Sustainable intensification pathways : *Diversity, adaptation to local contexts, multicriteria evaluation & innovation approaches*

Seminar on Hot Topics in Sustainable Agriculture, and Land, 15-17 February 2016, Brussels

Florent Maraux, Philippe PetitHughenin and Bernard Triomphe (Cirad)

cirad

Outline

- Context
- Sustainable intensification
- Diversity of SI pathways & examples
- Evaluating SI?
- Supporting the transition to SI?

cirad

Context

- Demand for high quality food will increase by 70% till 2050 due to population growth and changing diets
- Need to increase availability & accessibility of food, by reducing the waste and increasing the ag sector.
- So far, humankind very successful in increasing food production & feed itself and making agriculture the basis for economic development around the world.

cirad

Context

- But agricultural practices often have negative impacts
  - *Soil fertility degradation, loss of biodiversity and ecosystem functions pollution of water resources, GHG emissions, natural resource scarcities, etc.*
  - *Social & cultural aspects: exclusions,loosers & winners, loss of typicity, etc.*

- Growing consensus on the need to increase sustainability; “business as usual” not a sustainable option !

cirad

Sustainable Intensification

What is a sustainable production system?

- It uses crop varieties with high ratio of productivity to use of externally and internally derived inputs;
- It avoids the unnecessary use of external inputs;
- It harnesses agro-ecological processes like nutrient cycling, bio-logical N-fixation, etc.;
- It minimizes the use of technologies that have adverse impacts on environment and human health;
- It makes productive use of human capital in form of knowledge and capacity to adapt and innovate;
- It minimizes the impacts of system management on externalities such as GHG emissions, carbon sequestration, biodiversity, etc.

Source: Pretty (2011)

cirad

Sustainable Intensification

Many other definitions & propositions in the literature!

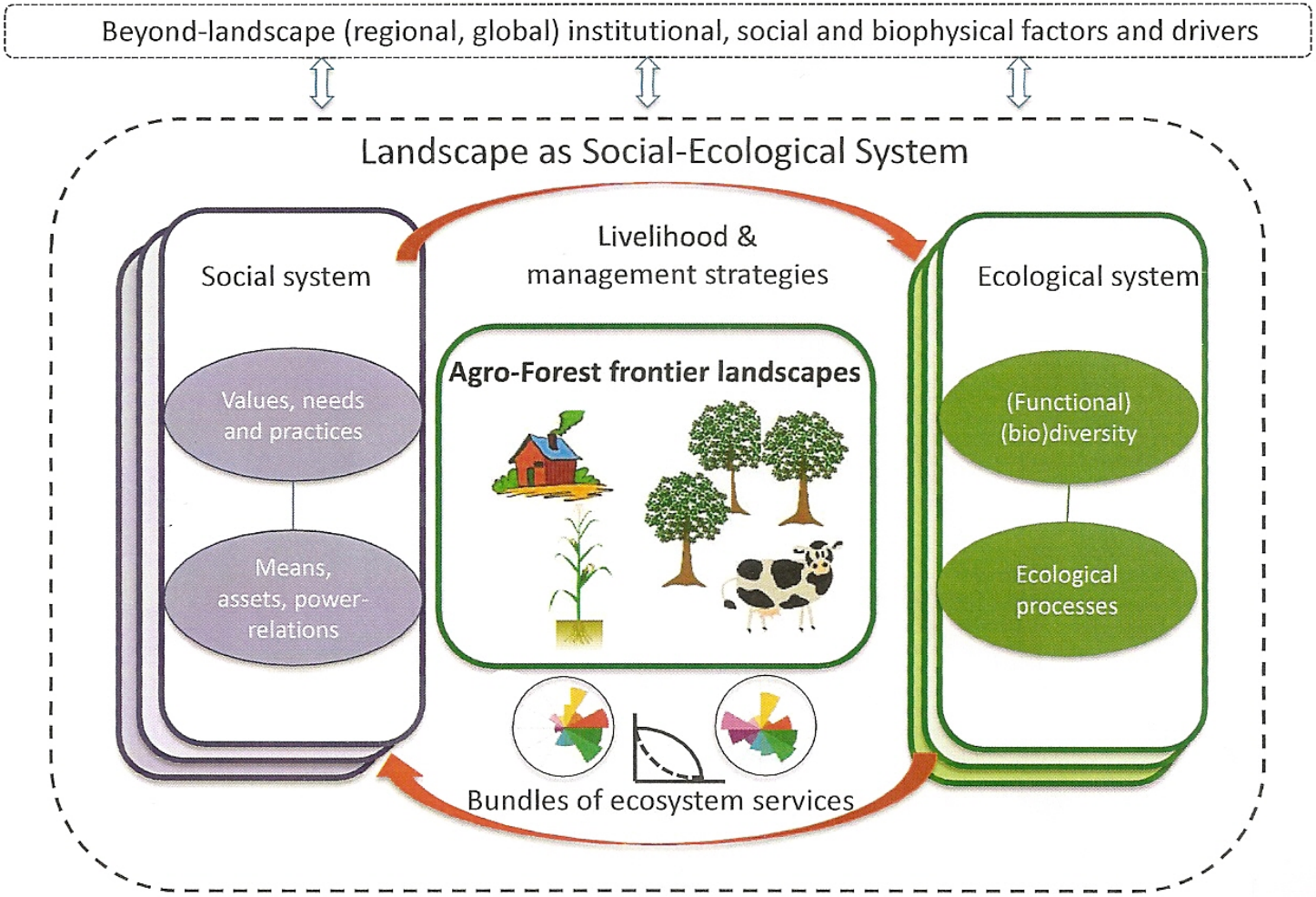
- Cook S, Silici L, Adolph B, Walke S, 2015: Sustainable intensification revisited; Issue Paper March **2015** , Food and agriculture, http://pubs.iied.org/14651IIED.html
- Charles H, Godfray J, Garnett T, **2014:** Food security and sustainable intensification,**,** http://rstb.royalsocietypublishing.org/content/369/1639/20120273.short
- Tilmana D, Balzerb C, Hillc J, Beforta BL, 2013:,Global food demand and the sustainable intensification of agriculture, http://www.pnas.org/content/108/50/20260.short
- Garnett T et al.,2013: Sustainable Intensification in Agriculture: Premises and Policies, **2013,** https://www.expo.cnr.it/it/system/files/Science-2013-Garnett-33-4.pdf

