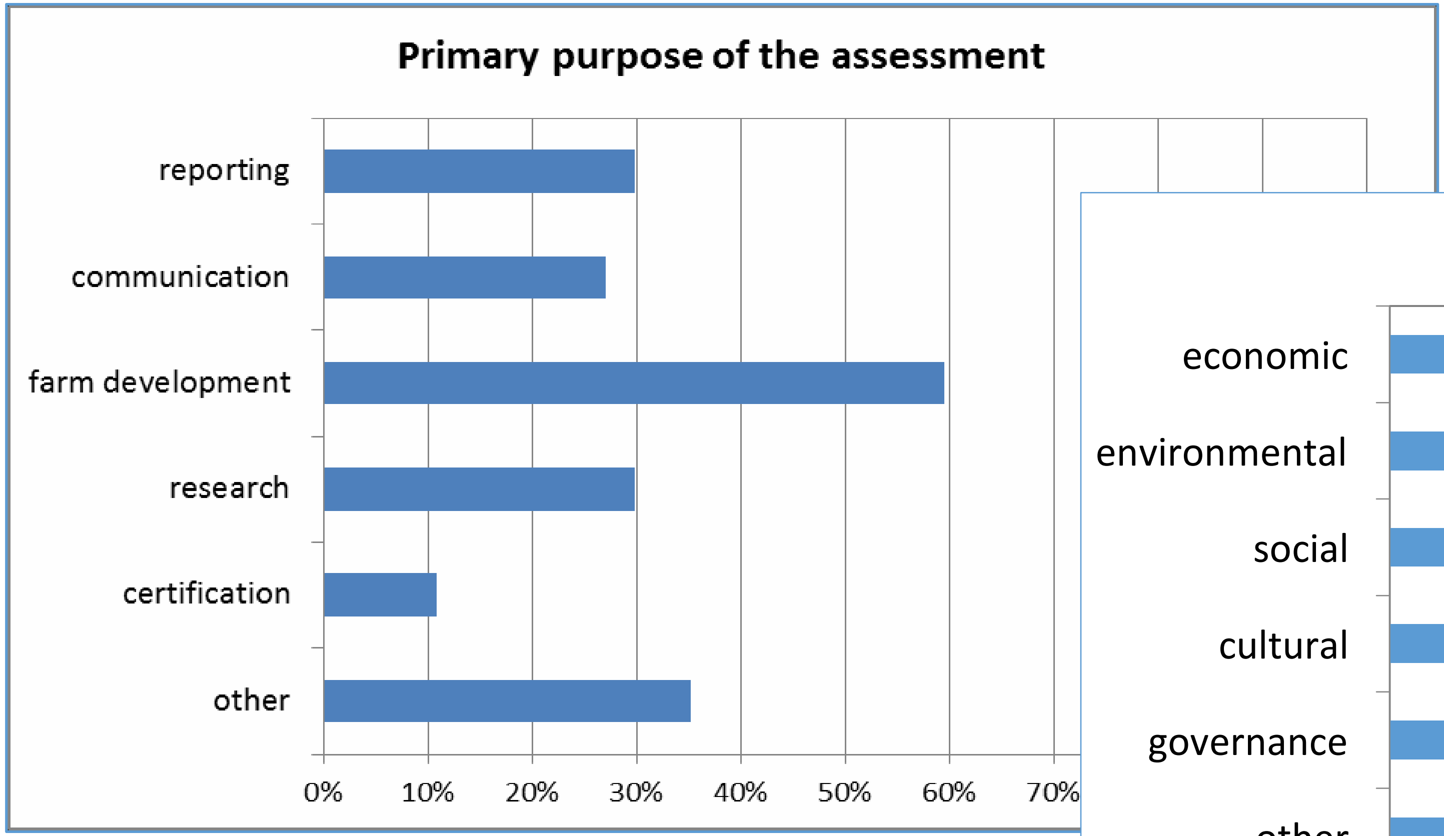
- ⇨ Tool selection from literature
  - specific to agriculture
  - for temperate climates
  - at least 3 dimensions: economic, environmental, social
- ⇨ Survey with tool developers / users (51 sent)
- ⇨ Info on 38 tools retrieved (75% response rate)

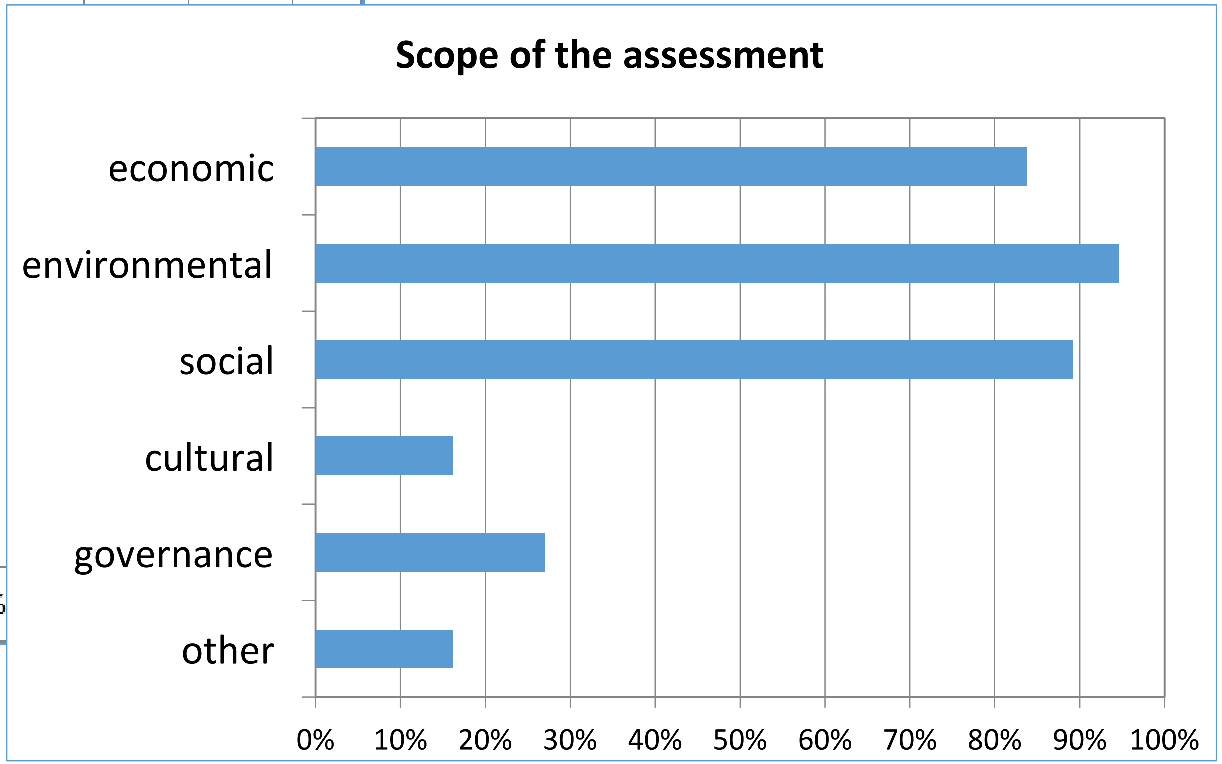



USA: 2
Europe: 9
Belgium: 2
France:3
Germany:2
Netherlands: 2
UK: 2
Total EU: 20
Mexico: 1
International: 14
New Zealand: 1
Ice cap climate
Tundra climate
Boreal climate
Warm temperate climate
Subtropical climate
Tropical climate

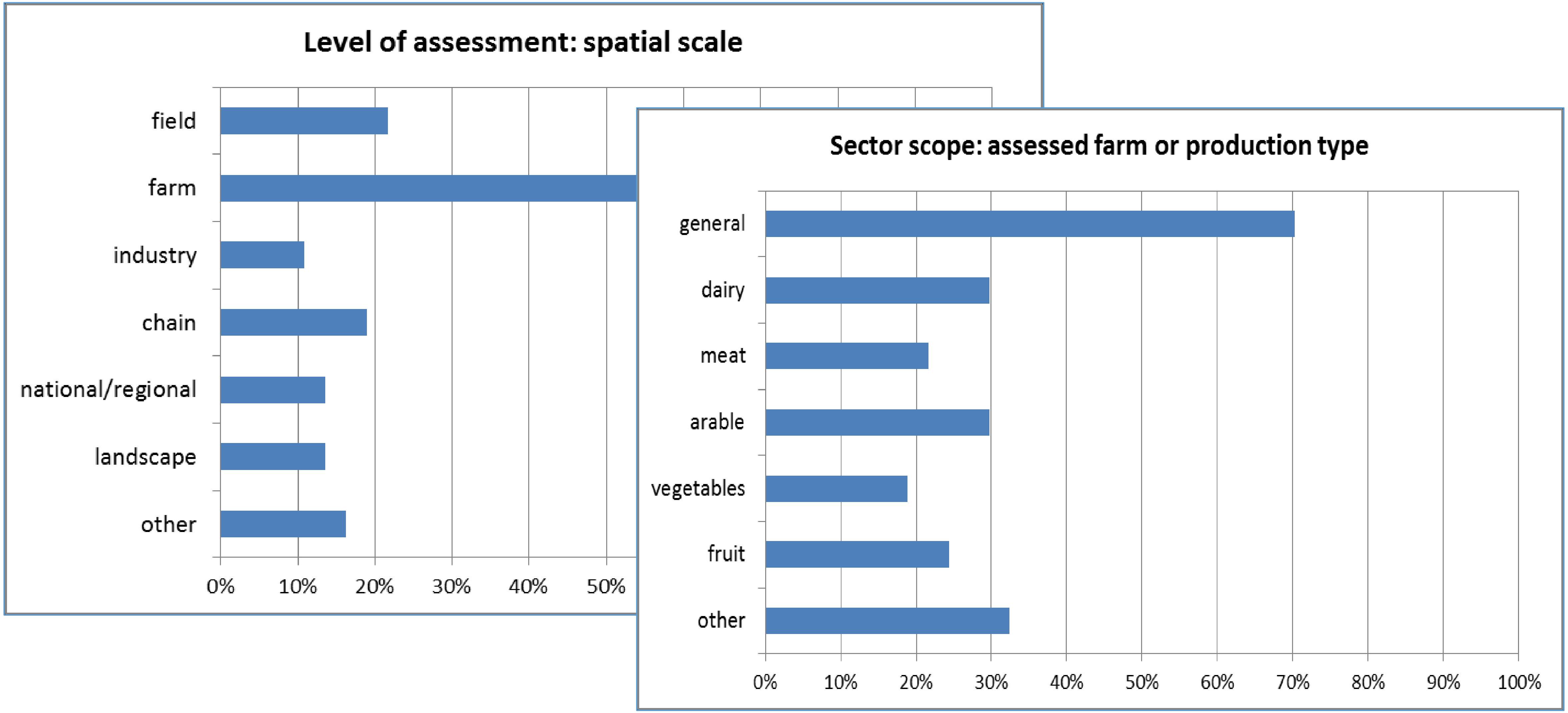
GENERAL CHARACTERISTICS:

purpose and scope of the assessment



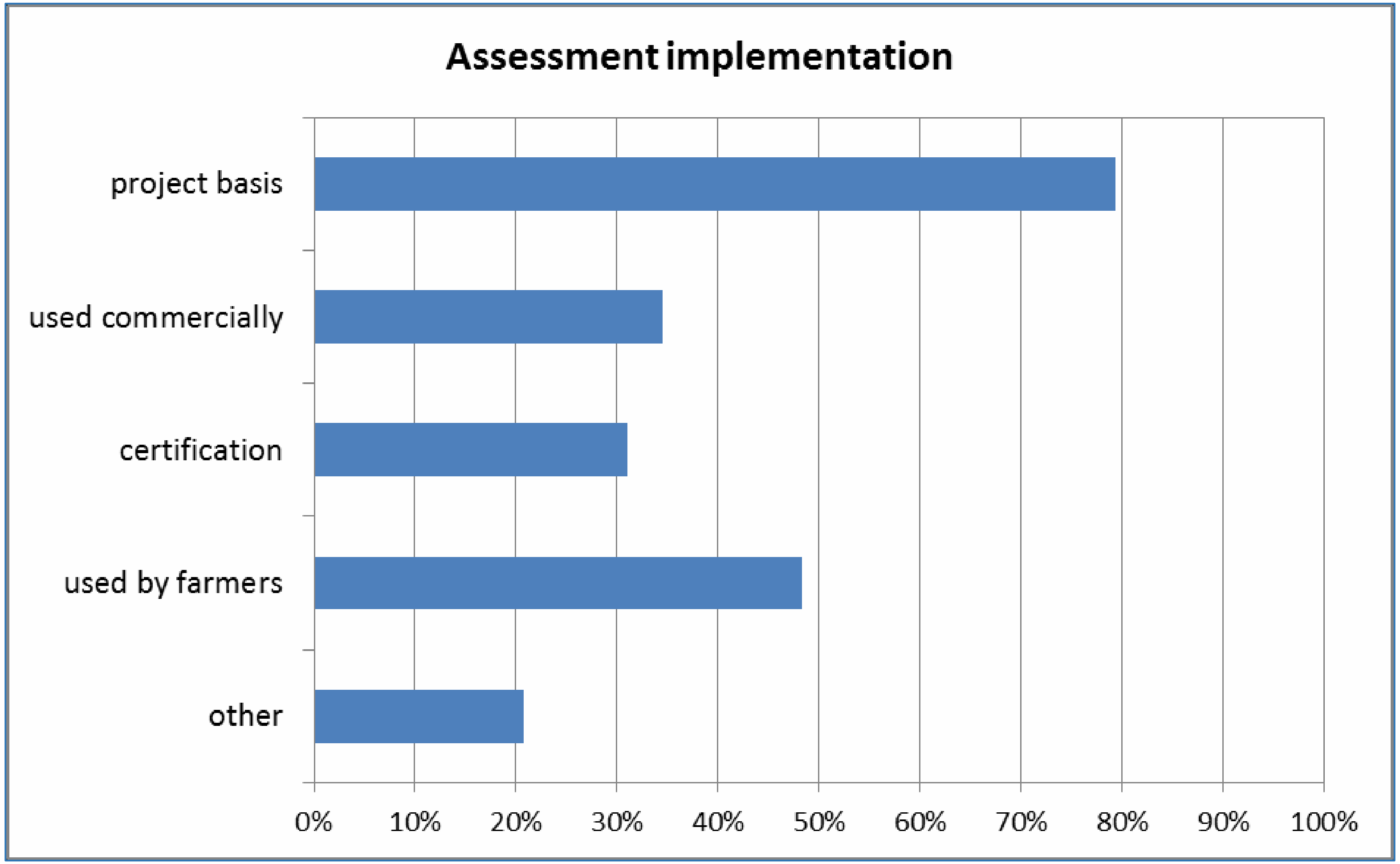


GENERAL CHARACTERISTICS:
level of assessment and sector scope



GENERAL CHARACTERISTICS:

implementation of the assessment



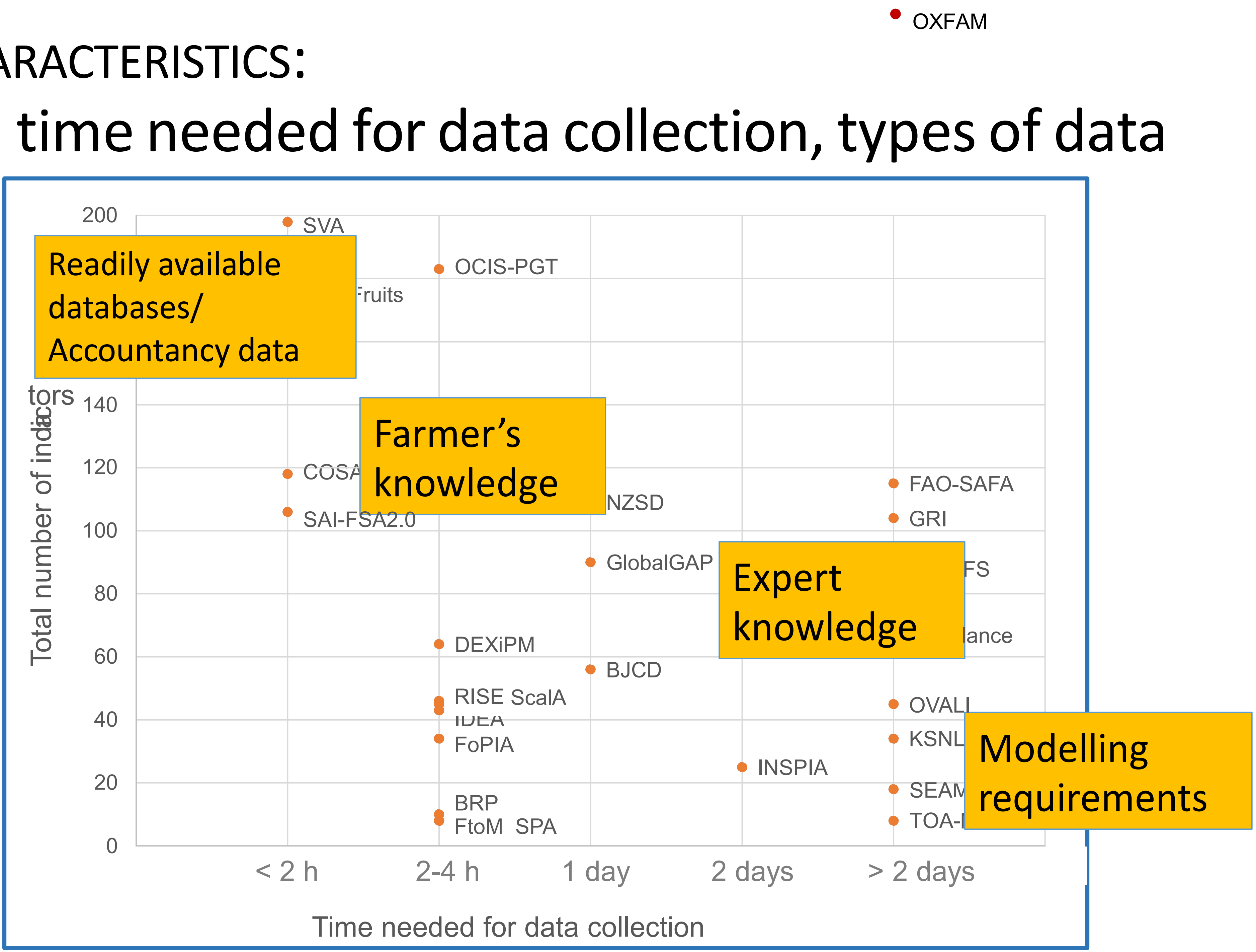
If implementation is voluntary, success is related to :

Adress the farmer's goals

the involvement of the farmer during tool developement

General characteristics:

time needed for data collection, types of data



2

Survey among experts on criteria for selection and weighting of indicators

Environ Dev Sustain
DOI 10.1007/s10668-016-9803-x

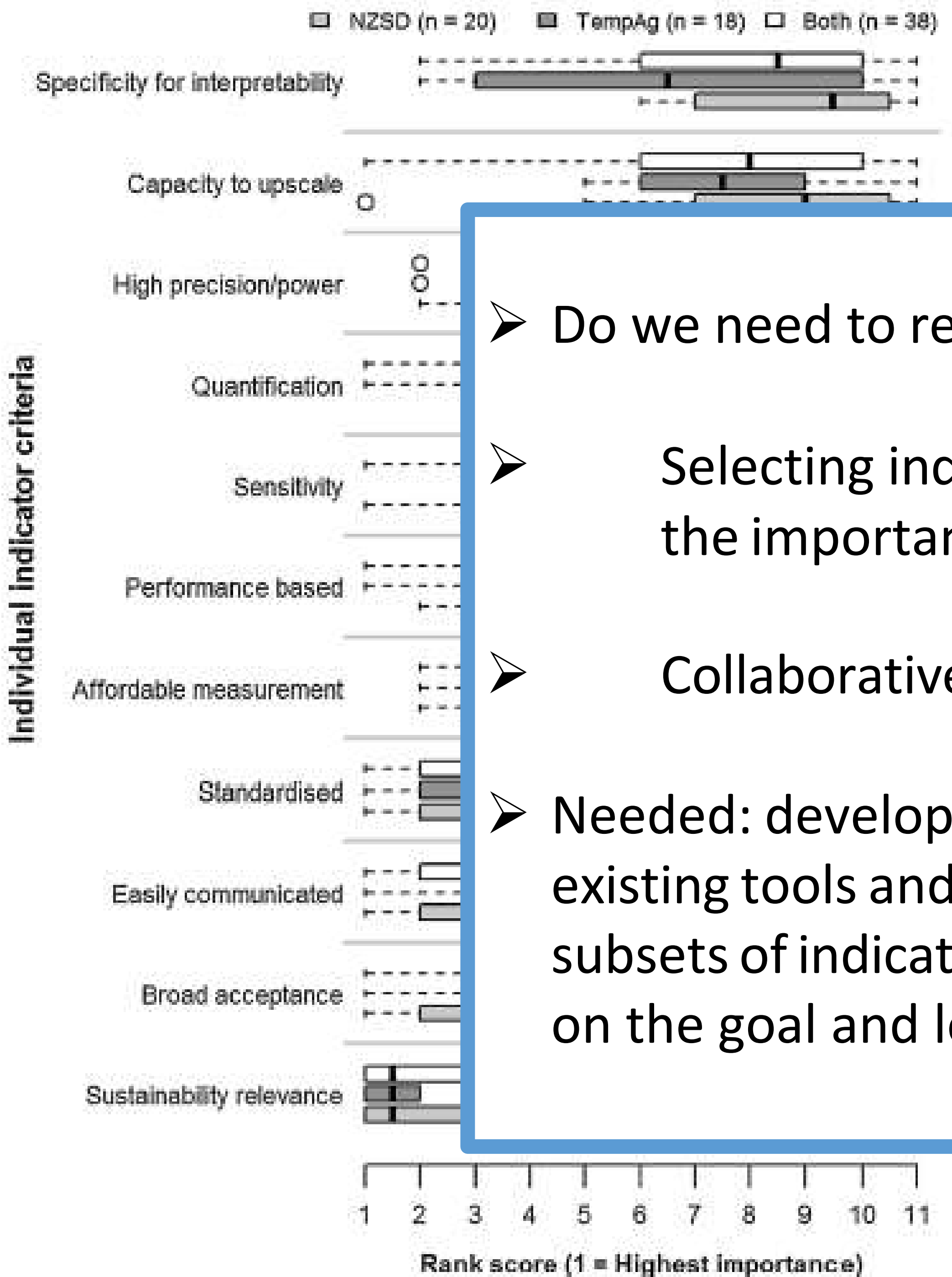
CrossMark

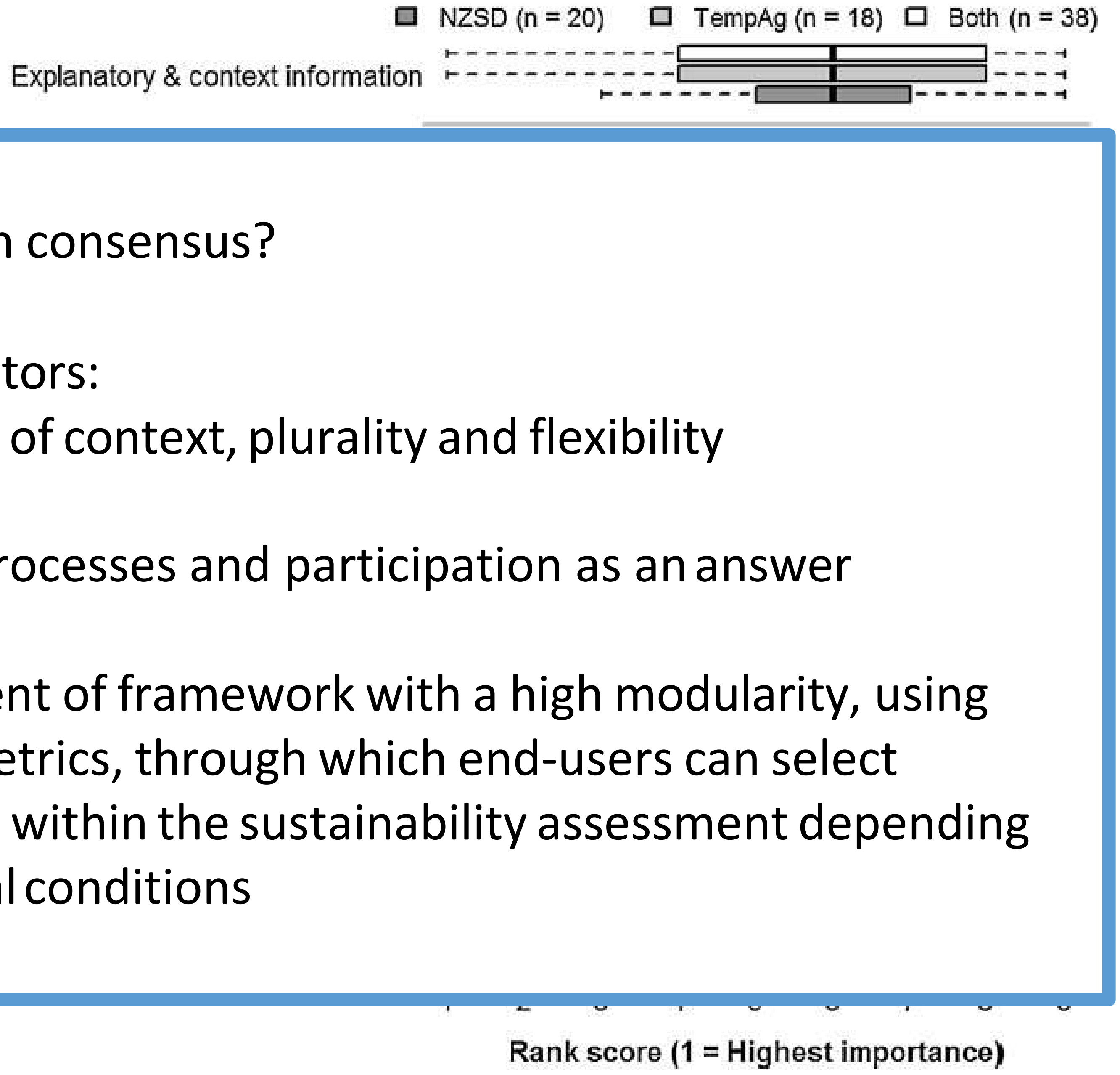
When experts disagree: the need to rethink indicator selection for assessing sustainability of agriculture