And the famous

- De Schutter O, **2010:** Agroecology and the right to food. A/HRC/16/49, Report presented to the Human Rights Council http://www.tandfonline.com/doi/abs/10.1080/14735903.2011.610206#.VrryR0rLTcs

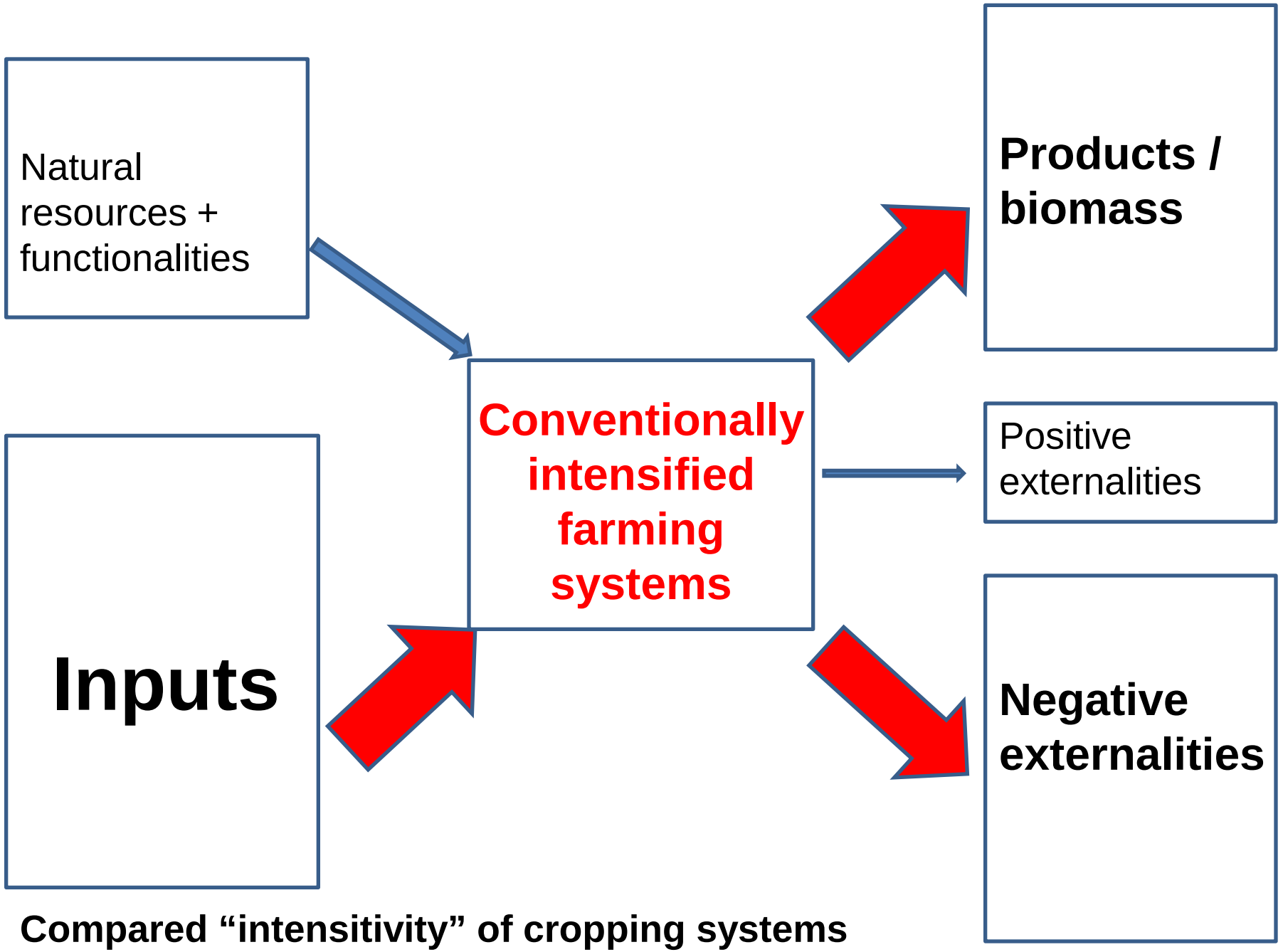
cirad

Adressing complex systems...an example



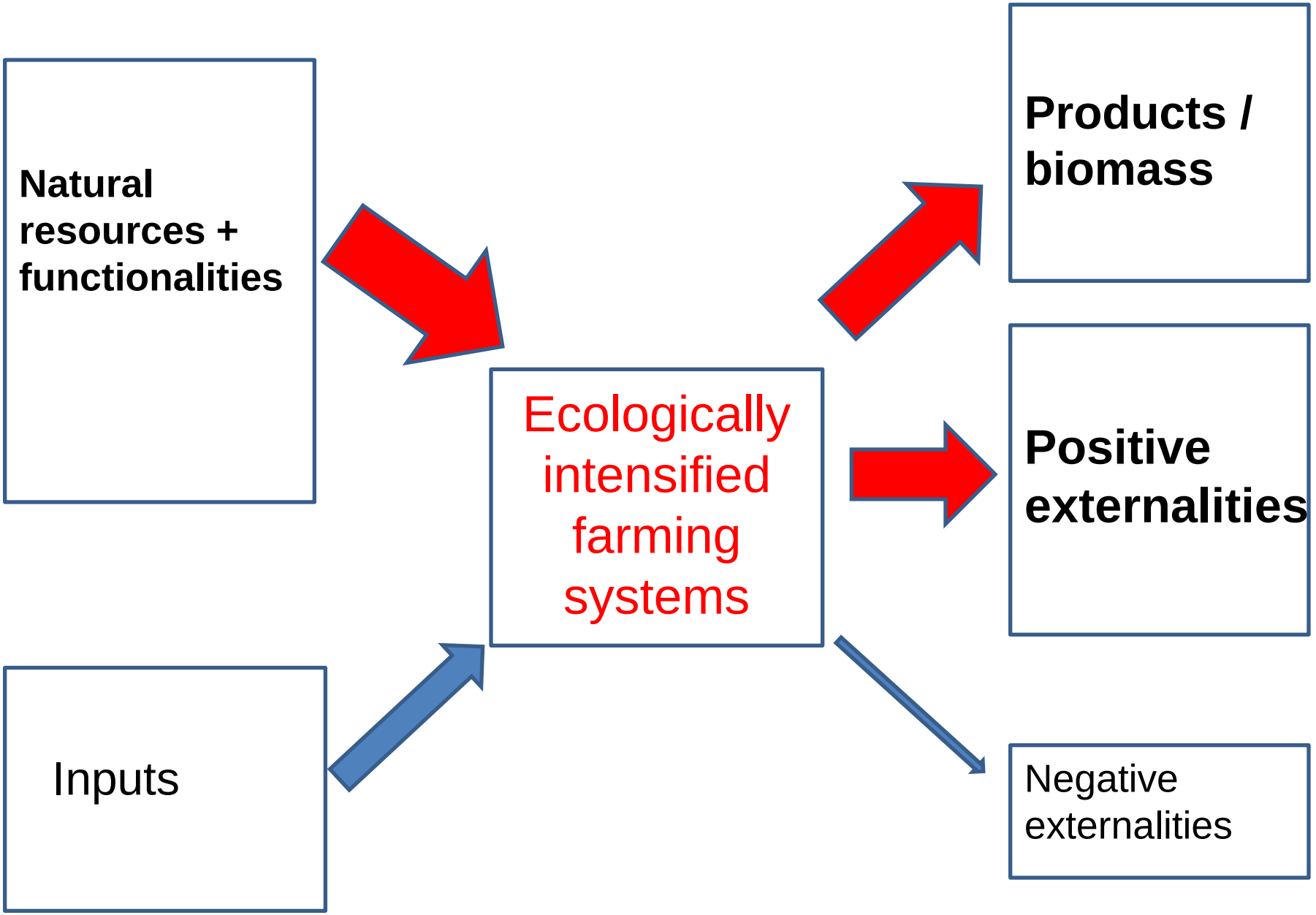
cirad

Diversity of Sustainable intensification options



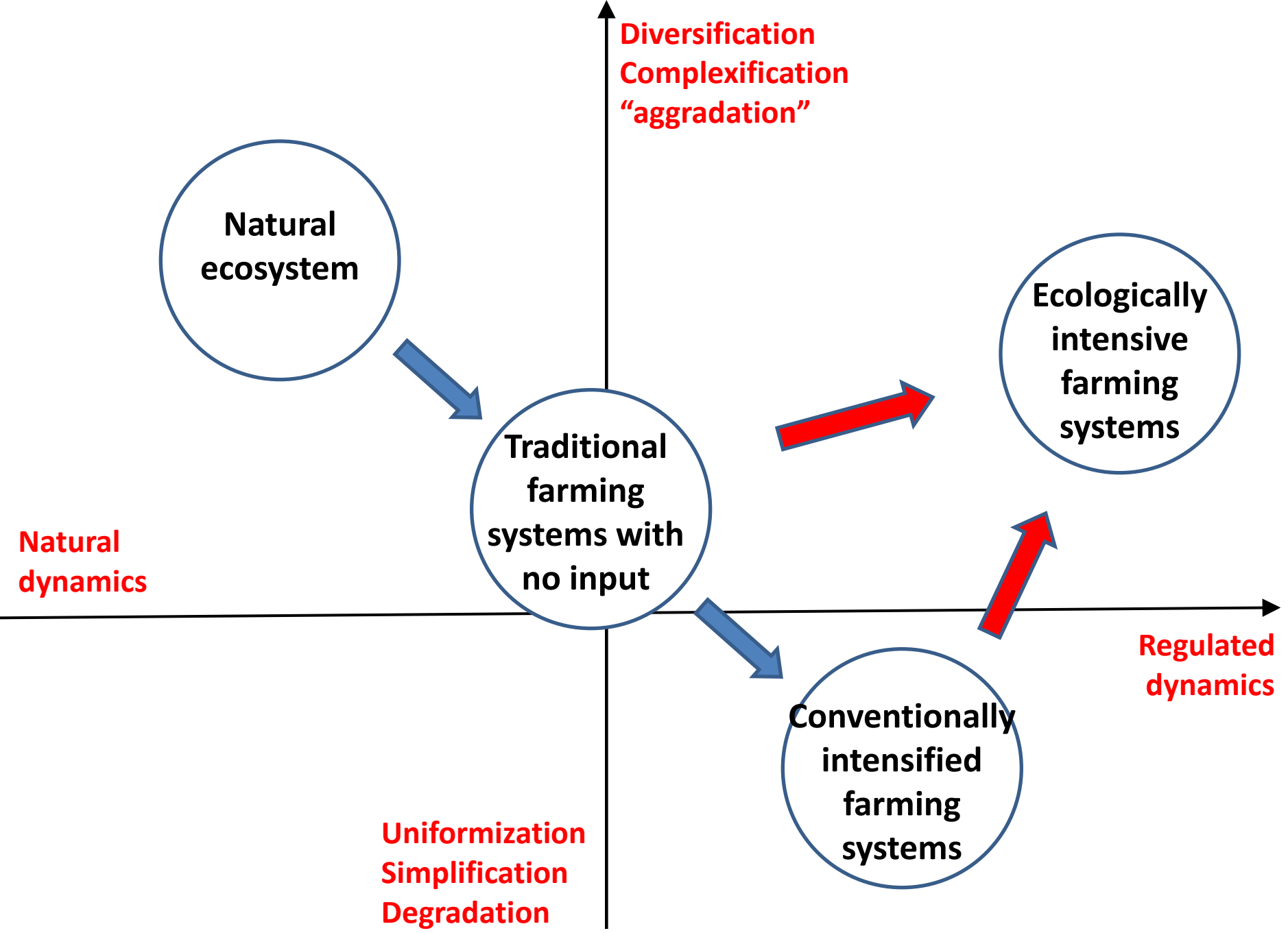
Compared "intensitivity" of cropping systems

(adapted from Griffon, 2013)



Compared "intensitivity" of cropping systems

(adapted from Griffon, 2013)



(adapted from Griffon, 2013)

Tentative typology of SI pathways

As proposed by the H2020 **ProIntensAfrica** project
(WUR, CIRAD, FARA & a consortium of 23 European and African partners)