Evelien M. de Olde[1,2] · Henrik Moller[3] · Fleur Marchand[4,5] · Richard W. McDowell[6,7] · Catriona J. MacLeod[8] · Marion Sautier[3,9] · Stephan Halloy[10,11] · Andrew Barber[12] · Jayson Benge[12] · Christian Bockstaller[13,14] · Eddie A. M. Bokkers[2] · Imke J. M. de Boer[2] · Katharine A. Legun[15] · Isabelle Le Quellec[12] · Charles Merfield[16] · Frank W. Oudshoorn[1,17] · John Reid[18] · Christian Schader[19] · Erika Szymanski[20] · Claus A. G. Sørensen[1] · Jay Whitehead[21] · Jon Manhire[12]

Received: 4 March 2016 / Accepted: 29 April 2016

Abstract Sustainability indicators are well recognized for their potential to assess and monitor sustainable development of agricultural systems. A large number of indicators are proposed in various sustainability assessment frameworks, which raises concerns regarding the validity of approaches, usefulness and trust in such frameworks. Selecting indicators requires transparent and well-defined procedures to ensure the relevance and validity of sustainability assessments. The objective of this study, therefore, was to determine whether





- Do we need to reach consensus?
- Selecting indicators:
  the importance of context, plurality and flexibility
- Collaborative processes and participation as an answer
- Needed: development of framework with a high modularity, using existing tools and metrics, through which end-users can select subsets of indicators within the sustainability assessment depending on the goal and local conditions

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

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Theme 1 - Pilot Activity 1

2

Debate and discussion sessions on IFSA

20 papers on Sustainability Assessment in TempAg workshop at International Farming Systems Assocaition (EU group) – July, Harper Adams University

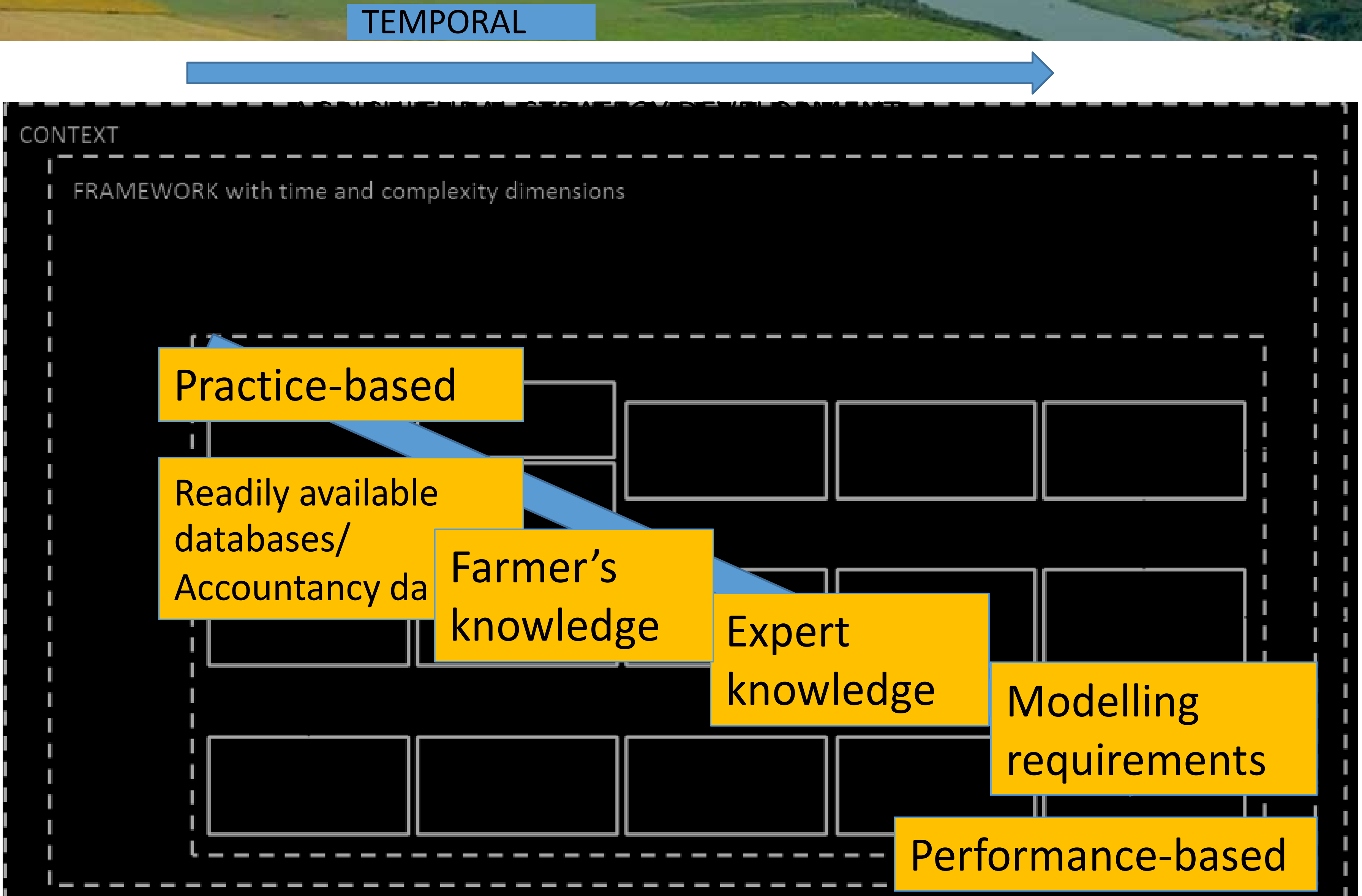
CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

TempAg

Theme 1 - Pilot Activity 1

2

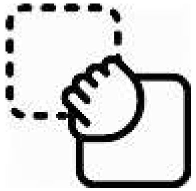
TOOL
COMPLEXITY



Coteur et al. 2016

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

3



Assess which systems can be made sustainable across spatial scales and those that may need to relocate or transform to do so.

Can we promise robust and meaningful country comparisons?

- Meaningful sectoral, regional and national comparisons may not be practical and certainly cannot be safely done <u>now!</u>
- target setting : important for comparisons and for motivating to transformation
- many limitations at the moment!
  - (see also EIP focus group on Benchmarking farm productivity and sustainability!)

- Equitable participation of stakeholders:
  important to achieve fair outcomes that underpin lasting commitment
- Local tuning : challenge the design and use of targets and benchmarks

- Will TempAg targets and benchmarking help or hinder transformation for sustainability and resilience?

Whitehead et al. 2016

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

Theme 1 - Pilot Activity 1

4 [redacted]**empAg**

Recommend a **TempAg approach** to translate ‘sustainability’ metrics between countries that is rapid, robust and real.

OLD: *How can conceptual frameworks be developed for defining agricultural sustainability at multiple levels?*

- No need to develop: a lot exist!
- Do not define a “general” agricultural sustainability : not possible, is normative and depends on context, sector, region,…
- In stead of defining: futureproof agricultural decisions
- A lot to do about implementation of such tools : farmer involvement and question of cost vs. benefit of implementation for the farmer
- Comparisons or progress through a collaborative process with all actors?
- Not only multiple spatial levels, also multiple goals, sectoral, temporal,

multiple actors
which is all
interrelated

4 **TempAg**

Recommend a **TempAg approach** to translate ‘sustainability’ metrics between countries that is rapid, robust and real.

OLD: *How can conceptual frameworks be developed for defining agricultural sustainability at multiple levels?*

- No need to develop: a lot exist!
- Do not define a “general” agricultural sustainability : not possible, is

NEW: *How can sustainability frameworks, metrics and tools and their implementation be enhanced to futureproof agricultural decision making at multiple levels on multiple scales ?*

- Not only multiple spatial levels, also multiple goals, sectoral, temporal, multiple actors which is all interrelated

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

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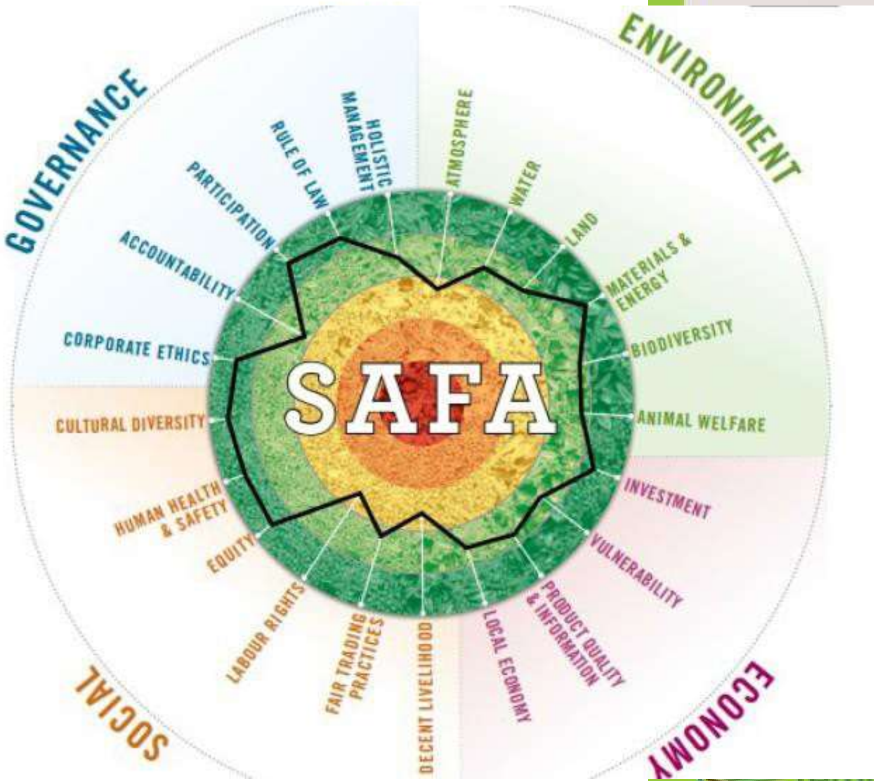
Theme 1 - Pilot Activity 1

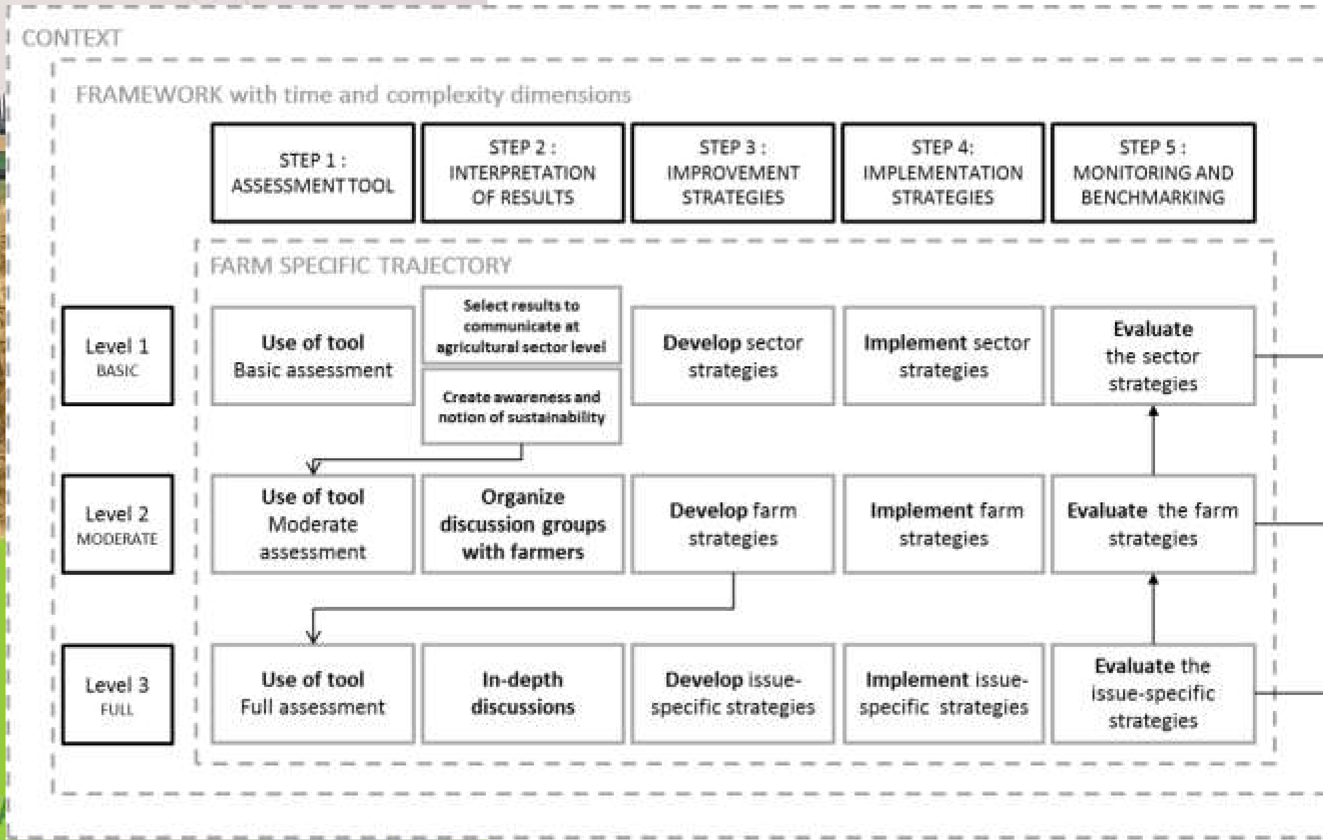
Future work:

Using what we have!

Existing fra ... on

Flanders
is agriculture and fisheries





www.ilvo.vlaanderen.be

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

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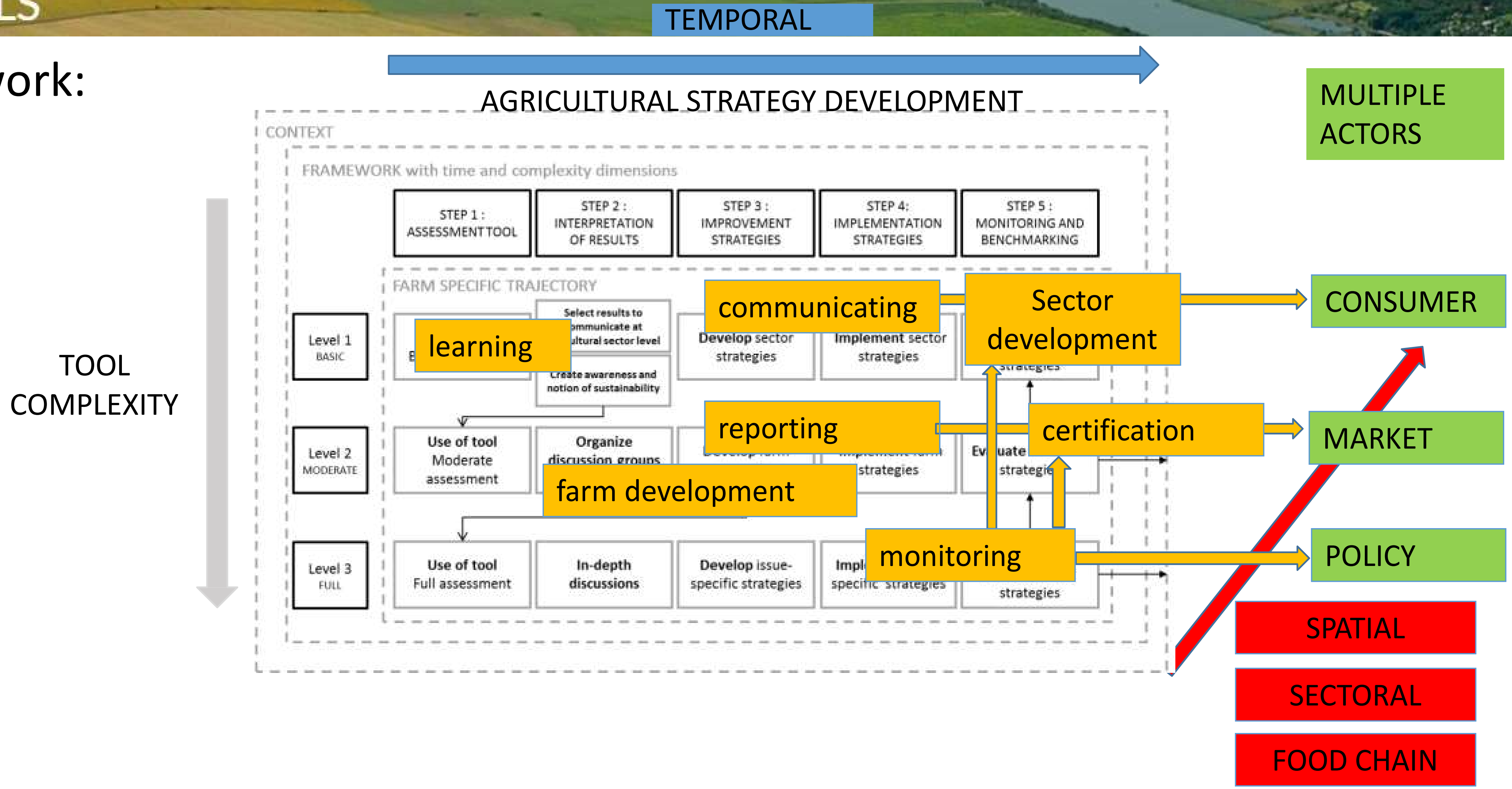
Theme 1 - Pilot Activity 1

Future work:



CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

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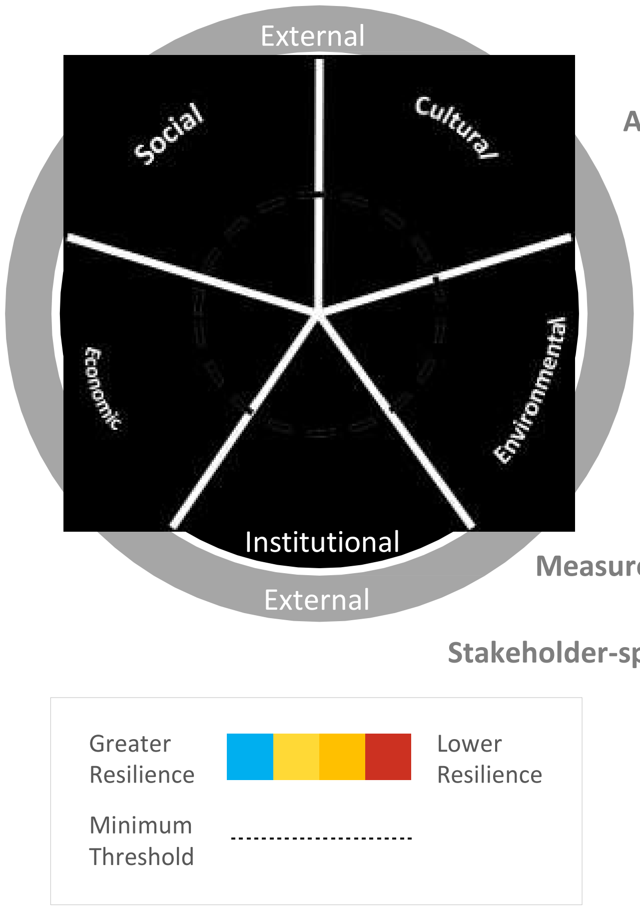
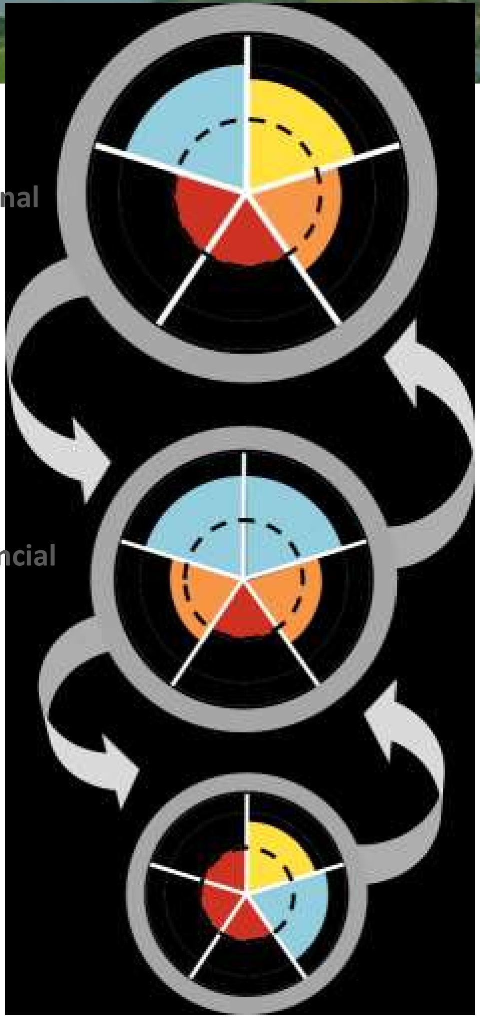
Indicators at multiple scales
Theme 1 - Pilot Activity 1

Future work:

How to construct the best metrics at different levels ?





Conclusions :

- One overall tool/approach : not possible !

- Focus on farmer's goals and involvement to achieve implementation
- Join policy to action on the farm: target both because both key 'sites of action' for transformation
- Collaborative processes and participation: an answer to context-specificity, plurality and flexibility
- Acknowledge all scales in the process: spatial, temporal, multi-actor/end-user, food chain, …
- Use existing tools and indicators, SAFA and multi-framework (in development)
- Sustainability indicator targets that motivate the transformation of farming systems for sustainability and resilience

- Puzzle and struggle!

CONCEPTUAL FRAMEWORKS FOR DEFINING AGRICULTURAL SUSTAINABILITY AT MULTIPLE LEVELS

- References:

- Coteur et al. (2016) A framework for guiding sustainability assessment and on-farm strategic decision making. Environmental Impact Assessment Review 60 (2016) 16–23
- Coteur et al. (2016) Benchmarking sustainability farm performance at different levels and for different purposes: elucidating the state of the art. Proceedings of the 12th European IFSA 2016, UK.
- De Olde at al. (2016) When experts disagree: the need to rethink indicator selection for assessing sustainability of agriculture. Environ. Dev Sustain.
- Whitehead et al. (2016) Target Setting and Burden Sharing in Sustainability Assessment beyond the Farm Level Proceedings of the 12th European IFSA 2016, UK.
- Wustenberghs et al. (2016) Discerning the stars: characterising the myriad of sustainability assessment methods. Proceedings of the 12th European IFSA 2016, UK.
- Wustenberghs et al. (2015). TempAg Pilot Activity 1.1.1. Survey of Sustainability assessment methods. ILVO, Merelbeke, Belgium.
- EIP focus group: “Benchmarking farm productivity and sustainability”

Theme 2: Ecosystem services in Agricultural Research

Janne Bengtsson, Lars Gamfeldt, Marc Barbier,
Muriel Tichit, Danielle Magda (SLU, INRA)
with Felix Herzog, Wolfgang Weisser, Tim
Diekötter, Knut Hovstad & others
(approx. 15 in total)

Main theme 2 questions

Originally:

- Optimising land management to produce food and other ecosystem services at landscape level
- How design land use systems that create synergies across ecosystem services (ES) and satisfy social, economic and environmental goals, at landscape scale?
    1) Quantification of ES in agriculture and their performance.
    2) Case studies analyses, integrated crop-live-stock-forestry systems, novel production systems at landscape level.