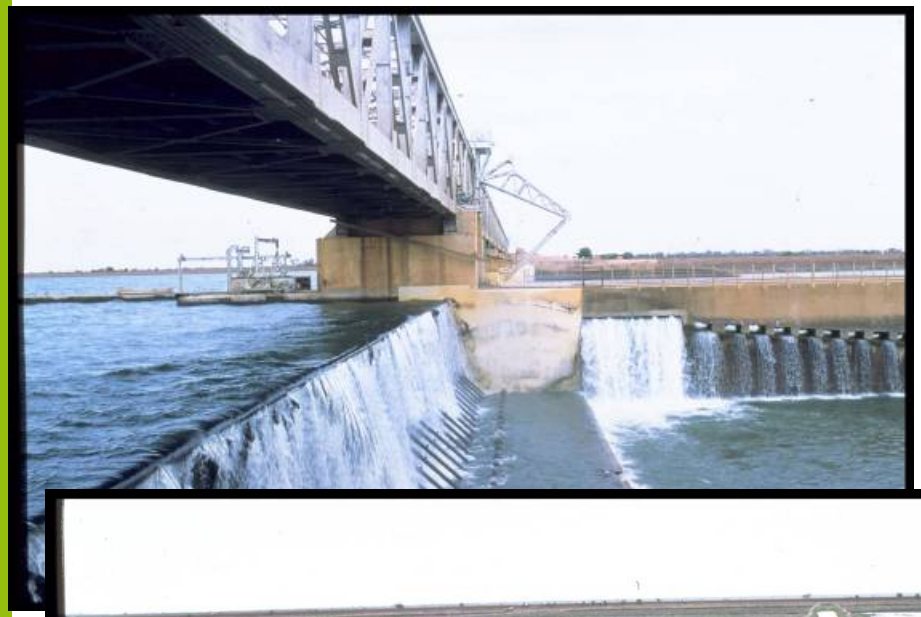
Four pathways identified

1. **high input**
2. **organic agriculture**
3. **agro-ecological agriculture**
4. **sustainable intensive agriculture**

Website: http://www.intensafrica.org/

cirad

1. High Input pathway



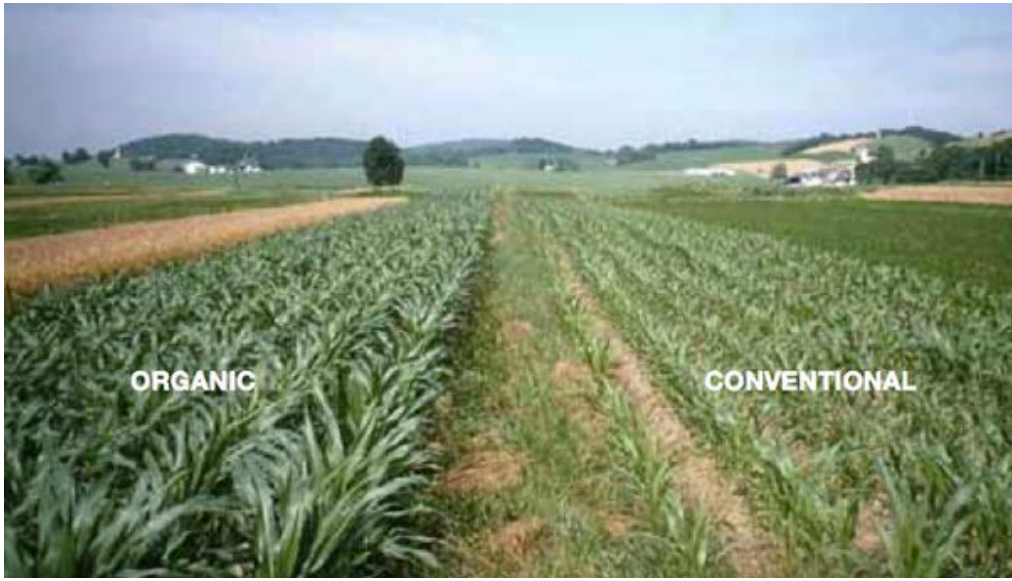
Based on the use of improved germplasm (incl. GMO), pesticides and mineral fertilizers, irrigation and mechanization.
Many policies and support services built around it.
Inspired by the Green revolution, and strongly supported by African Union / B&MG Foundation etc.

cirad

2. Organic Agriculture pathway

Excluding pesticides and mineral fertilizers, it emulates ecological systems and cycles and has a strong connection to certified markets and civil society organizations.

- **Less energy, water & inputs**
- **More profitable**
- **Greater resilience**
- **Less GHG emissions**
- **Greater bio-diversity**
- ***Suitable to BP producers (high cost of certification & following international standards) & consumers (high cost of produce)?***



3. Agroecological pathway…

…is based on a convergence of agronomy and ecology, mobilizing ecological services. It is gaining momentum in different circles, including policy ones.