Not adressed:

- How can tensions between competing land uses be resolved? (All TempAg, not theme 2)
- What are the limits to and trade-offs within sustainable production systems, and how are they best governed? (Knowledge base too insufficient)
- How can scale, location, diversity and complementarity of rural enterprises be optimized to enhance the provision of complementary activities within a landscape?

Main theme2 questions

Operationalised as:

How is the research effort (research landscape) on ecosystem services (ES) in temperate agriculture focused?

- Which are the most and the less studied ES?

  (from and to agriculture)

- Which pairs of ES or more have been studied together?

  (multifunctionality, synergies and trade-offs)

- Which types of agroecosystem are studied with an ES approach vs. those that are not or less studied?

  (grasslands, cereals, orchards,… habitats, regions)

- Identify knowledge gaps and barriers

What did we do?

- Examine the literature to find studies of ES in agriculture:
  - Web of Science search (title, abstracts + keywords)
  - Text analysis of WoS and Biodiversa projects
- Quite long search string (WoS)
- WoS: Of the 2796 papers found by machine
  - Selected 10 %
  - Read abstracts (and papers)
  - Classified into relevant and not relevant
  - Analysed content to answer questions

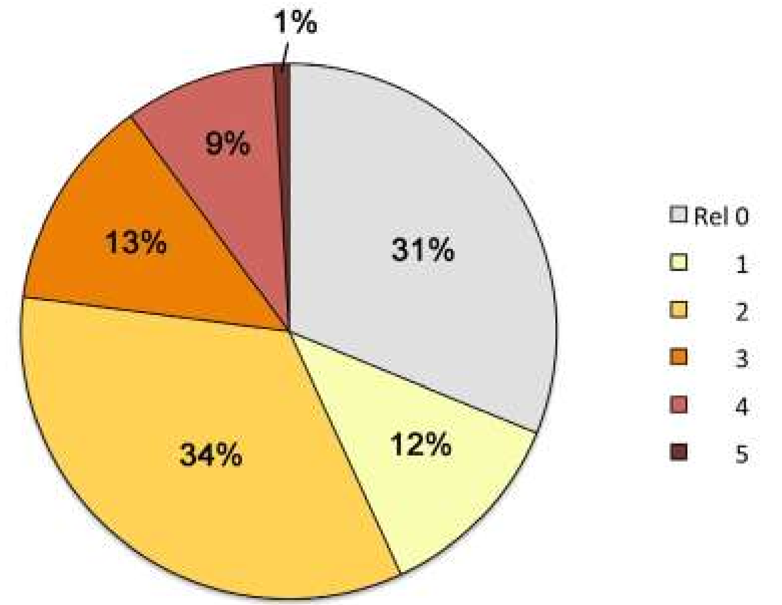
What did we do?

- Relevance assessment (two similar scales)
- Addresses ”scientific understanding” (depth)

Corpus analysis	WoS analysis relevance criteria
	Not relevant (habitat/region or not abt ES)
1 General terms	0 ES mentioned but not assessed or measured
	1 ES assumed and implicitly assessed
2 Indicators and methods of assessing ES	2 ES assessed by broad-scale indicators (e.g. land use cover)
	3 ES assessed/measured by proxies (e.g. diversity of pollinators)
3 Functional approach and mechanistic understanding of ES	4 ES actually measured on agricultural study sites
	5 ES measured as production function (using several sites/management/equivalent)

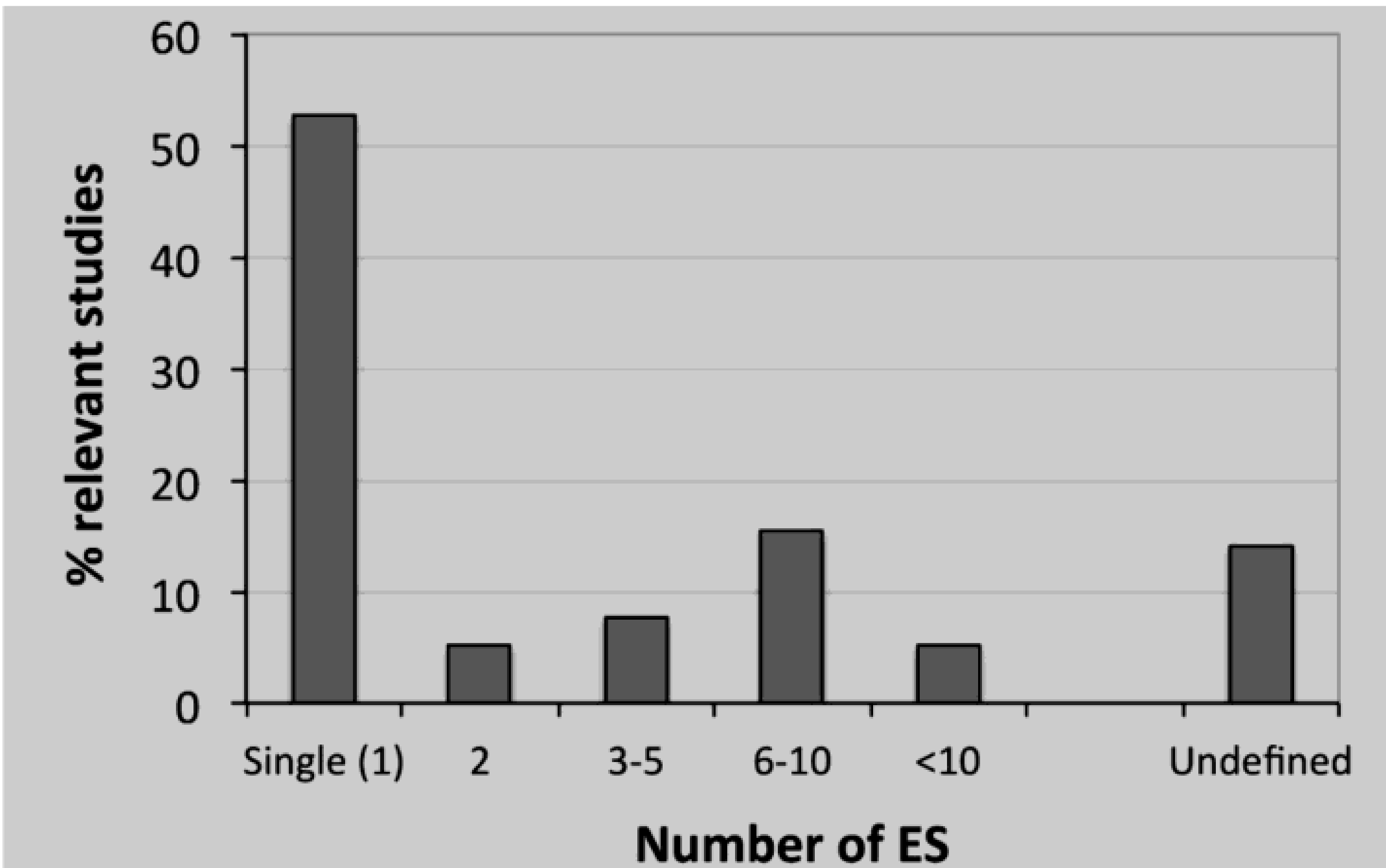
Results (short)

- Agroecosystems are <u>not</u> well studied in EU Biodiversa projects (compared to other ecosystems)
  Only 12 % mention agriculture or farming
- There is a shallow depth (little mechanistic understanding) in ES research in agriculture:
- Of 109 ”relevant” studies:
  - 43 % only mention ES
  - 47 % used proxies/indicators
  - 10 % measured (single) ES
- Similar in Biodiversa projects



Results: Which ES have been studied?

- Most studies only examine one ES
- Multiple ES mainly by proxies



Results: Which ES have been studied?

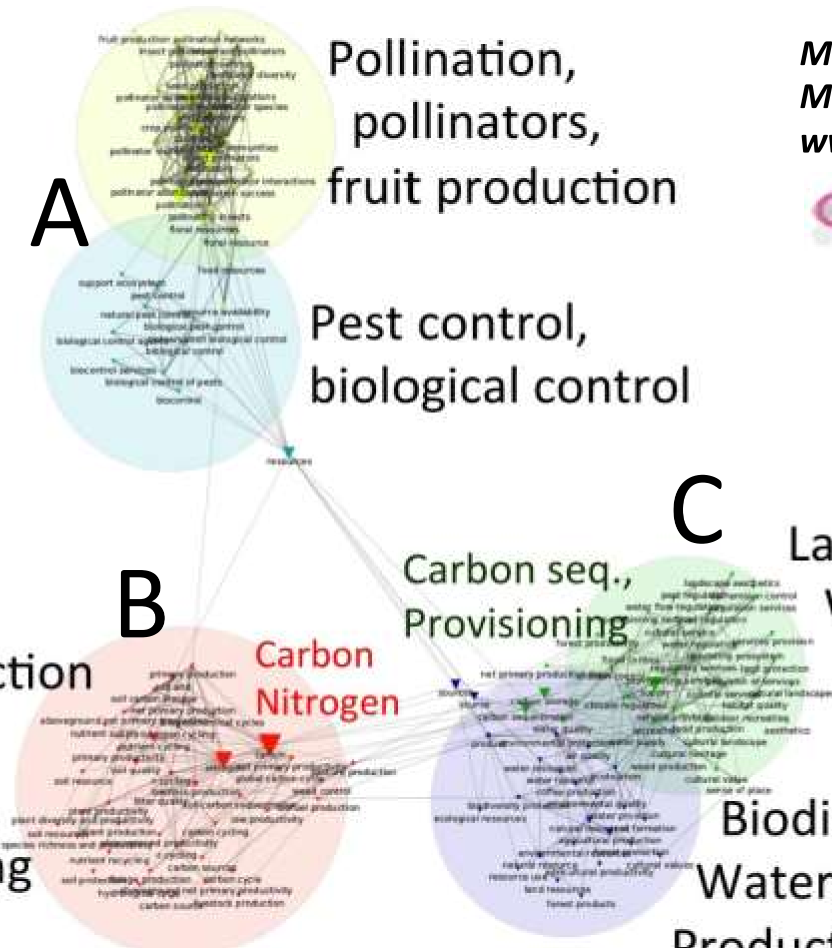
- Most studies only examine one ES
- Multiple ES mainly by proxies
- Most studied ES:
  - Cultural
  - Agricultural production
  - Population-based
  - Soil and water
- Most common ES often studied together

  (Ag prod, Biodiv, Water; not biocontrol, pollination)

Ecosystem service	No. studies
Cultural (diverse set)	21
Agricultural production	20
Biodiversity	20
Biocontrol	15
Water regulation	13
Soil erosion prevention	11
Pollination	9
Climate regulation	9
Soil fertility	9
Carbon sequestration	9
+ approx. 14 others (5 or less studies)	

Results:
Clusters of ES in agricultural research projects

- Populations vs. Plant-soil ecosystems vs. Land use and resources

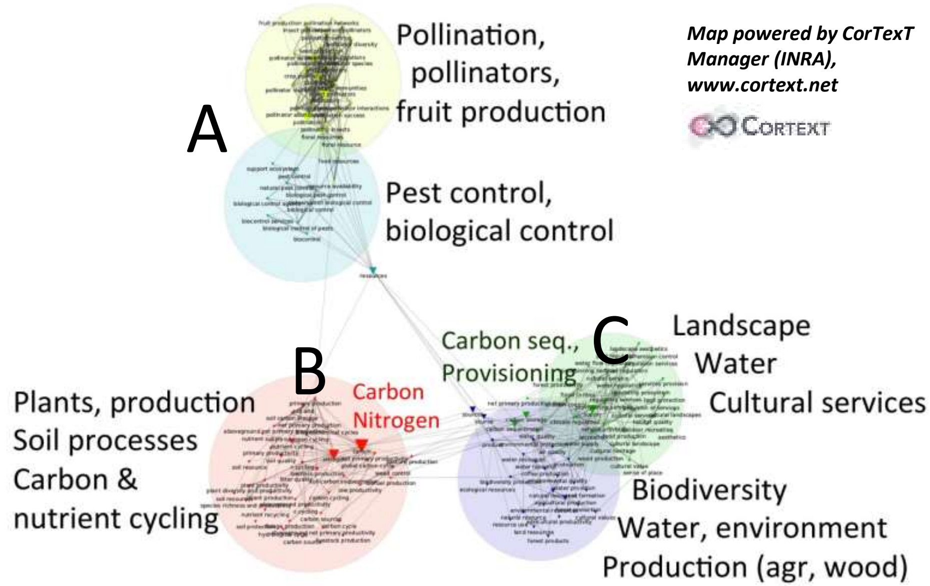


Map powered by CorTexT Manager (INRA), www.cortext.net

Result: Mapping clusters … (2)

Suggests:

- Big divides in ES research
- Dominance of what is rewarded (pollination)
- Illustrates how ecology has been introduced in agroecosystems
- An institutional challenge: linking ecology, agronomy and soil sciences, environmental research, and social science



Some kind of conclusions

- Few papers and projects analyzed multiple ecosystem services (or ES multifunctionality)
  - Most studies 1 service only , …., max 34 (10 prov, 12 reg, 12 cult)
- Most studies assessed ES – if at all – by proxies or broad scale indicators
  - Land use cover classes, interviews, economic indicators, etc.
- ES assessments by mechanistic studies and production functions extremely rare

> ➢ Indicates low scientific depth and precision in ES research (in temperate agriculture …?)

Questions and stumbling blocks

- Ecosystem services TO vs. FROM agriculture
  - A ”simple” question with complex and wicked answers
  - Most ES are managed by farmers – both ”to and from”
    - Example: Dung removal – dung from, removal to farming …
- Are some ES studied under other names in other areas of research and other contexts?
    - Needs a separate in-depth study
- Role of biodiversity?
  - Underpinning ES or an ES?
  - Used as a proxy for ES or as a policy goal?

Knowledge gaps and Barriers

- Human inputs vs. ecosystem (ecological) inputs?
- What do ES contribute to yield and sustainability?
- Trade-offs and synergies – how manage ES?
- ES under other concepts and names in agronomy

- Scientific barriers:
  - Ecology, agronomy, environmental sciences, landscape and planning, social sciences
- Institutional:
  - Production & technology – Sustainability & environment
  - Multiple ES emphasise need to rethink policies to link sectors

What remains to be done?

- Text analysis of WoS studies
  - Would give an estimate of Man vs Machine
  - On the way
- Which agricultural systems have been studied?
  - To be done Oct-Nov
- Examinations of other issues raised by results

Planned deliveries

- Scientific paper
  - Based on presentation at Ecosummit (and this discussion)
- Policy brief on ES in agriculture
  - Need feedback from steering group
  - State of the research
  - Research and policy needs
  - Policy relevance of ES research
- Report to TempAg
  - Format? Extent?

Continuation of theme 2?

Yes, the group wants to examine:

- Conceptual problems raised by agricultural ES:
  - Co-production of ES by farmers/technology and nature
  - The ”ES to / from agriculture” question
- Using ES in closing ”sustainable yield gaps”?
  - Understanding ES contributions to yield/agric production

National Agriculture and Food Research Organization

Research innovations towards sustainable agriculture and food industry in Japan

Basic Plan for Agricultural Research

The Ministry of Agriculture, Forestry and Fisheries (MAFF) implements a 5-year "Basic Plan for Food, Agriculture and Rural Areas", which serves as a guideline for advancing the reform of measures and efforts by the entire nation so as to enable Japan's agriculture and rural areas to accurately respond to structural and other changes in the economy and society, and to appropriately play their roles in the future, while fully demonstrating their potential.

2001 - 2005	2006 - 2010	2011 - 2015	2016 - 2020
Basic Plan I	Basic Plan II	Basic Plan III	Basic Plan IV

The National Agriculture and Food Research Organization (NARO) has been consolidated as the core institution in Japan for conducting R&D on agriculture and food, bringing back the results of such efforts to society, securing the nation's supply of high-quality and safe foods, reinforcement of industrial competitive power, preservation of the environment, and creation of new values.

Organizational Structure

NARO National Agriculture and Food Research Organization

- **NARO Headquarters**
  - Agri-Food Business Innovation Center, NARO
  - Hokkaido Agricultural Research Center, NARO
  - Tohoku Agricultural Research Center, NARO
  - Central Region Agricultural Research Center, NARO
  - Kyushu Okinawa Agricultural Research Center, NARO

  → **Development of agricultural production base and frontline in bringing the technology to society**

  - Institute of Vegetable and Floriculture Science, NARO
  - Institute of Fruit Tree and Tea Science, NARO
  - Institute of Livestock and Grassland Science, NARO
  - National Institute of Animal Health, NARO
  - Institute for Rural Engineering, NARO
  - Food Research Institute, NARO
  - Institute of Agrobiological Sciences, NARO

  → **Institutes for research in specific fields and collaboration with external agencies**

  - Institute of Crop Science, NARO
  - Institute of Agricultural Machinery, NARO
  - Institute for Agro-Environmental Sciences, NRO

  → **Core institutes for innovations in crop breeding, farming mechanization and environmental issues**

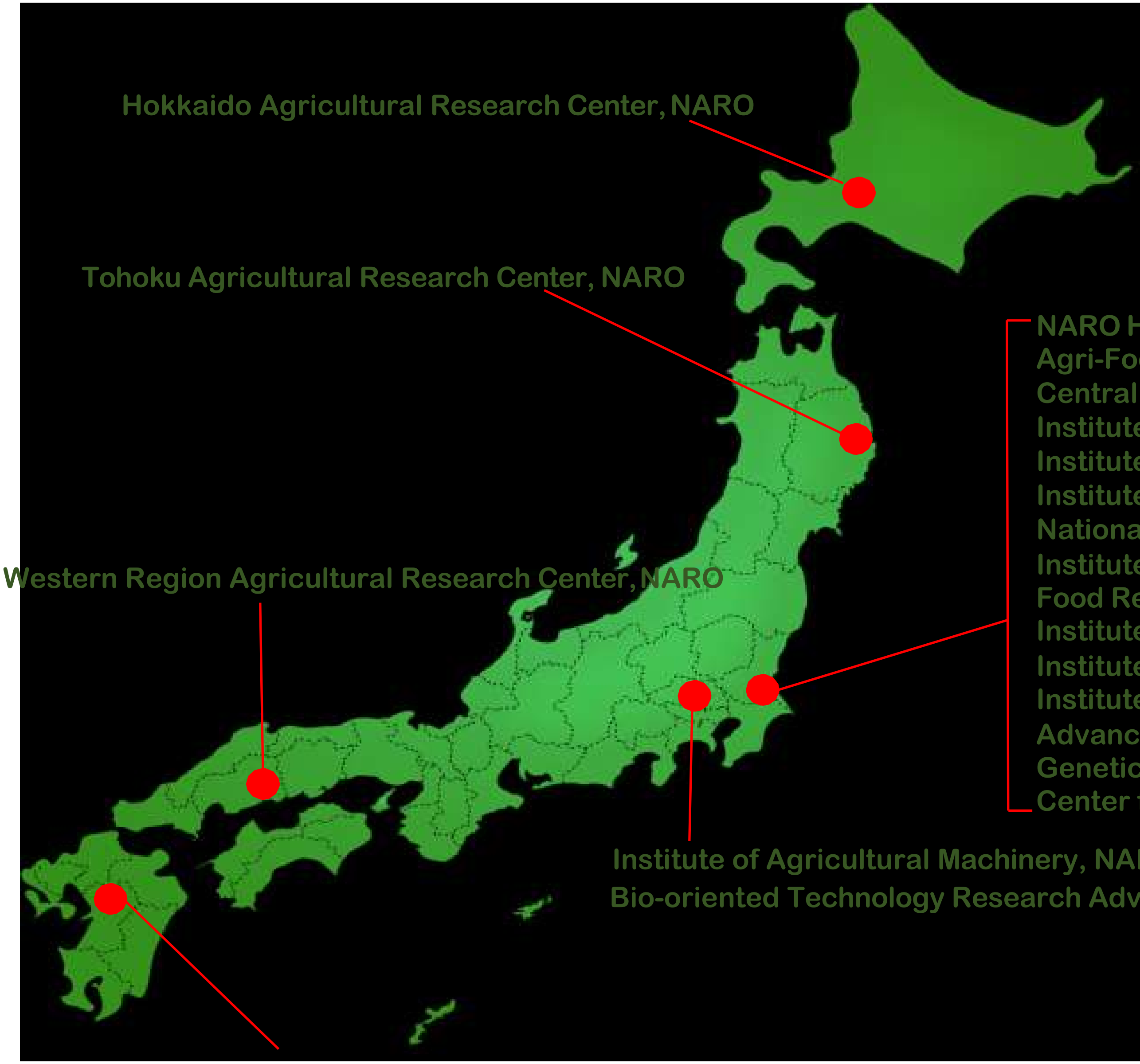
  - Advanced Analysis center, NARO
  - Genetic Resources Center, NARO

  → **Analytical support, management of big data, genetic resources**

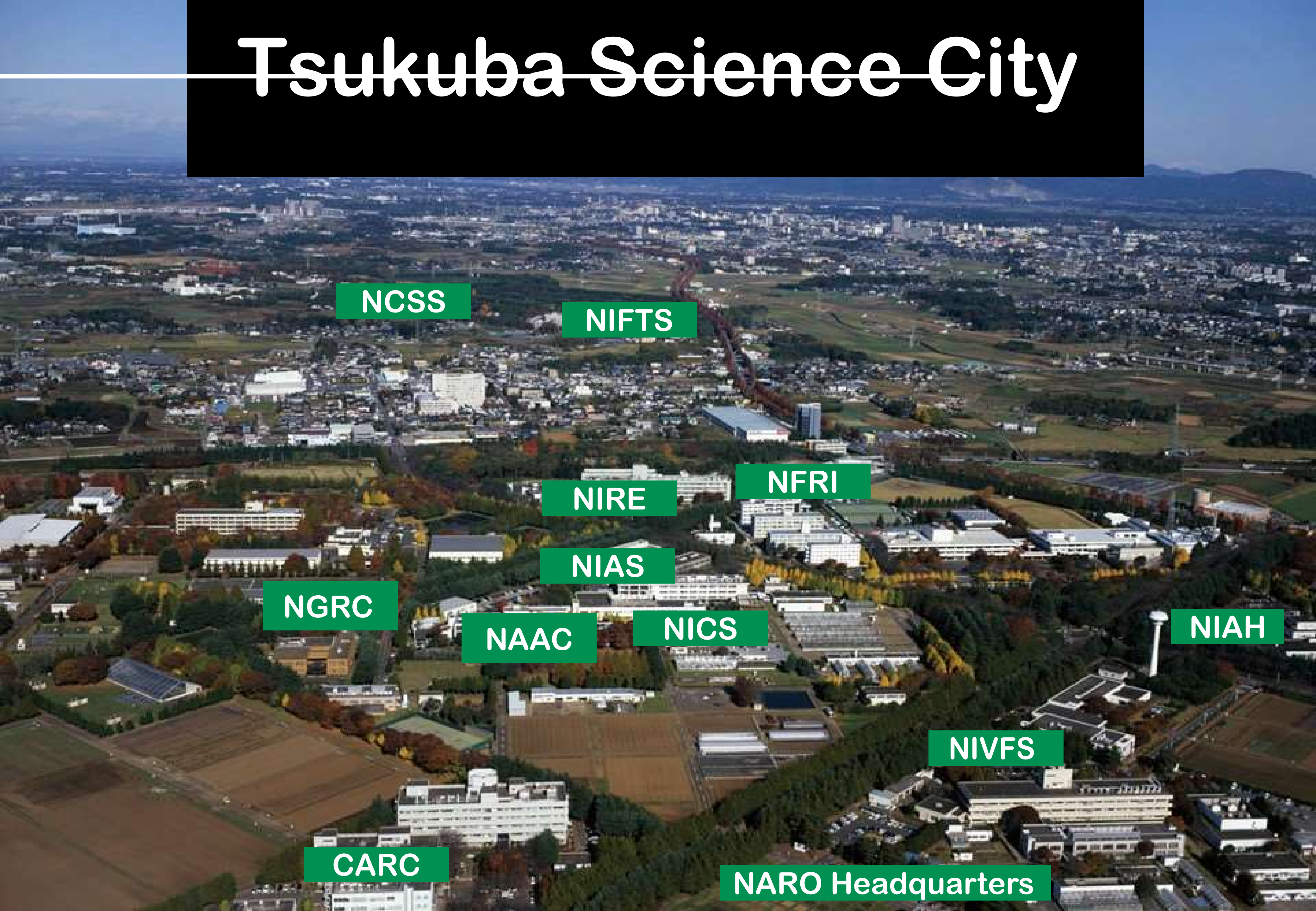
  - Center for Seeds and Seedlings, NARO
  - Bio-oriented Technology Research Advancement Institution, NARO

  → **Variety registration, allocation of fund**

Organizational Structure



Tsukuba Science City



Basic Plan IV 2016~2020

NARO
National Agriculture and Food Research Organization

1. Strengthening the capability of agricultural production and farm management
2. Development of new varieties and agricultural products towards realization of a strong agriculture, creation of innovative industries
3. Producing high-quality and healthy foods, ensuring safety and reliability of agricultural products
4. Resolution of environmental issues and sustainable use of local resources

NARO
National Agriculture and Food Research Organization

1 Strengthening the capability of agricultural production and farm management

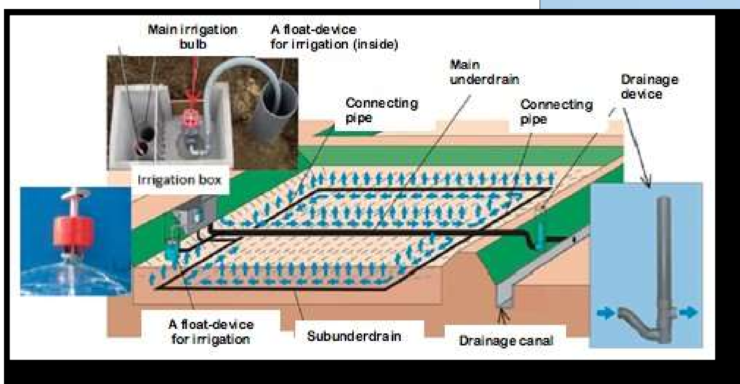
Addressing various issues facing the agricultural industry, such as the decreasing number and aging of farmers, to contribute to the enhancement of the base of agricultural production, to promote the development of farm management through innovative technologies, and to achieve vigorous productivity in paddy-field and upland farming, livestock production etc. by taking advantage of regional conditions.

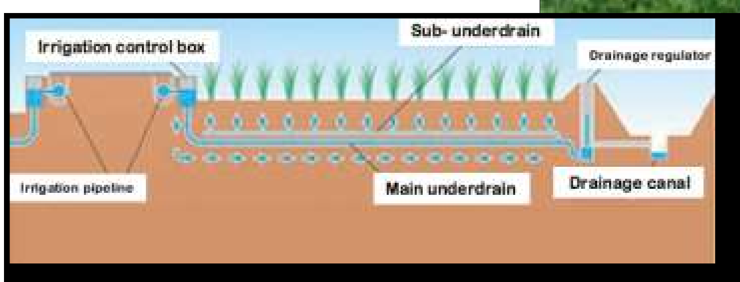
Water control system for upland crops

NARO
National Agriculture and Food Research Organization

Farm Oriented Enhancing Aquatic System (FOEAS)

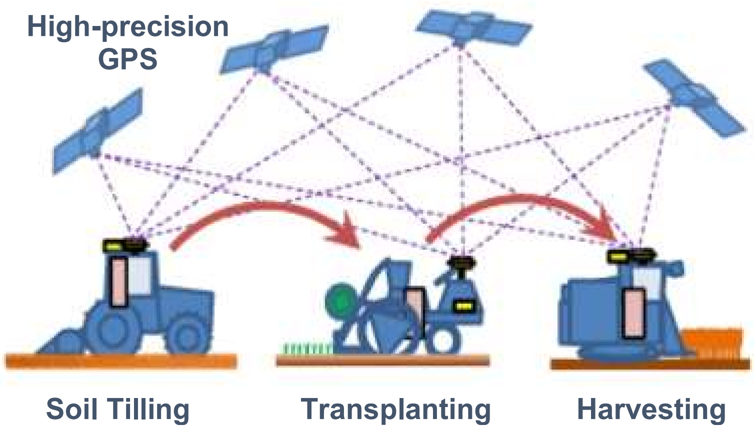
The system is equipped with underdrains and both irrigation and drainage facilities, and automatically supplies water during drought and drains excess water during heavy rainfall through the underdrains, thereby maintaining suitable soil moisture condition for upland crops without using electrical energy or fossil fuel.

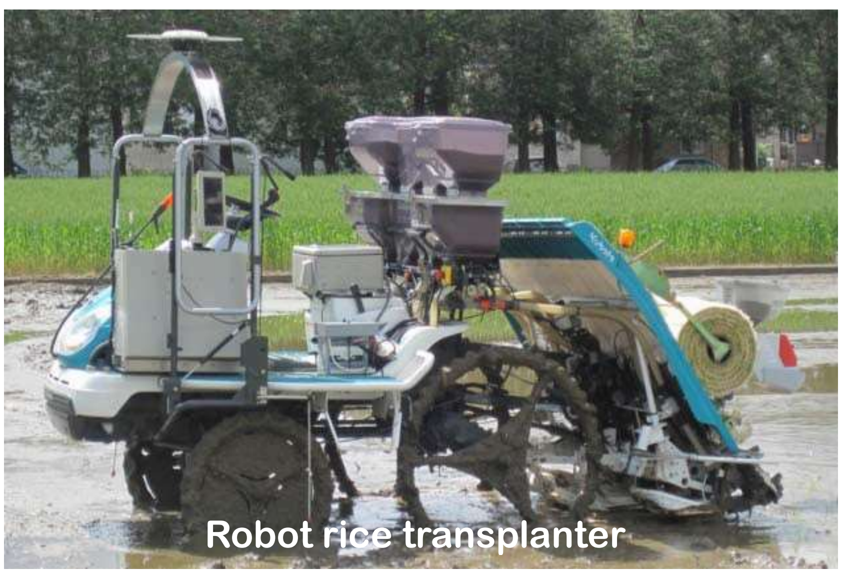




Agricultural robots

Research on agricultural robotics and the implementation of autonomous farming to address issues of managing large farms with minimal labor amidst the decline and ageing of farming households in Japan.





2 Development of new varieties and agricultural products towards realization of a strong agriculture, creation of innovative industries

We are promoting the development of novel crops and new agricultural products through genomic and agrobiological research, innovative research focusing on new elementary biological materials such as high-quality silk products which can factor in the development of new industries, and communicating the merits of such products to producers, users and consumers.

Rice breeding in response to future climate challenges

'Akidawara' has the same good eating quality as 'Koshihikari' but with 30% higher yield and resistance to lodging.

Mutant lines that can tolerate high temperature

Roots penetrate deeper into the ground

Basic Plan IV 2016~2020

National Agriculture and Food Research Organization

3 Producing high-quality and healthy foods, ensuring safety and reliability of agricultural products

- Development of technologies for improvement of productivity and profitability of horticultural crops (fruit trees, tea, vegetables, flowers), and elucidation of the functionalities of agricultural and food products to enhance marketability.

- Ensuring the safety and reliability of food, livestock products and agricultural crops, development of diagnosis and prevention technology for livestock diseases, and development of integrated measures for pest risk management.

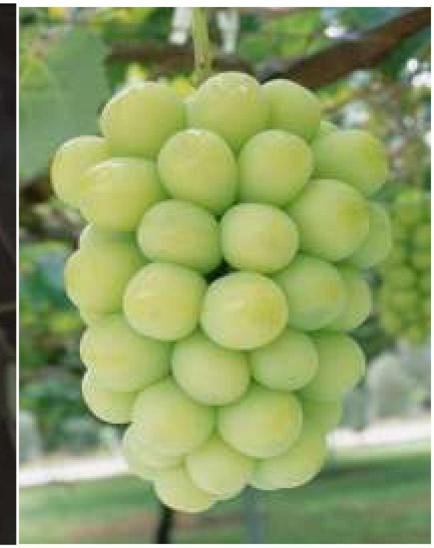
Fruit varieties with specific traits

NARO
National Agriculture and Food Research Organization

‘Fuji’ apple

‘Akizuki’ Japanese pear

‘Himekonatsu’ peach



‘Shine Muscat’ grape

‘Azumi’ mandarin

‘Taishu’ persimmon

‘Porotan’ chestnut

Vegetables with specific traits

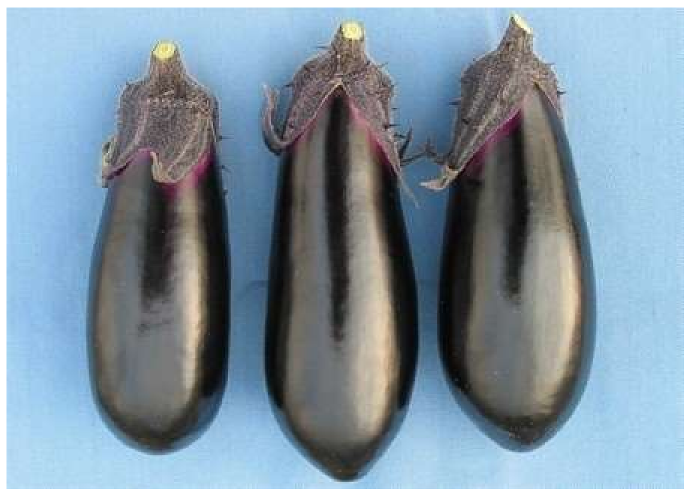
NARO
National Agriculture and Food Research Organization

‘Nitakikoma’ tomato

High sugar tomato

‘TC2A’ pumpkin

‘Kuerurich’ red onion



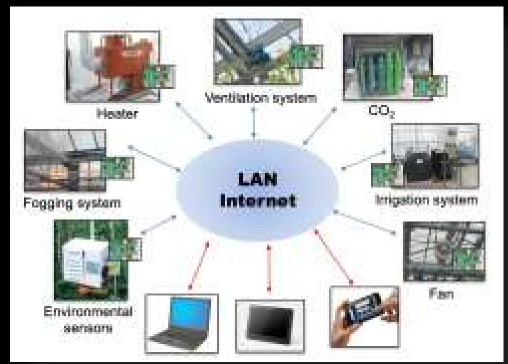
‘Anominori’ eggplant

‘Ookimi’ strawberry

Tsukuba Plant Factory

Advanced hardware and software techniques for achieving high year-round yield and low-cost production in greenhouse horticulture.

The newly developed Ubiquitous Environment Control System (UECS), for environment control has been adopted and is in operation.

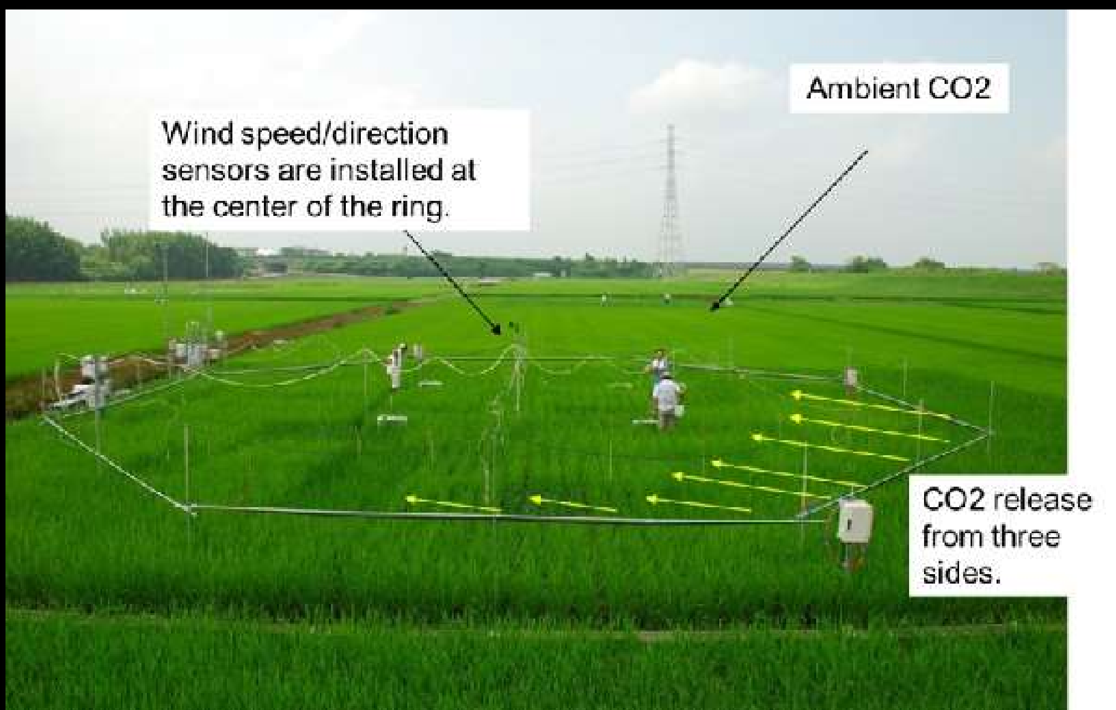


4 Resolution of environmental issues and sustainable use of local resources

- Development of a resilient agriculture for adaptation to climate change and other environmental problems.
- Development of sustainable agriculture through efficient utilization of local resources and development of technologies for crop protection and soil management.
- Development of technologies to accelerate the reconstruction and recovery of agriculture in areas affected by the Great East Japan Earthquake and nuclear disaster.

Impact of climate change on agriculture

NARO
National Agriculture and Food Research Organization



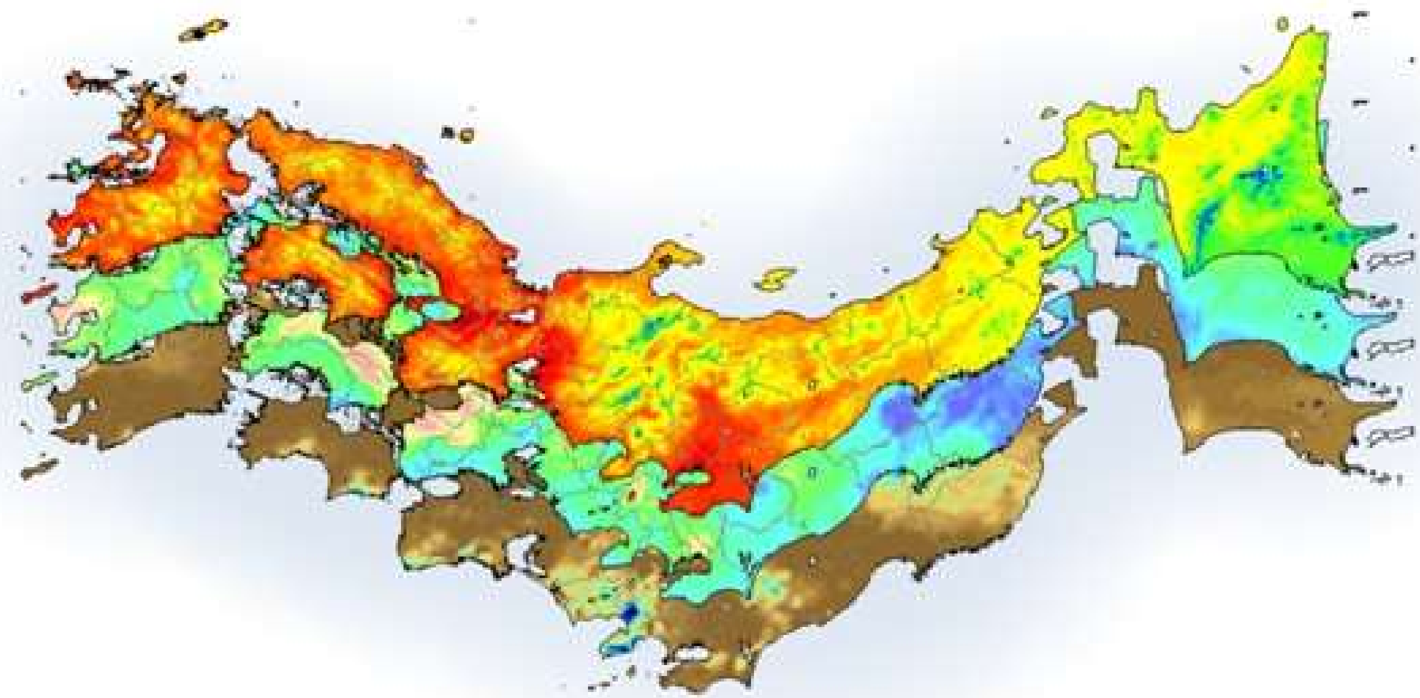
atform for investigating how future
cosystems are likely to respond to
gh CO_2 without disturbing various
cosystem-scale interactions.

ffects of elevated CO_2 on rice paddy
nder open-field conditions expected
the next 50 years.

Impact of climate change on agriculture

NARO
National Agriculture and Food Research Organization

The Agro-Meteorological Grid Square Data System (AMGSDS) provides daily updates of meteorological data sets that include nationwide weather forecasts at approximately 1 km square grids. The data enable us to establish an early warning system for agrometeorological disasters, and a decision support system for crop management with simulation models that can be used to predict crop growth and crop damage due to pests and diseases.



Reconstruction and revitalization

The Agricultural Radiation Research Center was established as part of ongoing efforts to ramp up the research necessary for reconstruction in the areas affected by the accident of TEPCO Fukushima Nuclear Power Station after the Great East Japan Earthquake in 2011.

Fukushima Research Station
NARO Tohoku Agricultural Research Center

Decontamination of affected fields

NARO
National Agriculture and Food Research Organization

Scraping topsoil using construction equipment

Scraping topsoil using agricultural machineries

Inversion tillage by plowing

Removal and soil stirring with water

Food and Agriculture for the Future

Basic direction centers on an "industrial policy" for developing agriculture and food industries into a growth sector as well as "regional policy" for promoting the maintenance and implementation of agriculture's multifunctional roles.

- Measures for securing stable food supply
- Measures for sustainable agricultural development
- Measures for development of rural areas
- Measures for restoration and reconstruction from the Great East Japan Earthquake

Pilot Activity 3 –
Sustainably improving food productivity at farm/enterprise level –
Yield gaps and resource use efficiency

Martin van Ittersum and Pytrik Reidsma
(Wageningen University, Plant Production Systems group)

Priority Areas and Activities

Delivering resilient Agricultural Production Systems (Multiple spatio-temporal level)	Optimising land management for food production & other ecosystem services (Landscape level)	Sustainably improving food productivity (Farm/Enterprise level)
New Zealand	**France/Sweden**	**Netherlands**
Enhancing sustainability metrics, frameworks and tools for future-proofing agricultural decision making at multiple levels	Optimising synergies between agricultural production and ecosystem services	Addressing yield gaps, resource use efficiencies and environmental impact

Aims pilot activity 3

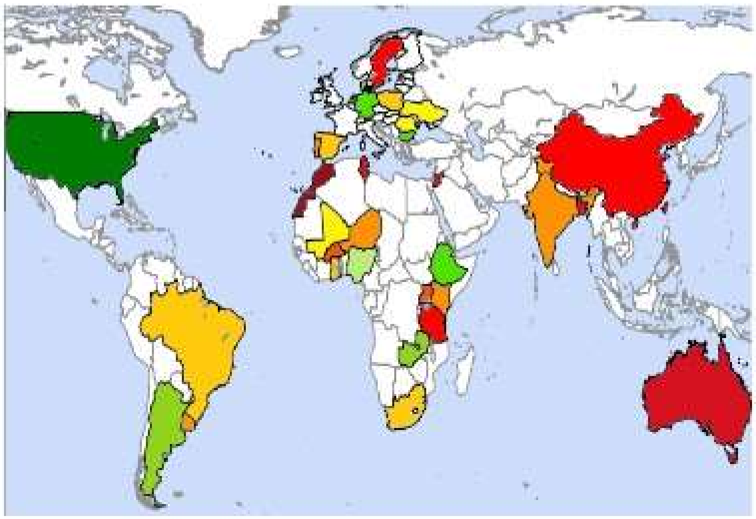
- Consistently quantifying cereal yield gaps using the Global Yield Gap Atlas (GYGA) procedure;
- Initial explanation of these yield gaps using a survey.
- *Resource use efficiency and environmental performance*

Task 1 – yield and water productivity gap analysis

- Yield gap analysis cereals of participating countries
- Methodological topics were discussed and aligned
- Semi-quantitative Uncertainty analysis
- Initial discussion yield gap analysis Grassland

Global Yield Gap Atlas

Go to the Atlas



Go to the Atlas for advanced users

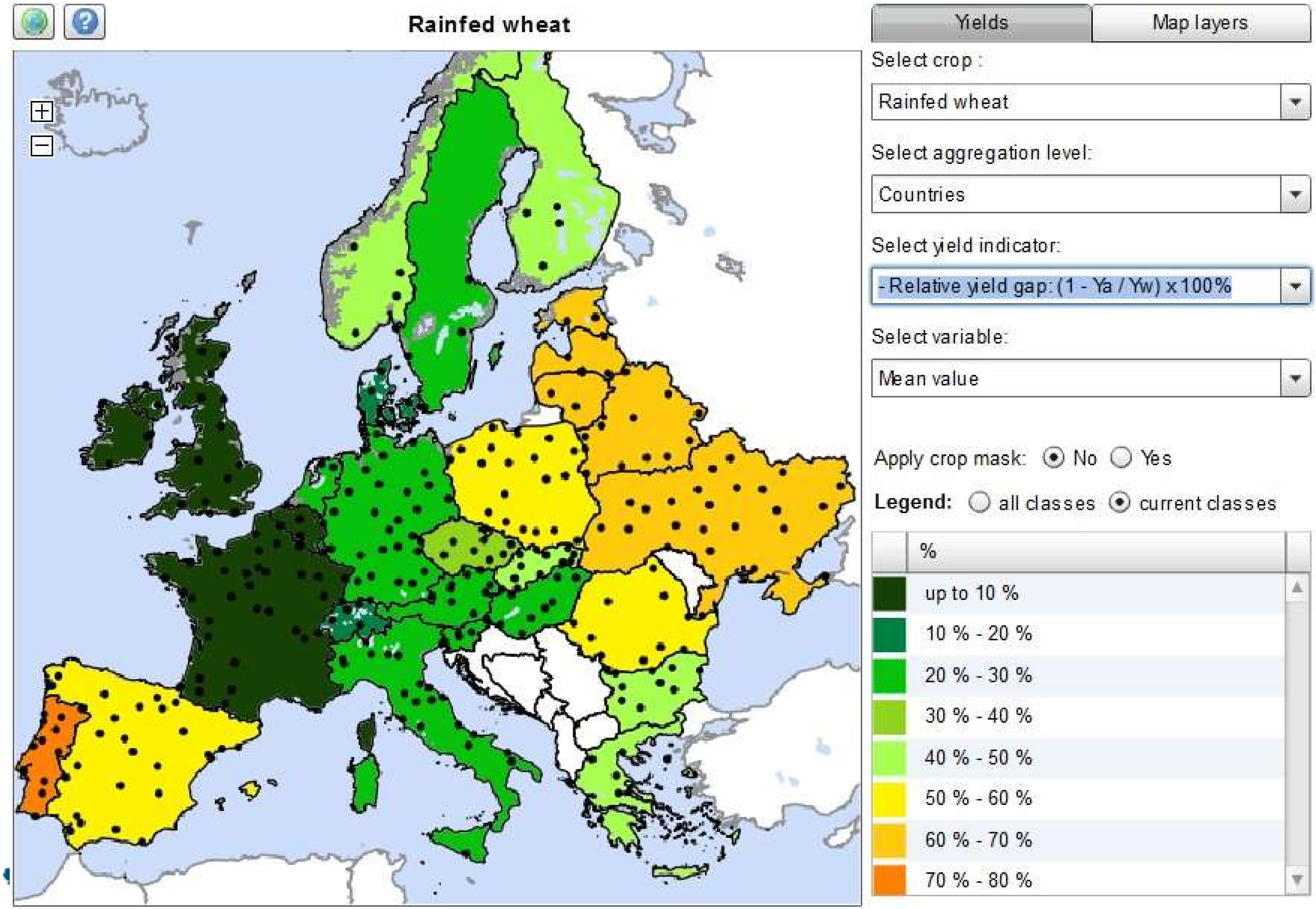
www.yieldgap.org

With University of Nebraska, ICRISAT, AfricaRice, and many regional and national partners