Reduction of the impact of Helicoverpa by planting pigeon pea around the gombo plots

Cucurbitaceas flies management by planting maize in patches or borders

…*Diseases regulation through plant biodiversity in horticultural systems*

cirad

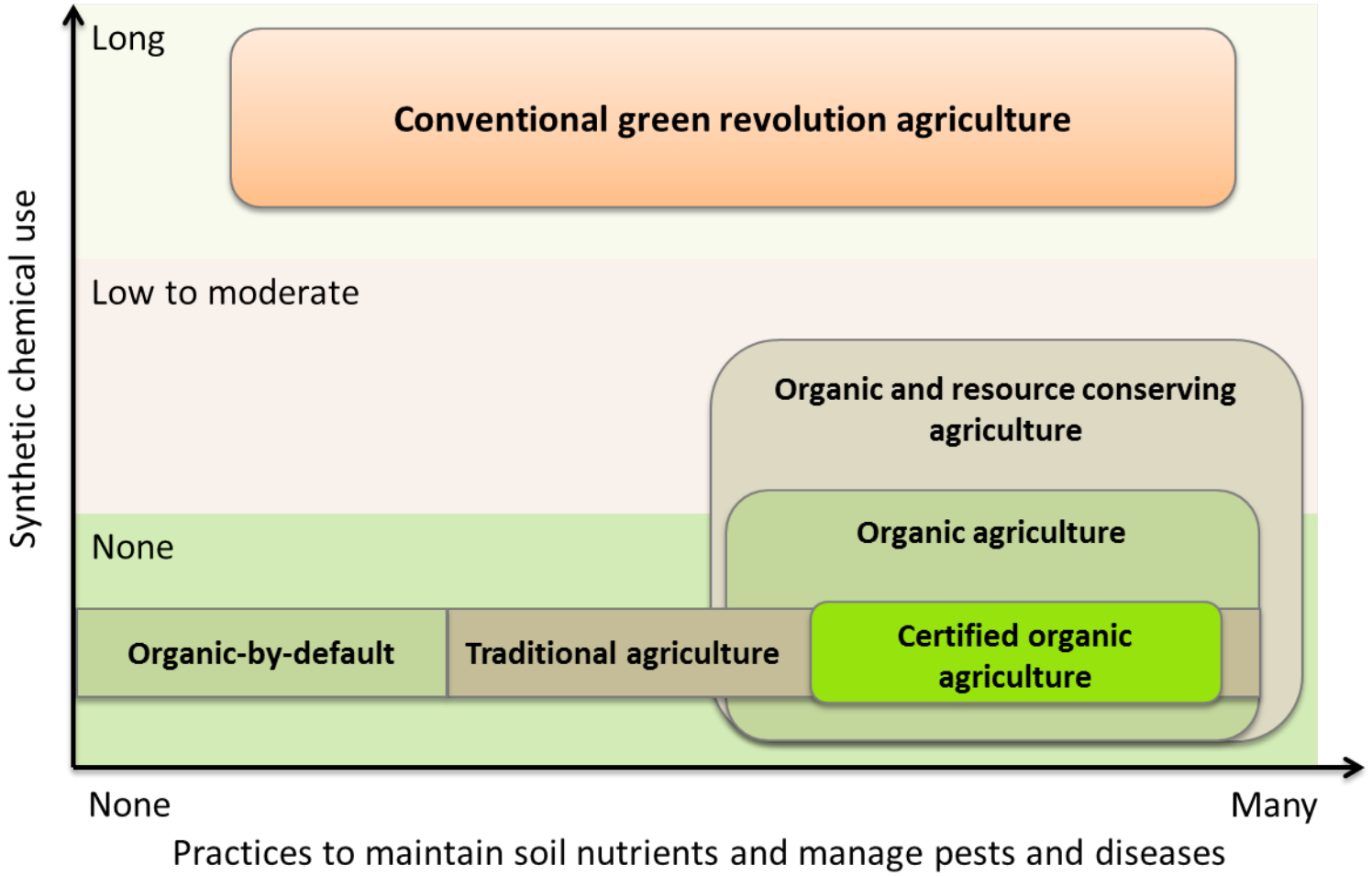
4. “Sustainable Intensification” pathway

combines elements from the other pathways, including GMOs, and is advocated by the “Montpellier panel”

*“The Montpellier Panel is a group of African and European experts from the fields of agriculture, trade, ecology and global development chaired by **Sir Gordon Conway**. The Panel is working together to enable better European government support of national and regional agricultural development and food security priorities in Sub-Saharan Africa.”*

cirad

Another typology of SI systems & pathways



Source: Bennett & Franzel , 2013

cirad

Specific challenges for transforming Sub-Saharan African agriculture

- Food and nutrition security, poverty reduction, catalysis of the economic development, natural resources management, rural territories management, etc.
- In SSA today, 11 out of 17 Millions people entering the labor market every year live in **rural areas**.
- Rural areas should continue to lead in the labor force increase till the early 2030s. Between now and 2025, SSA's economies will have to incorporate 330 Millions youth (195 in rural and 135 in urban areas).