- Major food crops in the world
- Global protocol with local application
- Local data and evaluation
- Strong agronomic foundation
- Investment B&M Gates Foundation

Global Yield Gap Atlas

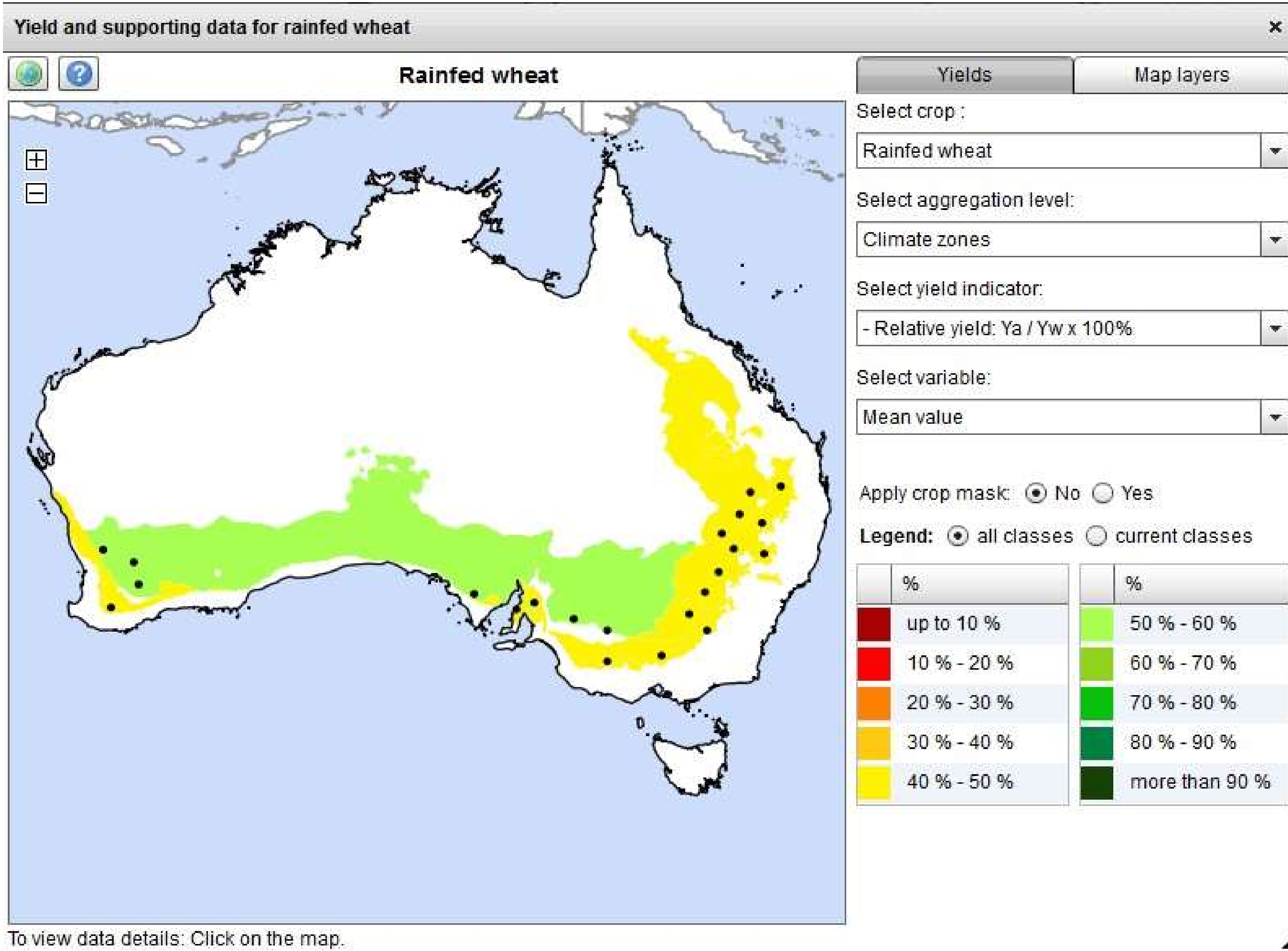
Rainfed wheat – yield gap (draft results!)



Other temperate countries in progress

- Argentina
- Australia
- Brazil
- Japan
- South Africa
- United States of America
- Uruguay

See: www.yieldgap.org



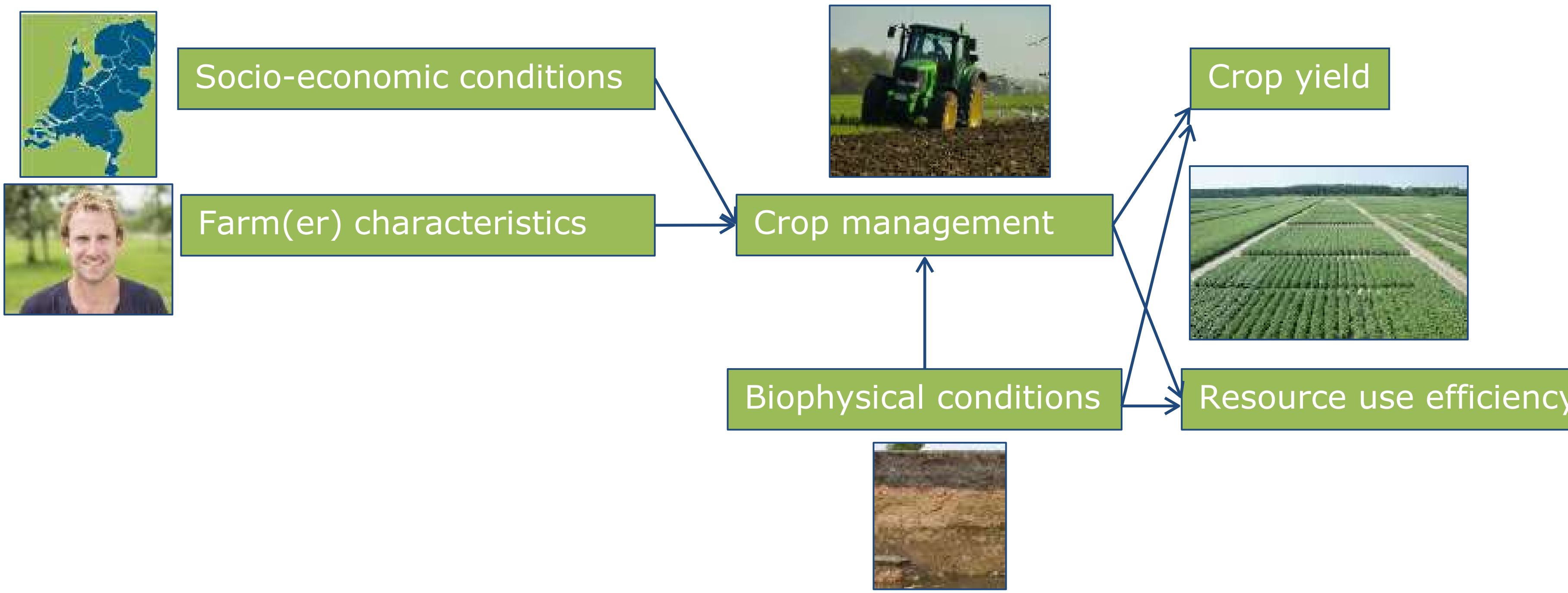
www.yieldgap.org

Task 2 – Initial explanation of yield gaps

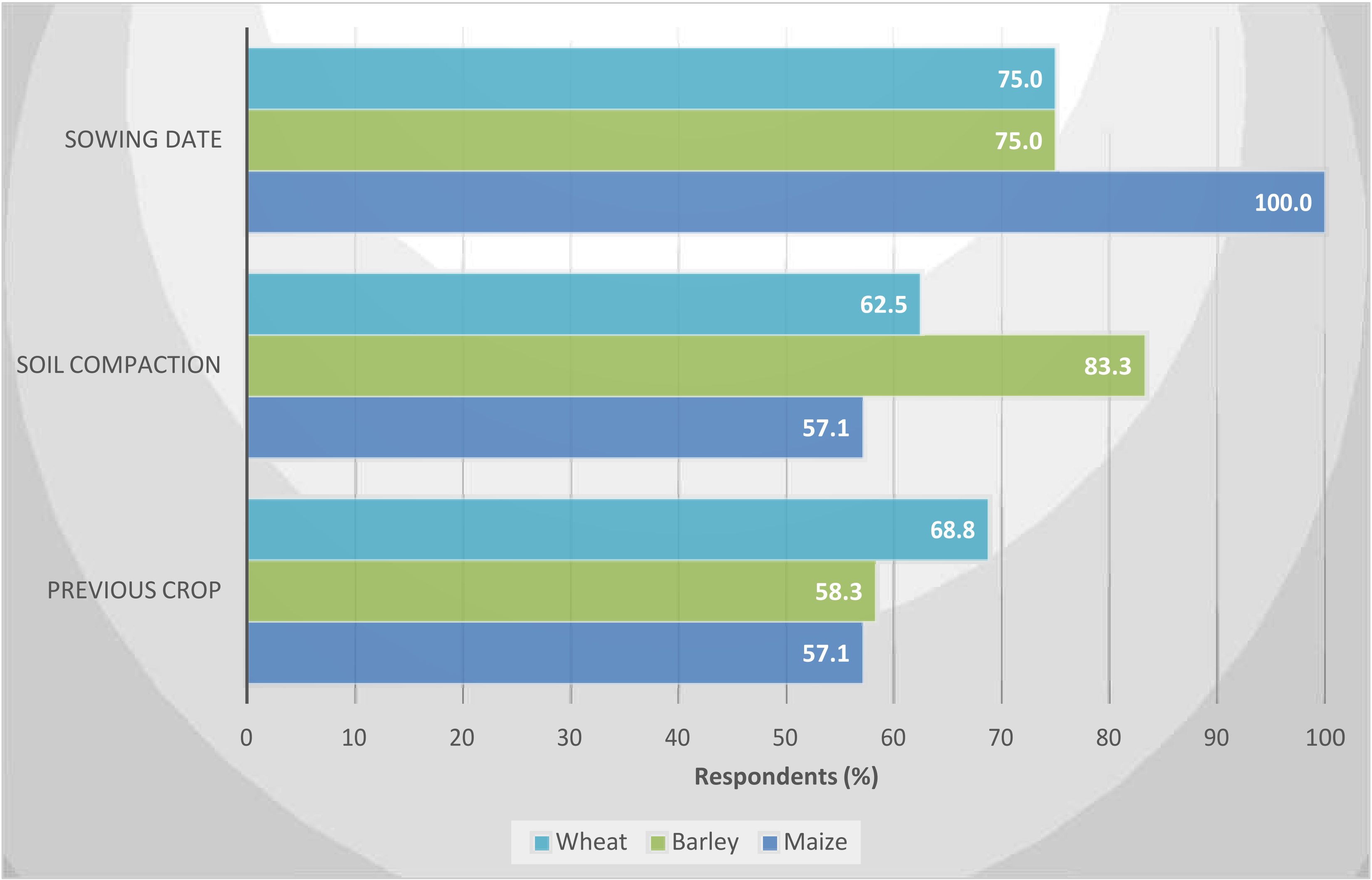
- A semi-quantitative survey was held between December 2015 and February 2016
- 17 surveys from 11 different countries were received for wheat,
- 13 from 10 different countries for barley,
- 8 from 8 different countries for maize

- Results were presented and discussed in workshop on March 14, 2016 in Berlin

Task 2 – Initial explanation of yield gaps



Task 2 – example result of survey

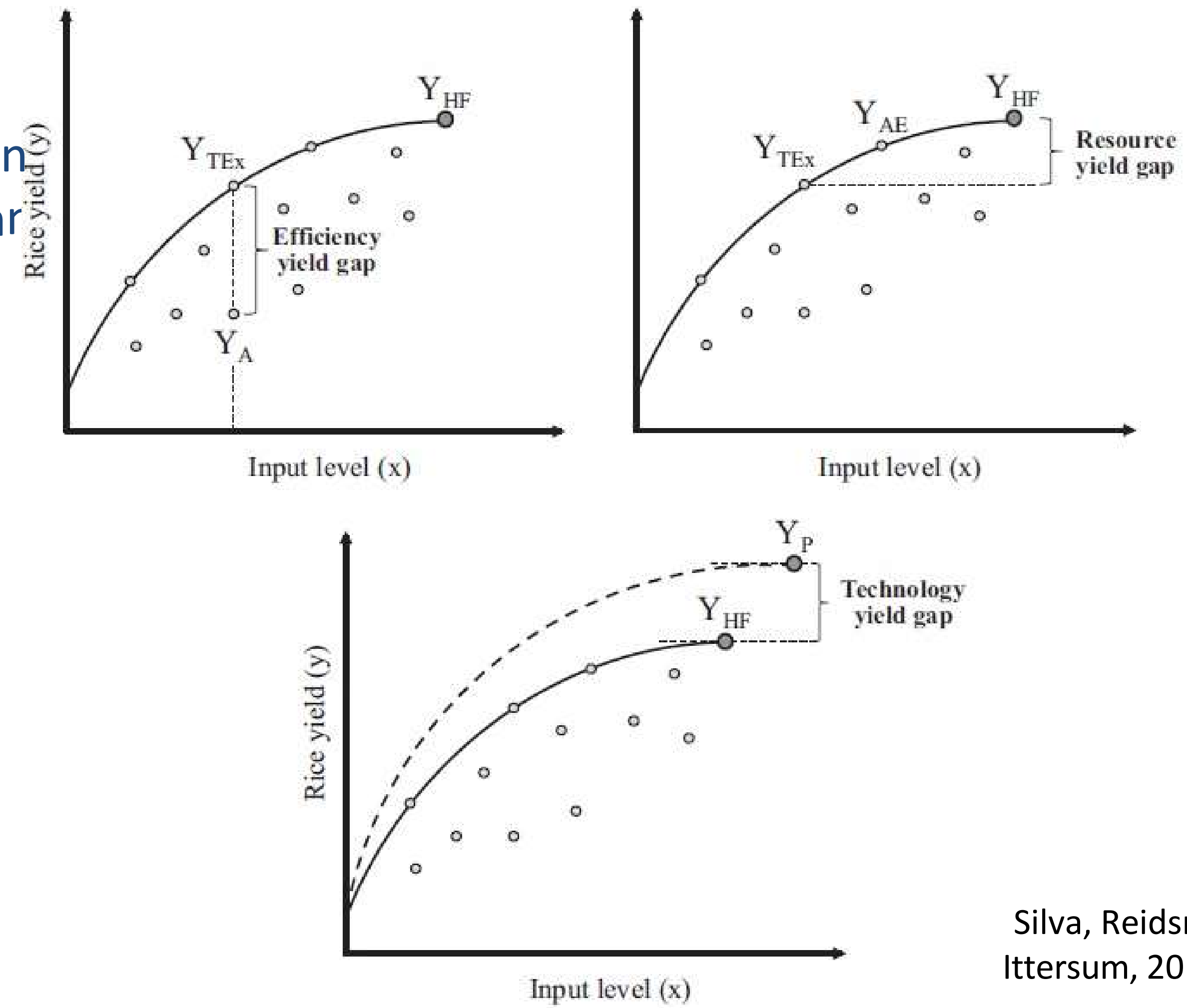


Task 2 – Next steps

- A more quantitative analysis of explaining yield gaps using (mostly) national data.
- Organizing a workshop with experts per country, following an agreed format to discuss survey results and come to a deeper understanding of yield gaps and data sources to allow a quantitative analysis.

Priority ideas next phase - I

1. Quan… and techr…



Silva, Reidsma, Laborte and Van Ittersum, 2016. Eur. J. Agronomy

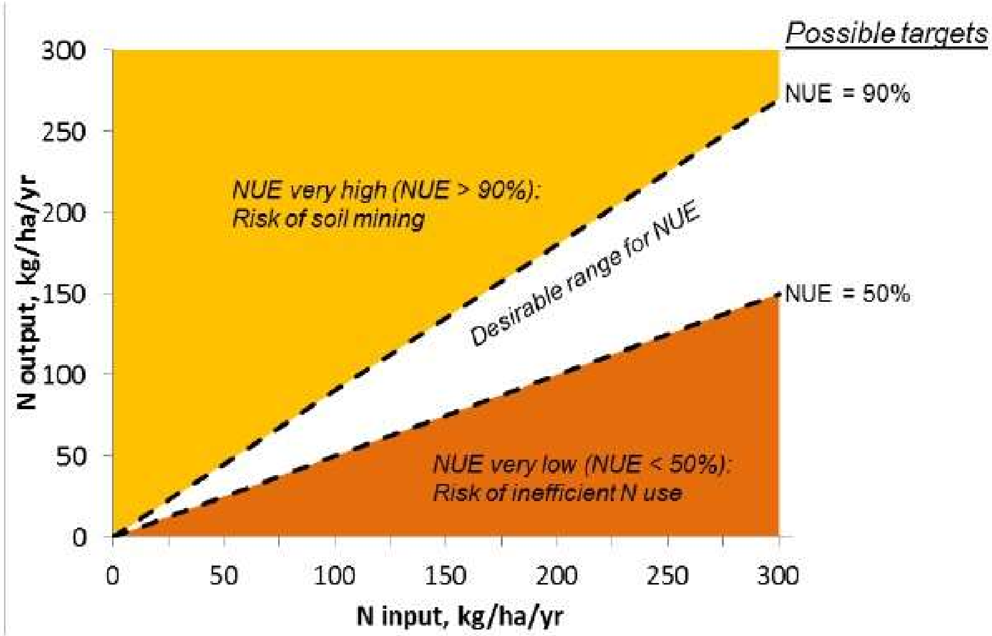
Priority ideas next phase - I

2. Trade-off analysis: production, resource use efficiency and environmental impact

- resources: in addition to land and water (see above): nitrogen, phosphorus, greenhouse gases, energy and perhaps biocides and labour
- is it possible to define ‘sustainable’ yield levels, with an acceptable compromise between yield, RUE and emission(s)?

Priority ideas next phase - I

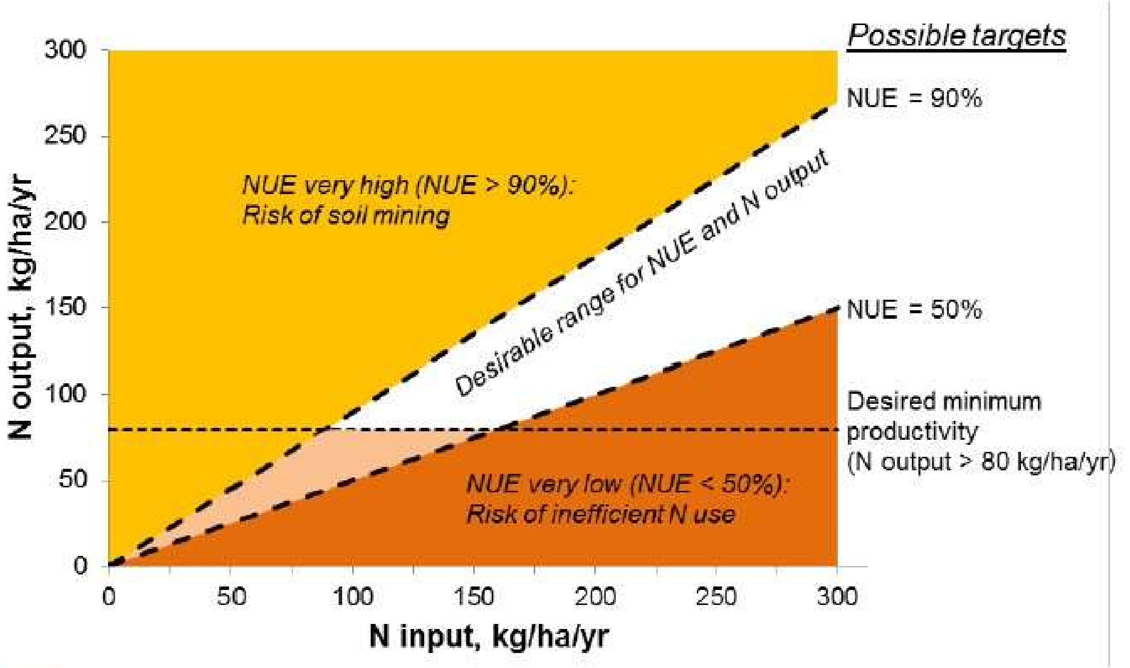
A graphical presentation, in three steps: (i) NUE



Oene Oenema, Wageningen Univ.

Priority ideas next phase - I

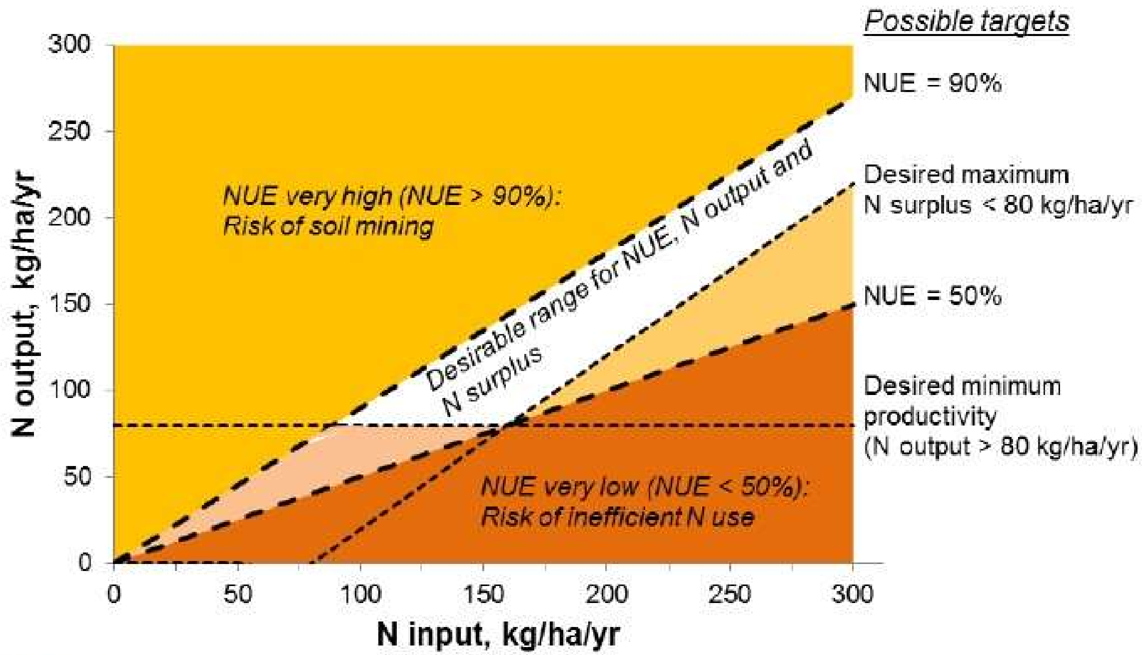
A graphical presentation, in three steps: (ii) N output



Oene Oenema, Wageningen Univ.