cirad

Inclusive and sustainable intensification pathways for Africa

- African farmers (men, women, youth) will have to engage a significant increase in land and labor productivity, while often facing extreme poverty, growing climatic constraints and opening markets.
- Agricultural intensification will shape future agrarian systems
- 2 key issues need to be addressed:
  - *The “modernization of agriculture” model presents a risk of massive eviction from rural areas*
  - *Smallholders have comparative advantages: they can be competitive and lead this transformation with support of public investments and policies*

Losch B. 2012 Ruralstruc

An unequal challenge for research

1 researcher
for 100 farmers
(Europe)

But 1 researcher
for 10.000 farmers
(West Africa)…

cirad

Pathways of intensification in & for a huge diversity of contexts

- Ecological intensification mainly driven by better agrobiodiversity management.
- To make the best use of natural resources, we need to maximize the biomass production, by intercepting throughout the year as much (solar radiation, CO2, N, …) as possible by:
  - Optimizing plant functional biodiversity at different scales and revisiting plant breeding to adapt plants to complex association;
  - Regulating bio-agressors;
  - Amplifying biogeochemical cycles in the soil, recycling the nutrients from greater soil depths and increasing microbial activities

cirad

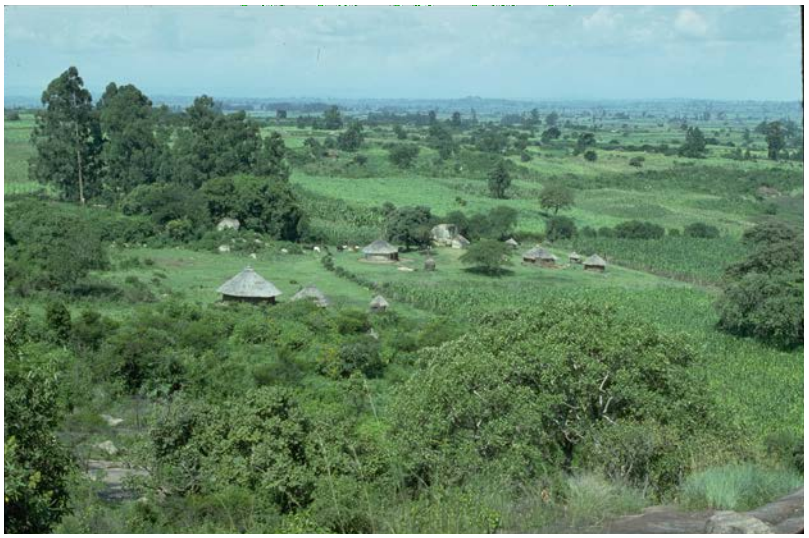
A challenge for sustainability

Introduction of …

(trees, hedgerows, conservation agriculture …)

Efficiency improvements

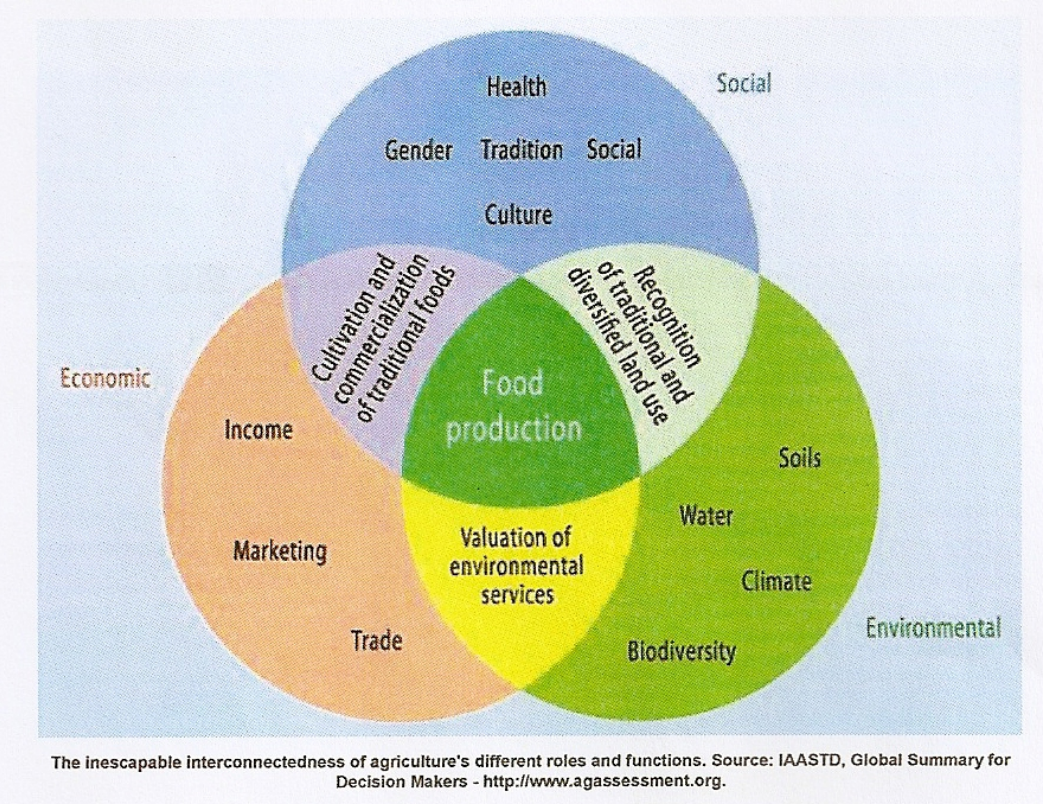
(intercropping, landscape organization…)