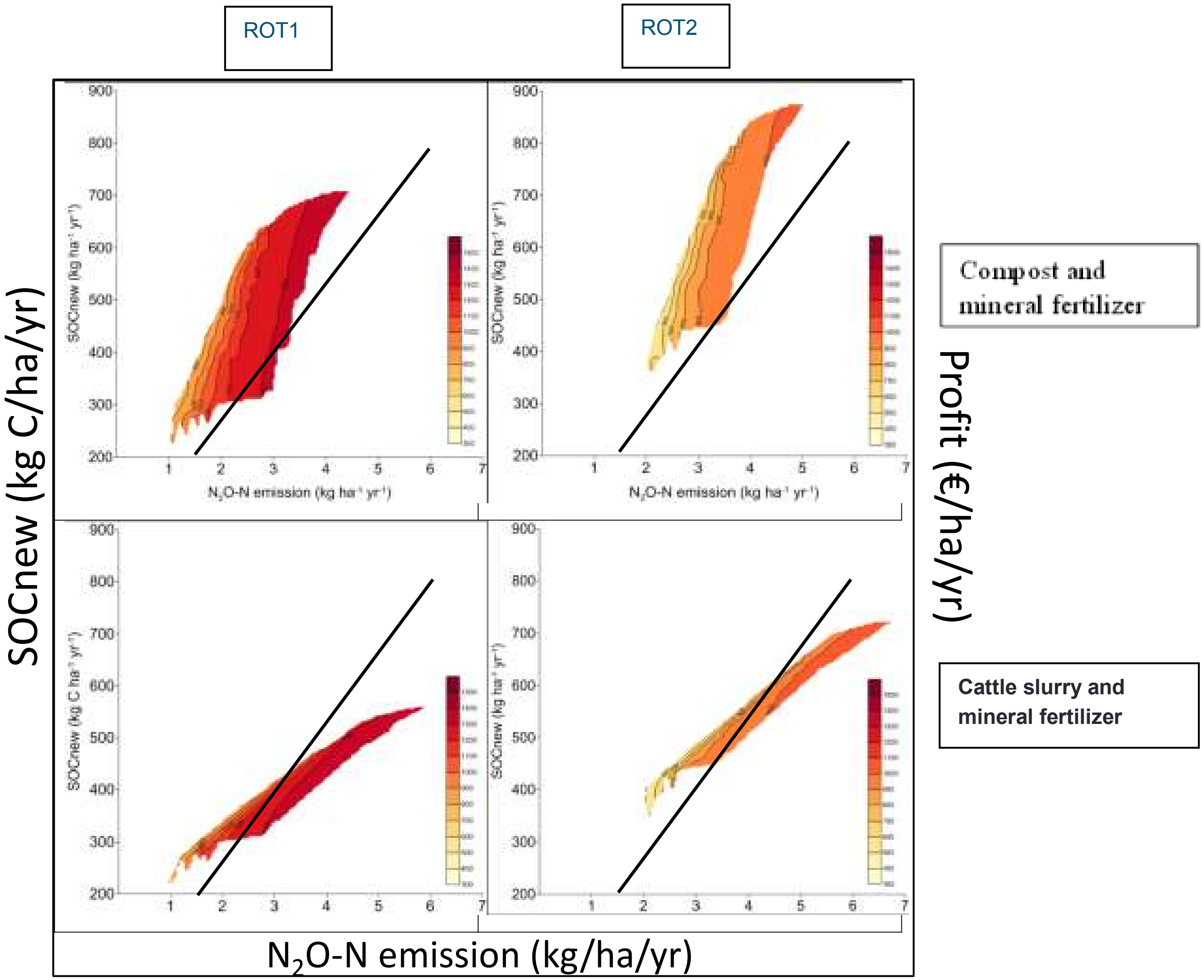
Priority ideas next phase - I

A graphical presentation, in three steps: (iii) N surplus



Oene Oenema,
Wageningen Univ.

Priority ideas next phase - I



Bos et al., accepted for Agricultural Systems

TempAg
SCIENCE FEEDING TEMPERATE AGRICULTURE

Thank you for your attention

Policy relevant research priorities to address sustainable agriculture in Finland

- TempAg Foresighting Workshop, London, 5-7 October 2016

Prof. Heikki Lehtonen, Luke / Economics and Society

Luke
NATURAL RESOURCES INSTITUTE FINLAND

Contents

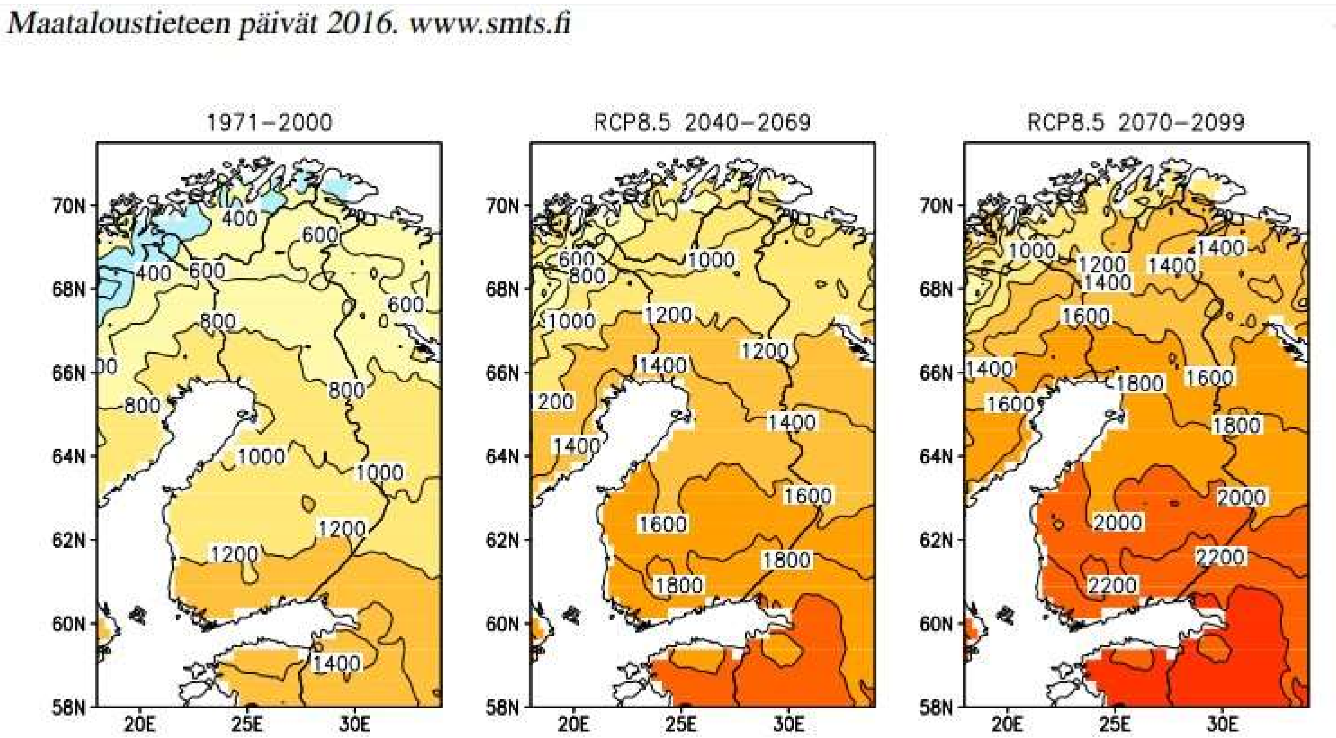
- Main challenges for agricultural sustainability in Finland
- Solutions for improved sustainability, suggested by research,
- The role of policies
- Conclusion: What kind of policies and research are needed?

Main sustainability challenges

- Economic and social challenges
  - Decreased and still decreasing (?) *real* prices of food and agricultural products
  - Rapid rate of input price inflation
  - Decreased profitability of agriculture
  - Larger farms, higher debts, low profit margins, high risks
- Challenging environmental targets!
  - water protection (”-30%”), greenhouse gases (”-39%”), biodiversity (”increase”)
- Climate / global change affects these challenges

=> analyse what is needed to cope with the climate and global change, and utilise opportunities

Climate change increases temperature sums (degree days) - causing problems and potential benefits



Projected climate change in Finland up to 2100, reference period 1971-2000

Source: Jylhä et al 2009, Ruosteenoja 2013

- Annual average temperature +2 - + 6 ° C
  - In winter +3-+9 ° C
  - **In summer +1-+5 ° C**
- Annual precipitation + 12 - + 22%
  - In winter +10 - +40%
  - **In summer + 0 - +20%**
- **Increased evapotranspiration during the growing period – increasing risk of water deficit, threat of worsening early summer drought**
- Growing season length +30–45 days until 2100
  - **Middle Finland 1100 -> 1600 degree days**;
  - Southern Finland 1300 -> 1900;
  - Northern Finland 900 -> 1200 degree days
- Increasing frequency:
  - rainy days, heavy rainfalls, dry spells
- **Decreased length of thermal winter => Higher risk of N, P leaching**
- **Reduced snow cover and permafrost**

Some climate and management related sustainability problems

- Spatio-temporal variability of crop yields (among field plots, years, etc.)
- Feed quality losses
- Winter time crop damages
- Soil compaction, wet conditions
- Increasing nutrient (N,P) leaching
- Plant pests becoming more frequent
- VOLATILE MARKET PRICES

Some climate related problems in North Savo region:

Ice encasement, due to warmer winters (hypoxia, frost). Photo: P. Virkajärvi (top),

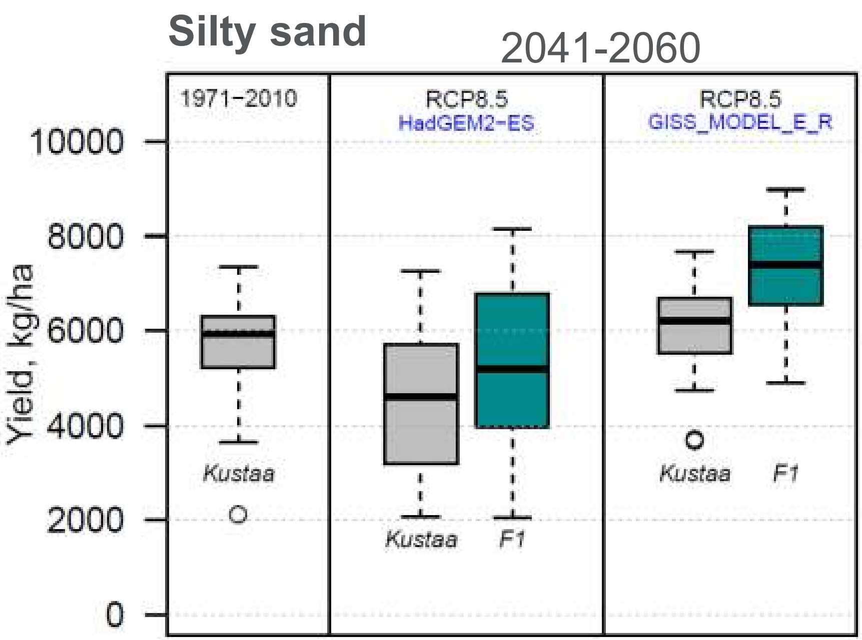
Problems due to soil compaction. Photo: H. Mäkipää (middle),

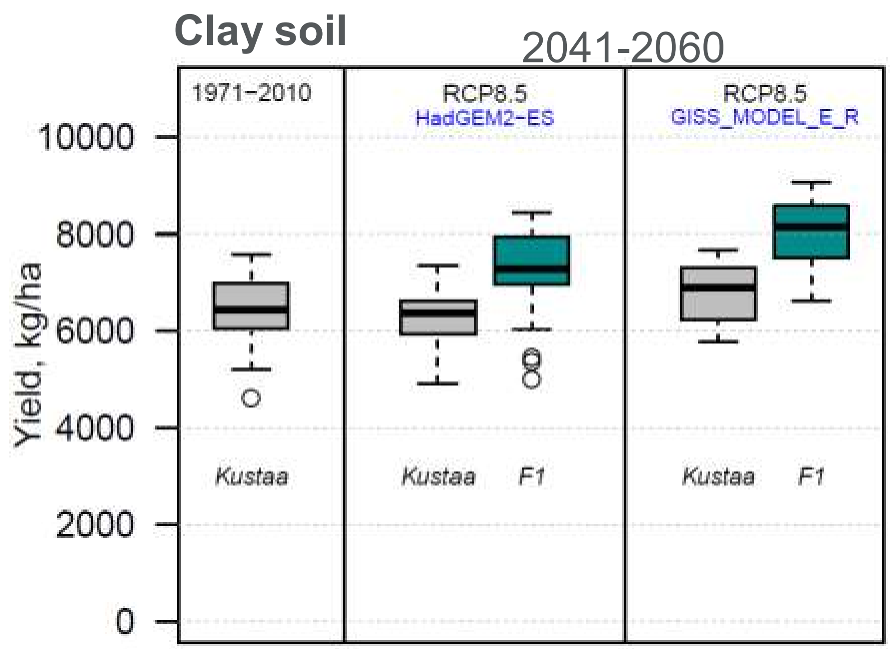
Compacted soil, heavy axle loads. Photo: A. Mustonen (bottom, right);
Winter related damages (left, bottom. Photo P. Virkajärvi);
Effects of summer drought (bottom, middle. Photo E. Juutinen)

Future rainfed potential yields of barley in North Savo region, Finland

Water-limited yields simulated with crop model WOFOST using different emission scenario (RCP8.5) / climate model combinations for Kuopio (10 x 10 km grid)

- Current cultivar, ”Kustaa”
- Possible future cultivar, ”F1” (only thermal requirement changed)

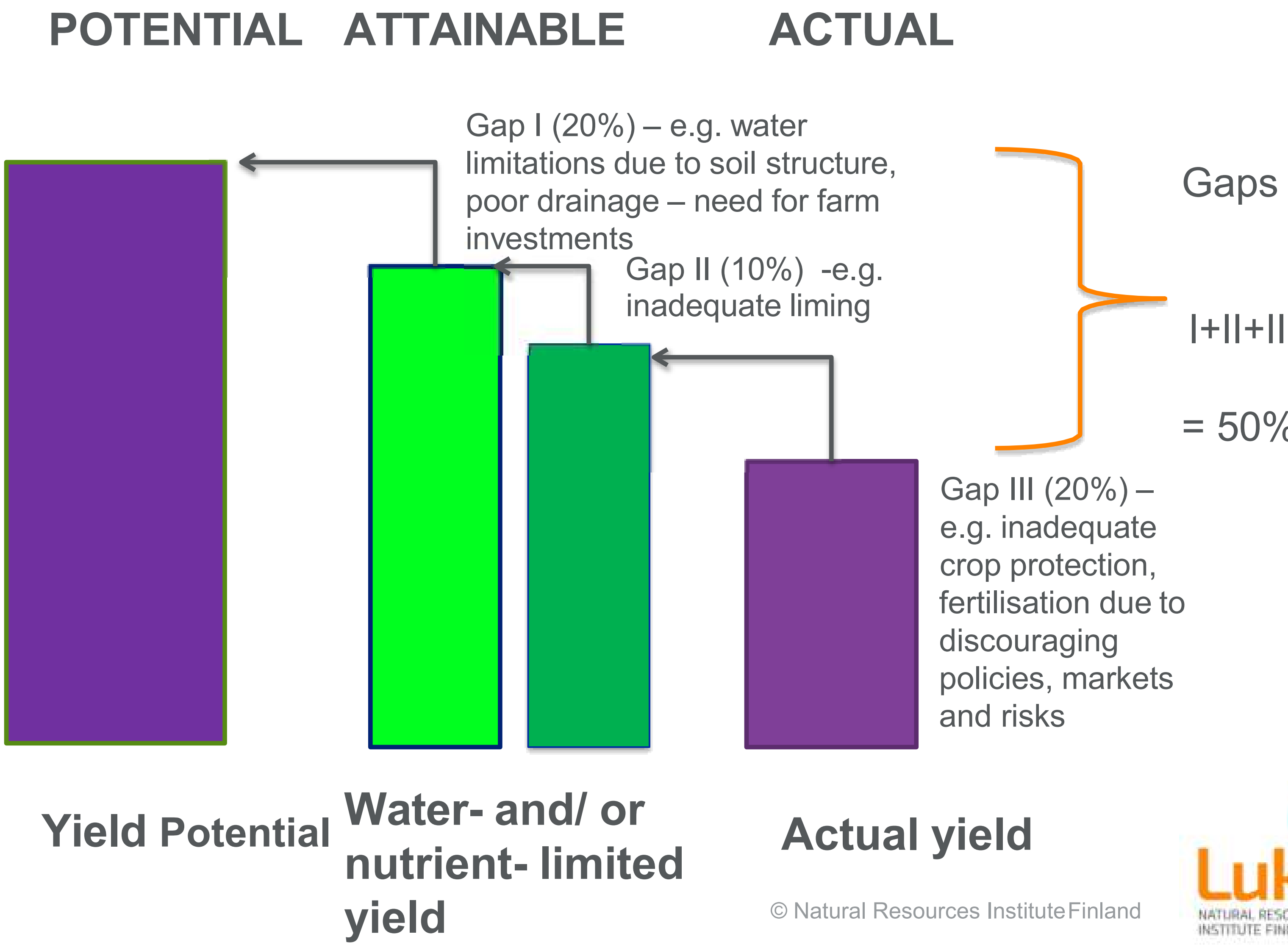




Rötter, R.P., Höhn, J., Trnka, M., Fronzek, S., Carter, T.R. and Kahiluoto, H., 2013. Modelling shifts in agroclimate and crop cultivar response under climate change. Ecology and Evolution, Vol 3, 12: 4197–4214. DOI: 10.1002/ece3.782

Luke NATURAL RESOURCES INSTITUTE FINLAND

Yield gaps and their drivers



Research: Adaptation solutions, grass

- 2 => 3 Three cuts of silage grass per year
  - Earlier cuts
- New grassland species and cultivars
  - More resistant to heat stress and drought
  - Better nutritive value
  - Sufficient winter hardiness
- Adjusted fertilisation levels
  - Proper timing, according to developmental phases
  - According to yield potential of different crops and cultivars
- Prevention of soil compaction
  - Sufficient drainage, improved soil structure and water retention
  - Development of machinery/use of machinery, lower axle loads

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Research: Adaptation solutions, cereals

- **Use cereals cultivars requiring longer growing season**
  - Decrease vulnerability to (early summer) drought
  - More tolerant of heat stress
- **Earlier sowing times**
- **Improved / changed crop protection needed**
  - Currently no/little fungicide use => can be increased
  - More diverse crop rotations may relieve disease pressure
    - higher yielding oilseed /clover crops and cultivars => more protein production?
- **Adjusted fertilisation levels and timing/split applications**
  - Timely split applications according to development phases
  - According to yield potential of different crops and cultivars
- **Improved soil structure, soil pH, drainage**

  => resilience, extra costs…

Already realised adaptations - expressed by farmers of the North Savo region

- From 2 cuts to 3 cuts in silage harvesting (all cuts fertilised)
- Clover-grass mixes
  - Improved feed quality, nitrogen fixation, longer harvesting period
  - Downside: higher water content, high Ca-content (not suitable for non-lactating cows), increasing costs for manure spreading
- New cultivars – cereals, grass, oilseeds
- Different kinds of grass seed mixtures used on different field parcels
  - Robustness to weather conditions and reduced timeliness costs
- Additional seed given for rotational grasslands already at the 2nd year – found to be profitable despite higher costs
- Investments in drainage: (controlled) sub-surface drainage
- Cooperation between farms to optimise harvesting time and use of machinery; investments in machinery with reduced axle weights

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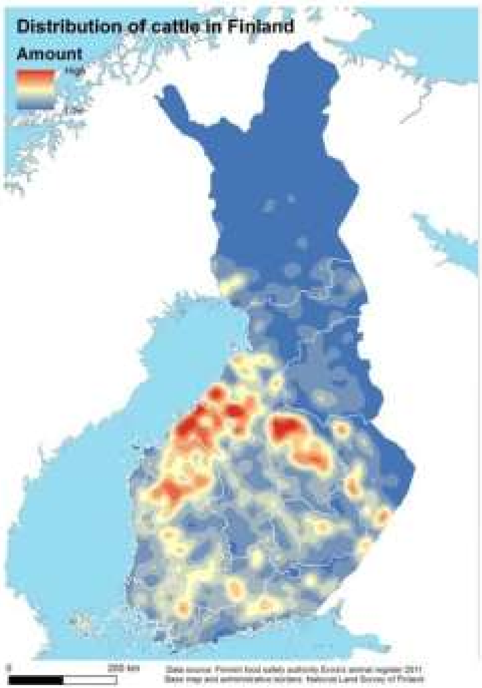
Stakeholder workshops (2014-2015) revealed disappointments to current policies

”Policy schemes favor part-time farms, but are difficult /impossible for full-time, expanding farms”; ”It is easier to adapt to climate change than to EU and national policy changes”

- “Some policy schemes discourage productivity growth, re-organisation and structural change”
- “Overall effect of many individual retarding policy effects accumulate, making ambitious farmers frustrated”

Distribution of cattle in Finland



Fewer and larger dairy farms (aver 35 cows/farm) need land; Frictions on land market => high land prices => intensive production, higher yields demanded

Questions: How to improve functioning of land markets? – too short rental contracts, low commitments for land maintenance

How to improve ”land availability” for agricultural activities producing most value added in the region? …while simultaneously decreasing GHG emissions ?

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How do agricultural and agri-environmental policies affect the adaptations?

- CAP pillar 1 is largely production neutral, but results in high land rents, weak land supply
  - Increased costs of rented land + logistics costs due to distant field parcels

- CAP pillar 2: LFA and agri-environmental (A-E) schemes
  - LFA payments encourage extensive production, increase land rents
  - A-E includes restrictions for N and P fertiliser + offers risk free subsidy payments => Most farms commit to A-E, do not aim for high yields (risk aversion)
  - A-E includes biodiversity and water protection measures, popular among part-time crop farms, provide additional subsidy revenues => weak land supply, high land rents
  - A-E is poorly suited for a farm which aims for higher yields through higher fertiliser and/or crop protection inputs, or has high livestock density

What is the overall feasibility of agricultural policies for sustainability, adaptation to climate change?

- Policy distorts land use and market driven incentives for higher yields
  - Risk-free subsidies and volatile market prices lead to cost minimisation, extensive land use – not to efficient use of nutrients
- Farm structure development partly promoted and inhibited by the policy system: frequent changes, uncertainty, high land prices, high financial risks

- BUT Still some farmers say the policy system is ok!
  - ”Policy rules are difficult only if they change frequently”
  - ”Do not policies distract from long-term farm development!”
  - Subsidy payments stabilise farm income
- ”If you really want to increase crop yields and overall productivity, do not commit to A-E scheme!”
  - Investment aids aiming for structural change are not coherent with env. objectives; farms with high livestock density dependent on rented land

Conclusion: Need for more ambitious policy and research!

- Synergy between **structural aids** and A-E scheme
  - Promote / require drainage and soil improvements, reduced soil compaction, promote risky long-term investments with societal benefits
- Revision of **AE schemes**, to realise opportunities
  - Advanced, intensive, large scale farmers could produce env. benefits
    - e.g. farm level nutrient balances (kg/ha) vs fertilisation limits
- More flexibility of policy implementation, to account for (e.g. bio-physical) regional characteristics, to properly address the challenging policy targets

- **Key research(policy) ssues**:
- Soil & water (drainage, irrigation, nutrient leaching, water quality, economy)
  - http://macsur.eu/images/eventlist/events/Policymakers2016/2_Lehtonen.pdf
- Nitrogen use efficiency (cultivars, yield gaps, management),
- Livestock/manure (scale, orientation, processing, utility, food demand)
- **Major re-organisation** of food and agriculture production: economy, risks (financial, environmental), **land use** - integrate evolution and revolution
- Strong links: water protection, GHG mitigation, adaptation to climate change

Some papers on cross cutting policy and research topics in food and agriculture

- Lehtonen, H. & Niskanen, O. 2016. Promoting clover-grass: Implications for agricultural land use in Finland. *Land Use Policy* (2016), pp. 310-319. DOI:10.1016/j.landusepol.2016.09.005
- Lehtonen, H. & Rankinen, K. 2015. Impacts of agri-environmental policy on land use and nitrogen leaching in Finland. *Environmental Science and Policy*, Volume 50, June 2015, p. 130–144. doi:10.1016/j.envsci.2015.02.001
- Lehtonen, H. & Irz, X. 2013. Impacts of reducing red meat consumption on agricultural production in Finland. *Agricultural and Food Science* 22:356-370. http://ojs.tsv.fi/index.php/AFS/article/view/8007/6412
- Peltonen-Sainio, P., Salo, T., Jauhiainen, L., Lehtonen, H. & Sieviläinen, E. 2015. Static yields and quality issues: Is the agrienvironment program the primary driver? *AMBIO*. ISSN 0044-7447. DOI 10.1007/s13280-015-0637-9
- Huttunen I., Lehtonen H., Huttunen M., Piirainen V., Korppoo M., Veijalainen N., Viitasalo M. & Vehviläinen B. 2015. Effects of climate change and agricultural adaptation on nutrient loading from Finnish catchments to the Baltic Sea. *Science of the Total Environment* 529:168-181. doi: 10.1016/j.scitotenv.2015.05.055.
- Kässi, P., Känkänen H., Niskanen O., Lehtonen H. & Höglind, M. 2015. Farm level approach to manage grass yield variation under climate change in Finland and north-western Russia. *Biosystems Engineering* 140: 11-22. doi: 10.1016/j.biosystemseng.2015.08.006.
- Regina, K., Budiman, A., Greve, M.G., Grønlund, A., Kasimir, Å, Lehtonen, H., Petersen, S.O., Smith, P. & Wösten, H. 2015. GHG mitigation of agricultural peatlands requires coherent policies, *Climate Policy*, DOI: 10.1080/14693062.2015.1022854
- Palosuo, T., Rötter, R.P., Salo, T., Peltonen-Sainio, P., Tao, F. & Lehtonen, H. 2015. Effects of climate and historical adaptation measures on barley yield trends in Finland. *Climate Research* 65: 221–236.doi: 10.3354/cr01317
- Rötter, R.P., Höhn, J., Trnka, M., Fronzek, S., Carter, T.R. and Kahiluoto, H., 2013. Modelling shifts in agroclimate and crop cultivar response under climate change. *Ecology and Evolution*, Vol 3, 12: 4197–4214. DOI: 10.1002/ece3.782
- Rötter, R.P., Höhn, J.G. & Fronzek, S. 2012. Projections of climate change impacts on crop production: A global and a Nordic perspective. *Acta Agriculturae Scandinavica, Section A–Animal Science* 62 (4), 166-180

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Thank you!

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http://macsur.eu/
http://macsur.eu/index.php/regional/regional-case-studies/northern-savo
http://macsur.eu/images/eventlist/events/Policymakers2016/2_Lehtonen.pdf

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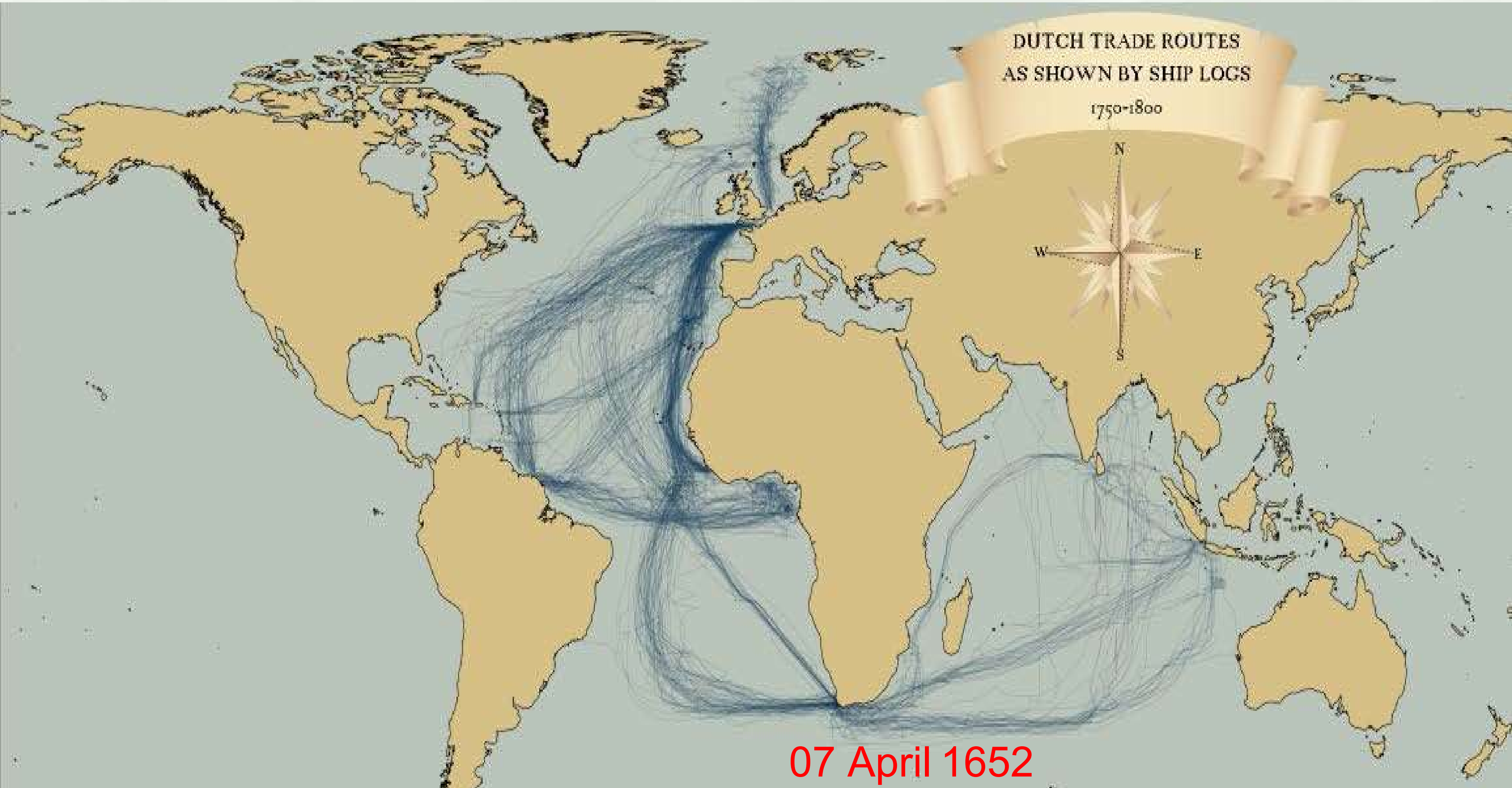
South Africa:

Issues of Agricultural Sustainability & Related Research/Development Priorities

B Ndimba, A Obi & P Mashela

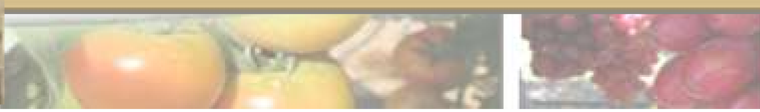
Excellence in Research and Development



07 April 1652

Dutch East India Co.

J v Riebeek Cape 'Commander'



The Agricultural Research Council (ARC) of South Africa

Established through the Agricultural Research Act (Act no. 86 of 1990). ARC's defined purpose is to: **promote sustainability and equitable economic participation in the agricultural sector; promote agriculture development and growth** in related industries; facilitate sector skills development and knowledge management; facilitate and **ensure natural conservation; promote national food security; and contribute to better quality of life**.

The ARC therefore has the role of generating, developing and transferring knowledge, solutions and technologies that will enhance the protection, food safety, quality, productivity and efficiencies of the agricultural sector. The key focus of research is within the crops and livestock sectors. This includes the conservation and utilisation of natural resources that are within ARC responsibility as custodian of national assets.

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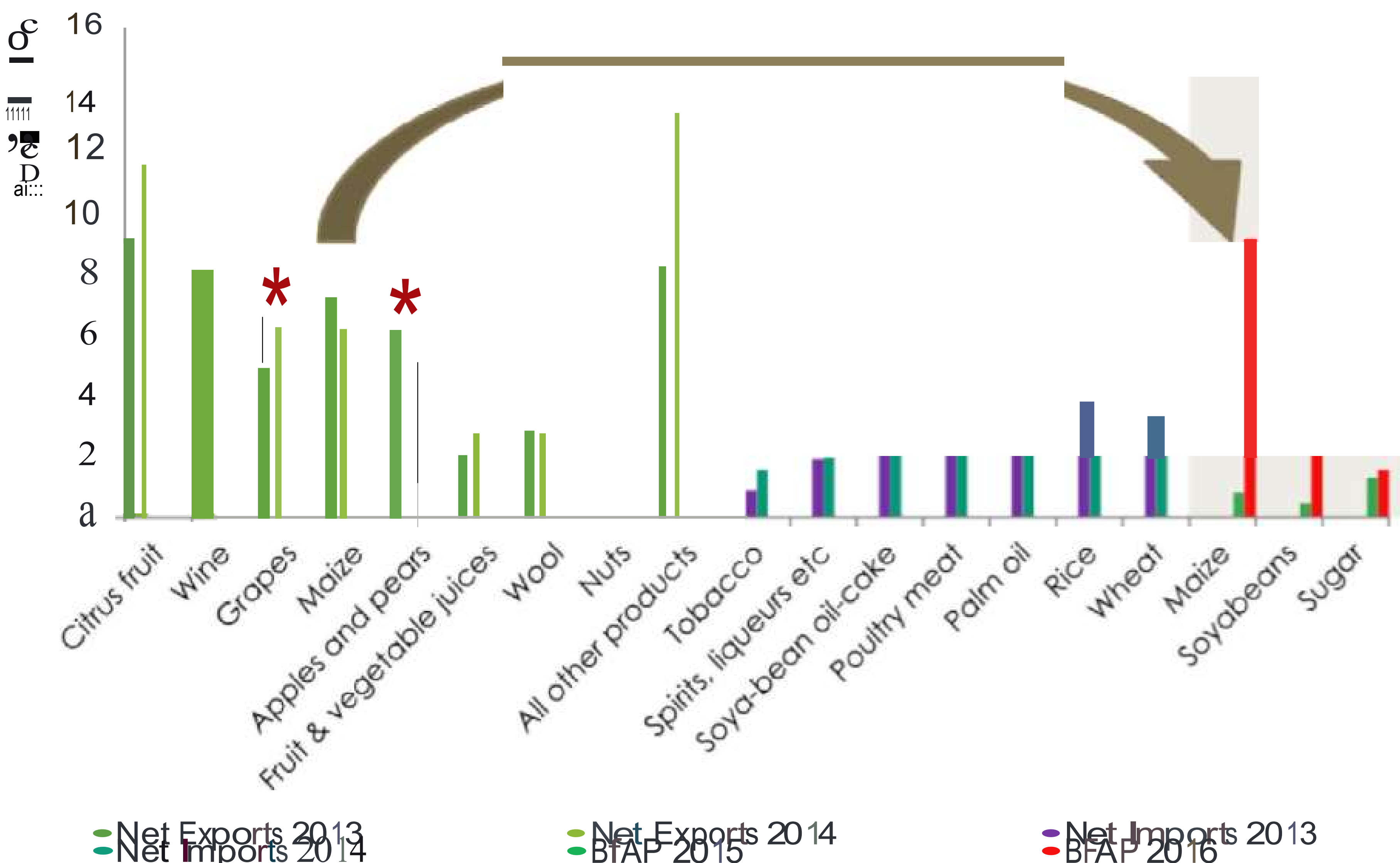
Excellence in Research and Development

Agricultural Crop Commodities

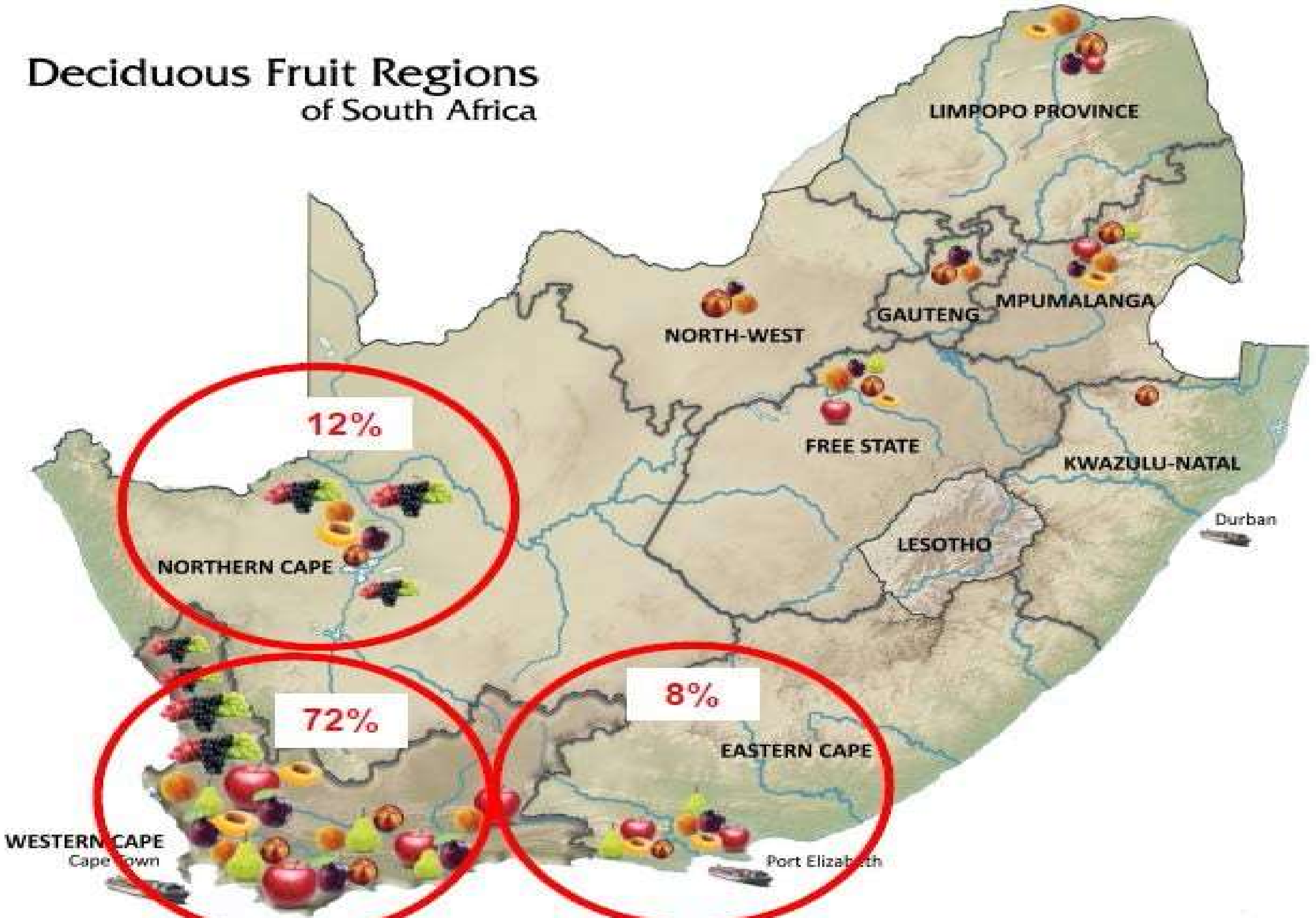
- **FRUITS**
- **VEGETABLES**
- **MEDICINAL PLANTS**
- **INDIGENOUS FLOWERS**
- **INDIGENOUS FRUIT AND VEGETABLES**
- **ALTERNATIVE FRUIT, VEGETABLES AND TEA PLANTS**
- **etc.**

Crop Commodities (worth Billions of Euros to GDP)



*Apples, Pears and Grapes worth more than R12 Billion in export forex income

– One of many examples…



HORTICULTURE SECTOR (DAFF analysis/priorities)

South African Agricultural Reality

Large-Scale Commercial Farmers



Resource Poor Farmers



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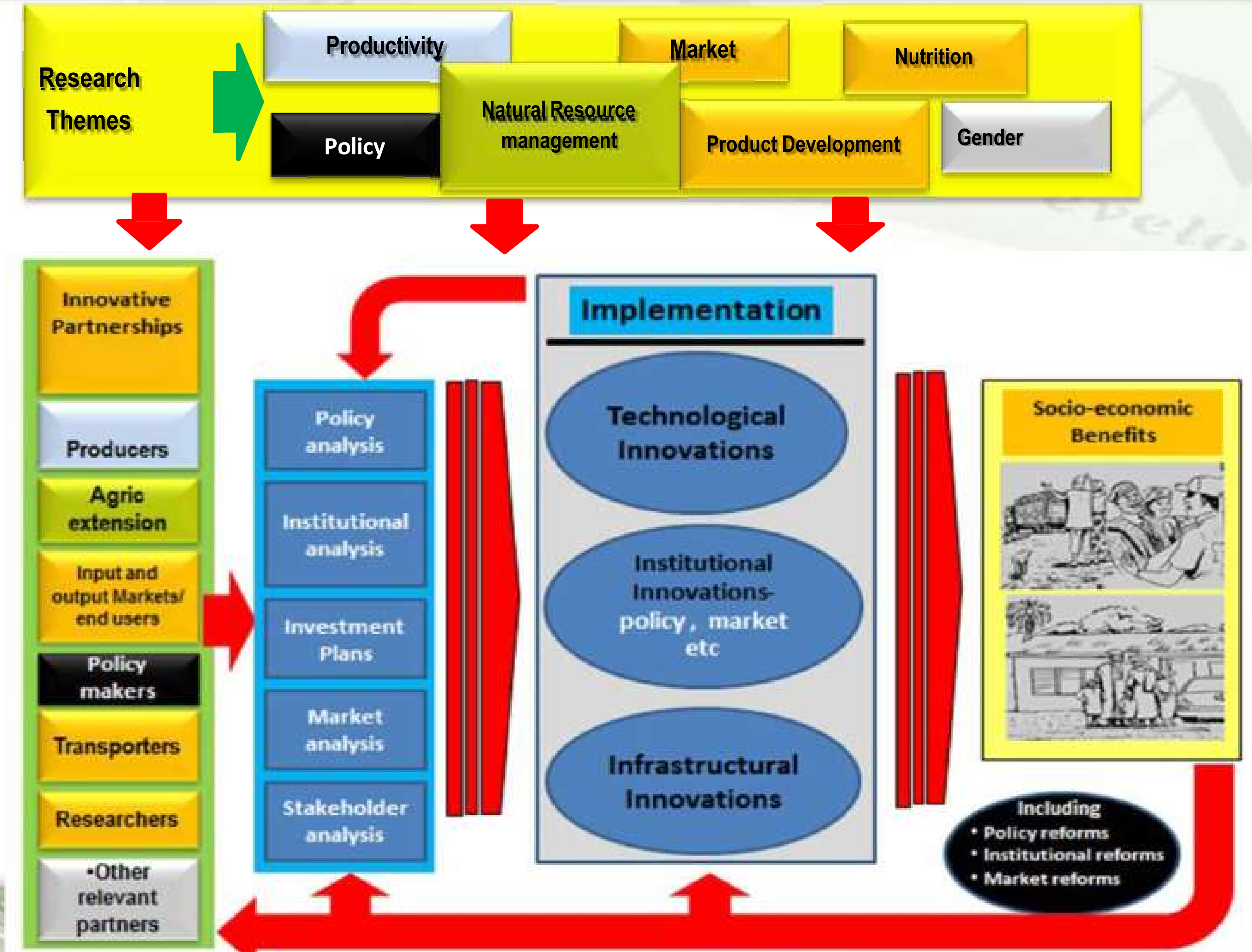
Framework for ensuring socio-economic benefits from smallholder systems



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AGRICULTURAL RESEARCH COUNCIL

ARC VISION 2050

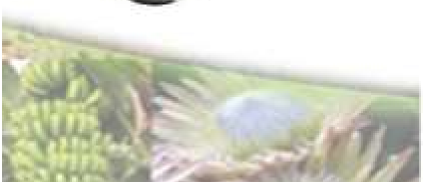

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Figure 26: ARC Vision 2050 aligned to development goals and strategies

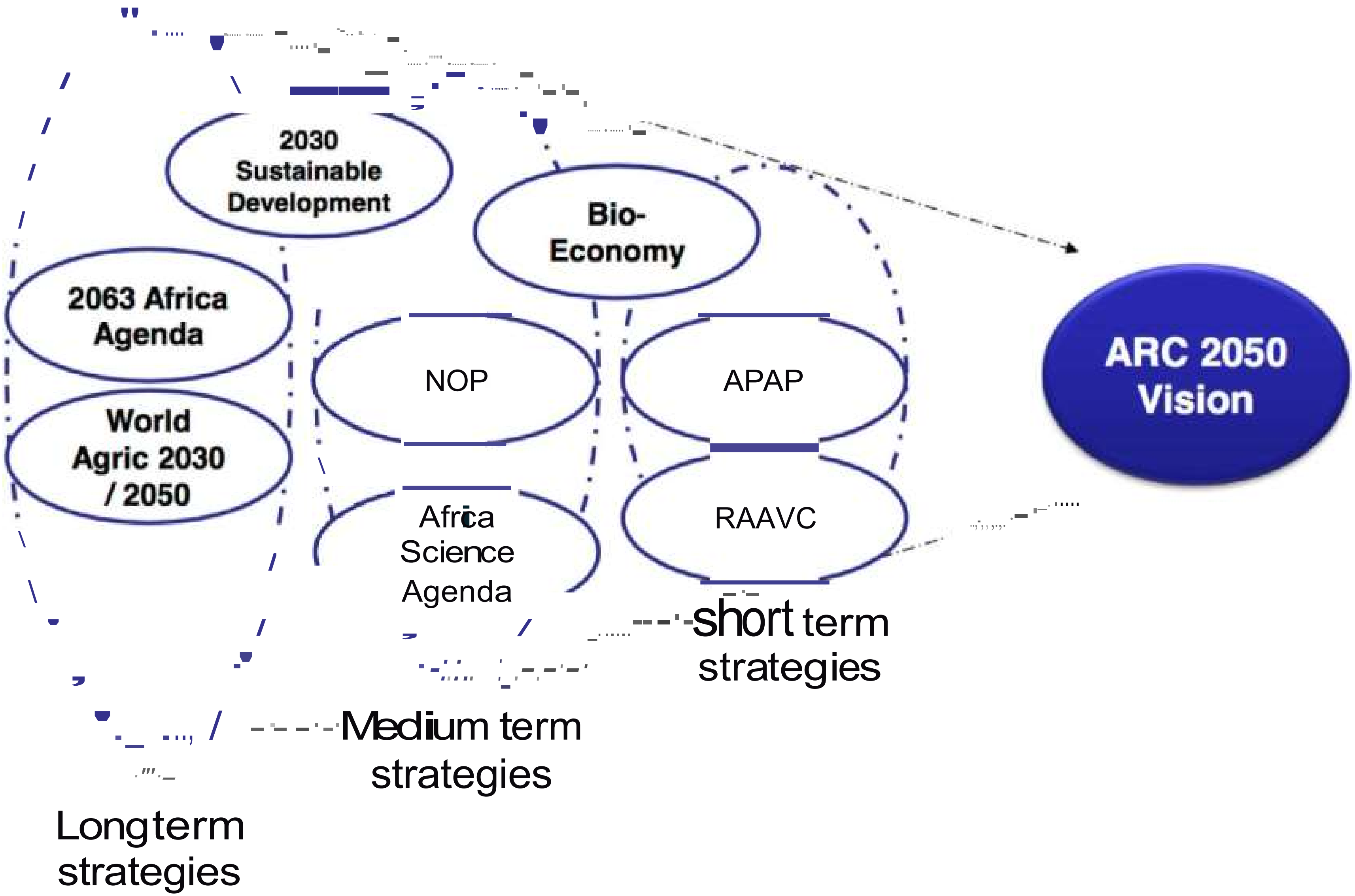
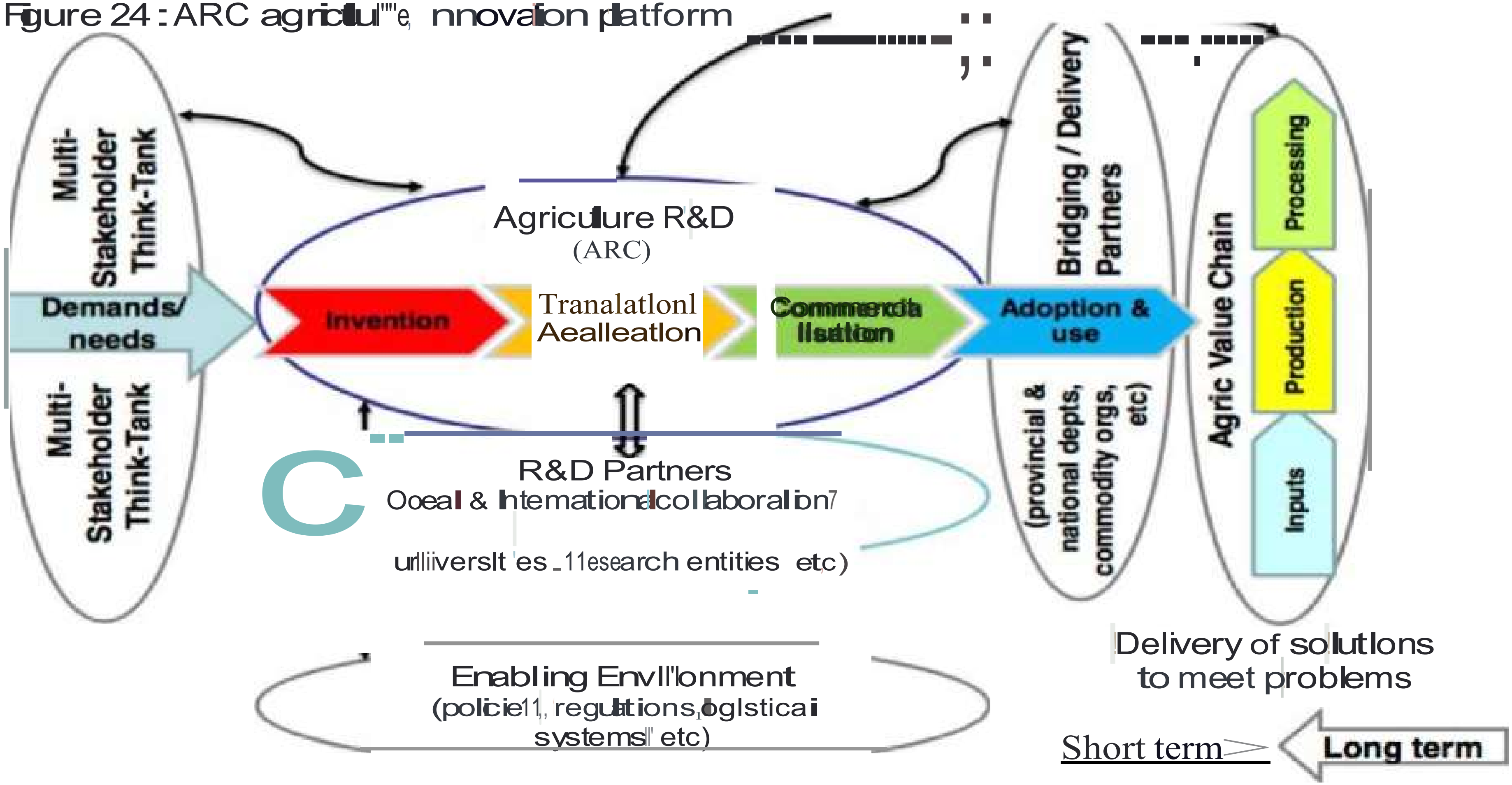
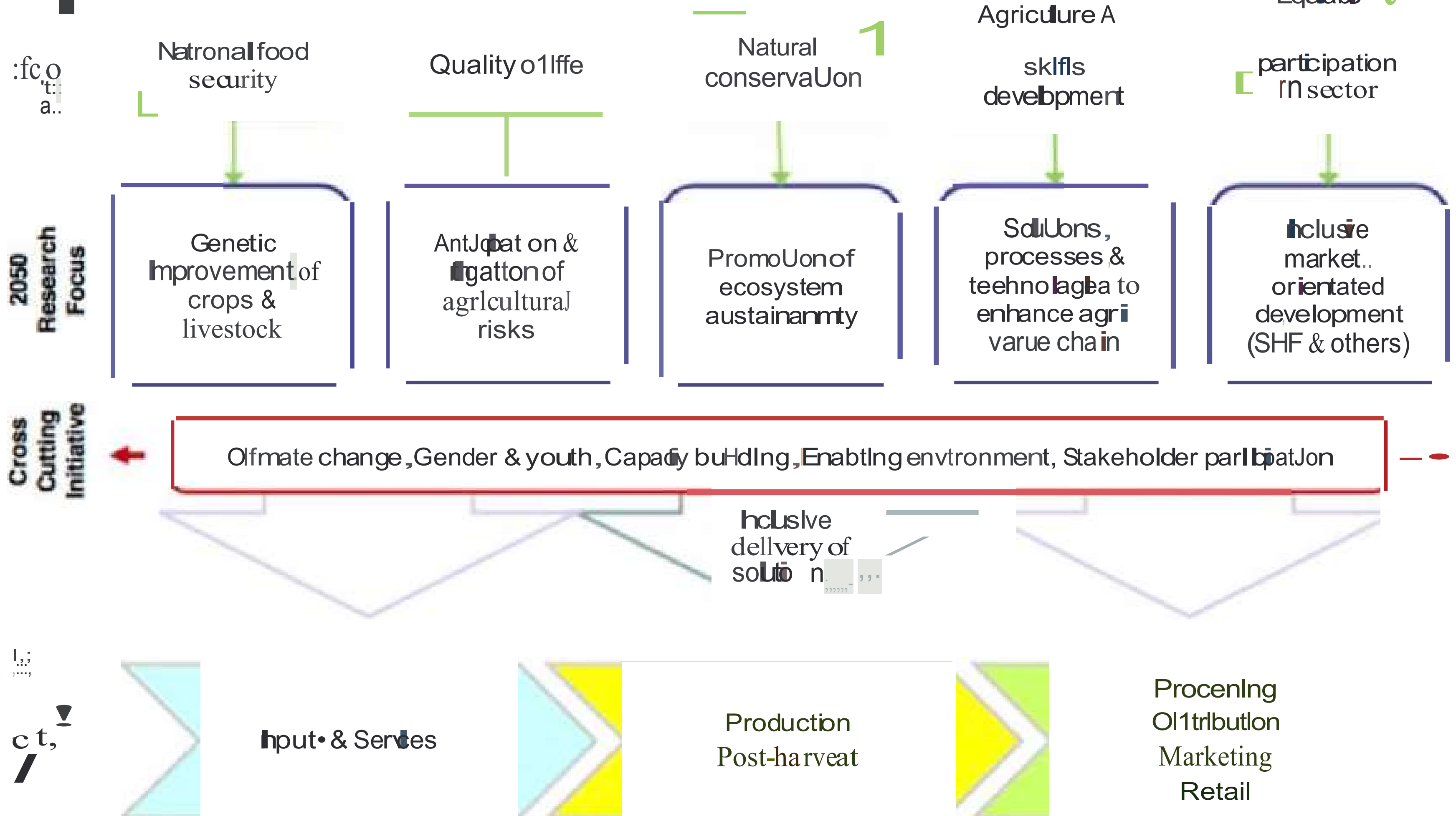


Figure 24 : ARC agricultural innovation platform



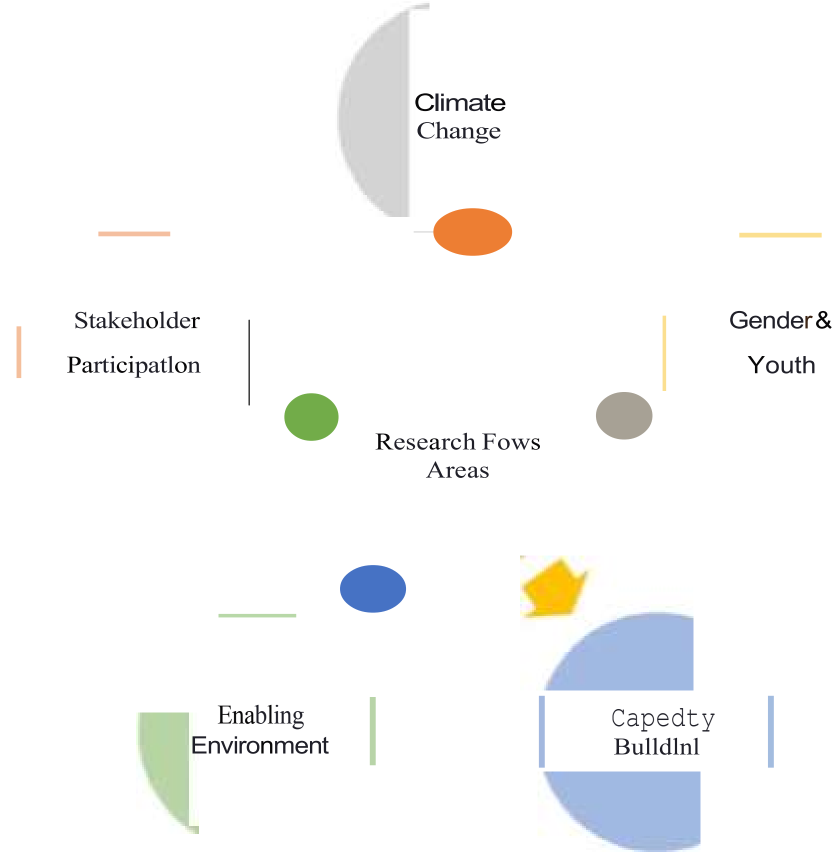
The above diagram starts on the left with the participation of the entire agriculture innovation platform players together setting the prioritised long and short term needs of the sector at a commodity level. This is then used to determine the research direction of the sector and in particular those of ARC.

Figure 17 : ARC research focus for 2050



A commodity based view on developing solutions aclioss the researoh focus areas to meet sectorial specific challenges is being developed.

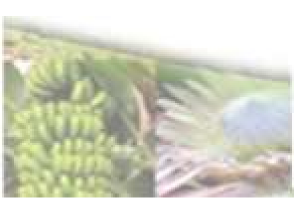
Figure 23: Cross cutting initiatives

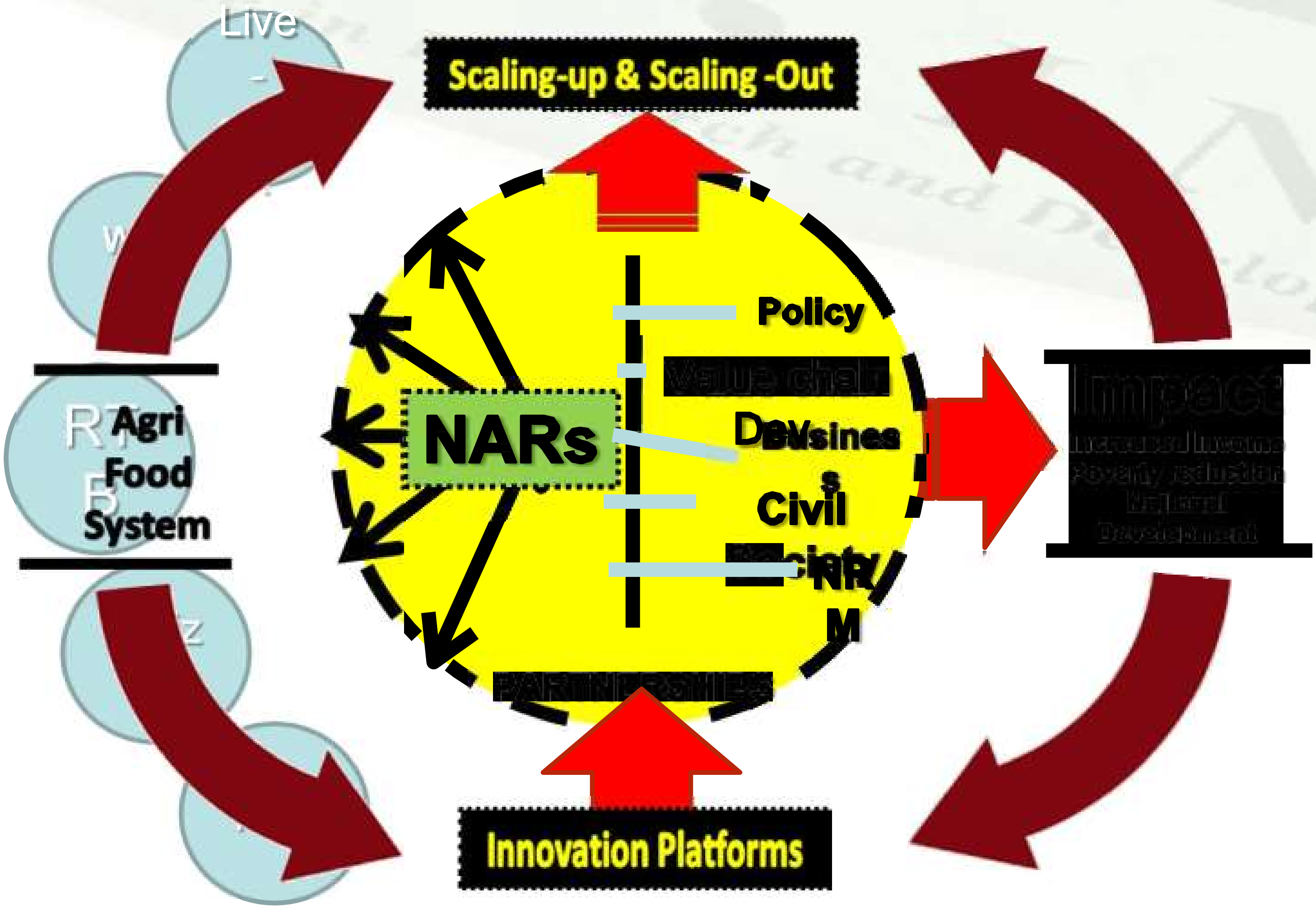


Mitigating and adapting to climate change risks, and effects.

All research and solution development activities need to consider what can be done to mitigate climate change. This could include providing solutions that are:

i. Resilient to climate shocks.
ii. Adaptable to new growing conditions.
iii. Reducing or mitigating the causes and effects of climate change.
iv. Reducing greenhouse gases through storage in biomass, healthy soils, reduced emissions, etc.
v. Neutral or positive net contributors to climate change.




Scaling-up & Scaling -Out
Policy
NARs
Agri
Food
System
Civil
Innovation Platforms

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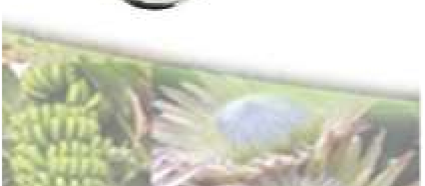
AGRICULTURAL RESEARCH COUNCIL

ARC VISION 2050



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Federal Ministry
of Food
and Agriculture

TempAg
SCIENCE FEEDING
TEMPERATE AGRICULTURE

Germany‘s Research & Innovation Agenda in the Agri-Food Sector

Maja Clausen, EU & International Research and Innovation (BMEL): TempAg Foresight Workshop, 6 October 2016; The Tower Hotel, London

Agri-food research landscape in Germany

Federal Government	Länder (federal states)	Private sector
Federal research establishments	Universities and polytechnic colleges	Research centres of enterprises
	Federal state research establishments	Business-related R&D bodies
		German Federation of Industrial Research Associations (AiF)

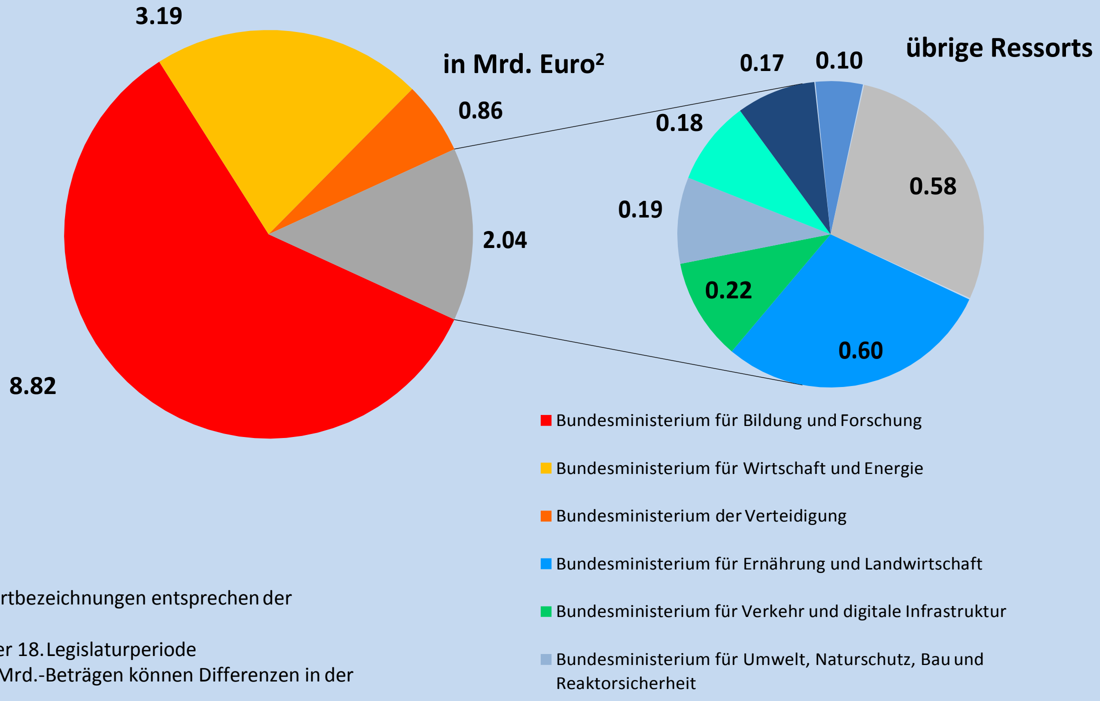
Total: 38
of which
BMEL 5

Helmholtz Centres
Leibniz Association
Max Planck Society
Fraunhofer Society German Research Foundation

Total: 84
BMEL co-finances:
6

Federal GER Government R&D expenditure by ministries:
Total: 15 bn € in 2015; BMEL: 600 Mio €

Ausgaben des Bundes für Forschung und Entwicklung nach Ressorts[1] 2015 (Soll)



1) Die Ressortzuschnitte und ressortbezeichnungen entsprechen der organisatorischen
Aufteilung der Bundesregierung der 18. Legislaturperiode
2) Auf Grund von Rundungen von Mrd.-Beträgen können Differenzen in der

Publicly funded research institutions in the German agri-food sector

Organising group	Personnel	Percent
Universities (14 agri-food faculties and 5 veterinary faculties)	4,415	40
17 Polytechnic colleges	737	7
31 Federal state research centres	1,844	17
4 Federal Government institutes and the Federal Institute for Risk Assessment 6 Leibniz Institutes (BMEL)	2,556 750 Sum = 3,306	23 7 Sum = 30
Others	746	7
Sum	11,048	100

Research institutions within BMEL‘s mandate

Federal Research Institutes

- Friedrich Loeffler Institute (FLI): Animal Health
- Thünen Institute (TI): Rural Areas, Forestry and Fisheries
- Julius Kühn Institute (JKI): Cultivated Plants
- Max Rubner Institute (MRI): Nutrition and Food

→ Federal Institute for Risk Assessment (BfR)

→ German Biomass Research Centre (DBFZ)

Selected Leibniz Institutes

- German Research Centre for Food Chemistry (DFA)
- Leibniz Institute of Agricultural Development in Transition Economies (IAMO)
- Leibniz Institute for Agricultural Engineering Potsdam-Bornim e.V. (ATB)
- Leibniz Institute of Vegetables and Ornamental Crops Großbeeren and Erfurt e.V. (IGZ)
- Leibniz Institute for Farm Animal Biology (FBN)
- Leibniz Centre for Research on Agricultural Landscapes (ZALF)

Additional stakeholders

Bundesanstalt für Landwirtschaft und Ernährung

Bundesamt für Verbraucherschutz und Lebensmittelsicherheit

Bundessortenamt

- Agency for Renewable Resources (FNR)
- Federal Office for Agriculture and Food (BLE)
- Federal Office of Consumer Protection and Food Safety (BVL)
- Federal Office of Plant Varieties (BSA)

German Agricultural Research Alliance (dafa)

- Umbrella organisation of German agricultural research organisations, established in 2011; at present more than 60 members
- Main tasks:
  - Giving German agricultural research expertise an audible voice and enhanced visibility
  - Identifying research areas of outstanding societal relevance
  - Facilitating participative multi-stakeholder discussion processes (including policy makers, private sector / associations, civil society / NGO's, funding organisations)
  - Assessing, structuring and prioritizing research needs
  - Provide research based policy advice and recommendations for government, funding agencies, foundations etc.

German Agricultural Research Alliance (dafa)

Multifaceted tasks of federal research

Carrying out **research:**

- Expanding scientific knowledge for the benefit of the common good / general public
- Focus on applied/problem-oriented research

Examination:

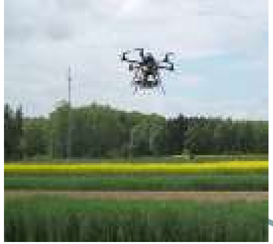
- Statutory tasks
  (e.g. Plant Protection Act, Animal Disease Act)

Providing **policy advice:**

- Developing scientific guidance for agri-food, nutrition and consumer protection policies

Four Research Clusters of BMEL

Future of Rural Areas
- High quality of life, strong economic sectors and efficient fostering -



Sustainable Agriculture
- Responsible and resource conserving soil management and animal husbandry -

Healthy Life
- Health, good nutrition and safe products -

Global Responsibility
- Ensuring global food security and responsible resource management -

Research clusters and priorities of the BMEL

Cluster *(time frame: 10 years)*	**Priorities** *(political formulation of goals to which research is to make a contribution; time frame: 5 years)*
Future of rural areas - high quality of life, strong economic sectors and efficient fostering -	1) Strengthening the future of labour and added value in rural areas 2) Ensuring and shaping attractive living conditions and future-orientated services of general interest in rural areas 3) Preserving and developing the environment and rural areas as places for recreation 4) Revising governance and implementation processes in rural development
Healthy lifestyle - Health, good nutrition and safe products -	1) Identifying and shaping future developments and behaviour trends 2) Generating effective preventive models 3) Developing safety systems adjusted to globalisation 4) Protect humans against zoonotic infections
Sustainable farm management - Responsible and resource-conserving soil management and animal husbandry -	1) Actively flanking adjustments of production processes 2) Gearing plant production towards resource efficiency 3) Ensure and strengthen animal health and animal welfare 4) Enhancing society's acceptance of processes and products
Global responsibility - Ensuring global food security and responsible resource management -	1) Endorsing the implementation of global sustainability goals and the right to food 2) Increasing productivity of agriculture, forestry and fisheries worldwide 3) Improving productivity, efficiency and inclusiveness of agricultural markets, trade chains and value-added chains at global level 4) Recognising society's expectations and demonstrating responsibility

Cross-cutting issues / Horizontal selection of topics

Big Data	Demography and population influx	Cooperation und transfer	Internationalisation	Regionality	Participation and transparency	Promotion of SMEs

BMEL involvement in EU Research Initiatives

- → Standing Committee on Agricultural Research (SCAR); including Strategic Working Groups (e.g. Food Systems)
- → Participation in 3 Joint Programme Initiatives (FACCE, HDHL, Oceans)
- → Participation in (currently) 18 ERA Nets within the agri-food domain (within the context of Horizon 2020)

International Research Activities of BMEL

→ Bilateral research collaboration with selected partner countries

→ Involvement in international & multilateral research initiatives within various platforms and fora (e.g. FAO, CGIAR, G7/G20, OECD, GRA, TempAg etc.)

→ Next milestones: Global Forum for Food and Agriculture (GFFA), January 2017 & High level agri-food activities within GER G20 Presidency 2017 (focus on ***agriculture & water***), including Agricultural Minister's Meeting (Jan. 2017) & Meeting of Agricultural Chief Scientists (FLW workshop, LOD Workshop and MACS in Nov. 2017)

Thank you!

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Addressing issues of agricultural sustainability: research approaches in temperate areas

Ivar Pettersen
Senior advisor, NIBIO
Associate Professor; University of Life Sciences – NMBU, ÅS

TempAg Foresight Workshop
Research, shaping policies for sustainable agricultural food systems in temperate areas.
London, 5-7 October 2016

Agriculture in temperate regions:

- Promises great social value from effective Agri-ecosystem transformation
  - Sector of high productivity growth and technical progress
  - Accountable for a disproportionately high share of potential mitigation and adaptation to global warming
  - Coupled production of social goods at all scales
- Suffers from obscure regulatory pathways towards 2050
  - Clear ambitions on outputs and food security,
  - Growing technological abundance – the bio-tech revolutions
  - Regulatory regimes, to a great extent, marked with uncertainty
- A High value, High risk situation for research and innovation

Manage High Value – High Risk

Integration Technological prograss	Souvereignty	Market integration: carbon, goods, investment - through low barriers and harmonization
Low productivity growth		
High productivity growth		

Exogenous or endogenous productivity?

- Less agri-science, more integrated life science
- Less Life-science more converegence
  - Computer science, BIG data and digitalization; bio-informatics and system-biology
  - Nano-biotechnologies
  - Human medicine drives biotechnology in general

Manage High Value – High Risk:

Scenarios with hope and fear

Tentative illustration

Market governance

Technologies for given environmental status

Integration **Technological prograss**	**Souvereignty**	**Market integration: carbon, goods, investment - through low barriers and harmonization**
Low productivity growth	*Hope:* Cheap renewable energy and effective water allocation *Fear:* Irresponsible land use; «research souvereignty»;	*Hope:* Great potential in division of labour *Fear:* Sustained depressed prices; «Race to the bottom» regu-lation; inequity
High productivity growth	*Hope:* Successfull Agro-ecosystem transition forming technologies *Fear:* Keeping the poorest down	*Fear:* Loss of rural vitality Non transparent supply chains

Manage High Value – High Risk:

Tentative illustration

Scenarios with hope and fear – Implications

Market governance

- No research souvereignty,
  even in case of Food Souvereignty;
  (convergence => no effective research is self-sufficient – TempAg may be important as a network provider.)

- Research priorities need be formed against broad socio-economic/ political contexts
  (Do not perform research for self-sufficiency in biomass if markets become well integrated!)

- Conctextual uncertainty relatively more important than contextual predictability
  (Perform stress-tests on sound scientific basis, rather than develop predictions)

Technologies for given

es