cirad

Evaluating / comparing SI pathways

- In different environments
- According to different criteria to take into account complexity

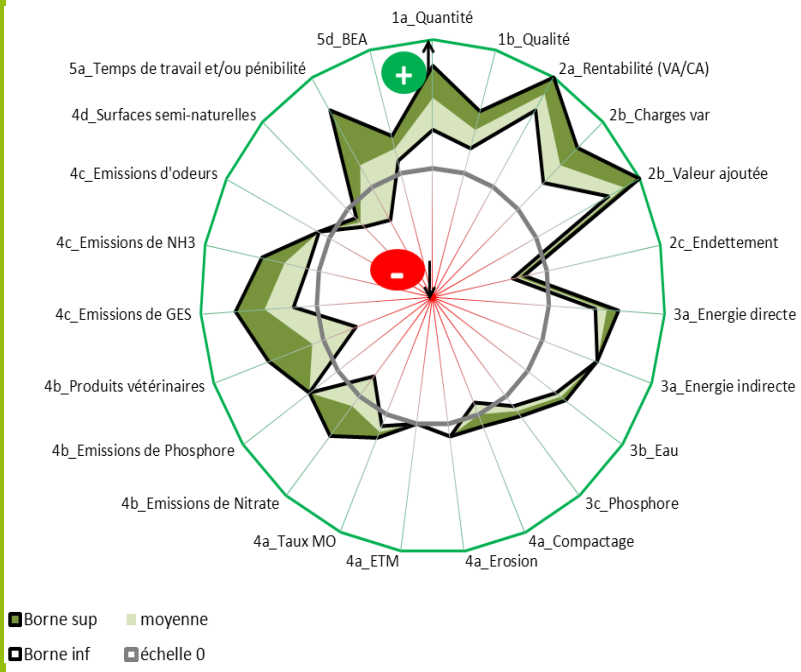


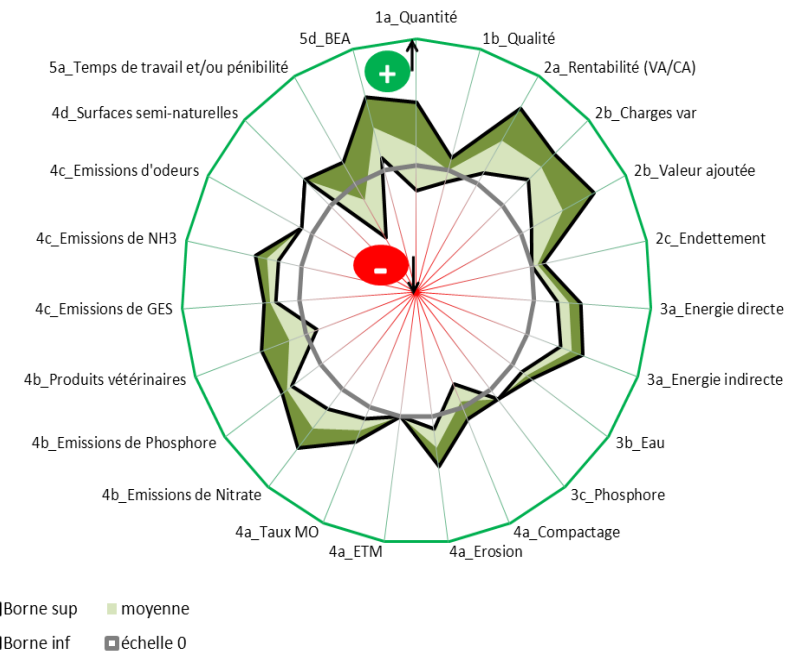
The inescapable interconnectedness of agriculture's different roles and functions. Source: IAASTD, Global Summary for Decision Makers - http://www.agassessment.org.

cirad

Comparing the performances of two systems in the production / environmental dimensions

- *low input cattle farm (meat production)*
- *Dairy Farm in lowlands*





Source: Guillou, 2013

Supporting transition to SI systems 1/2

- Making use of an Innovation (system) perspective
  - Multiple actors & their interactions
    - Farmers & FO, extension, research, private sector, government, NGOs, etc.
    - Role of innovation platforms & spaces, of innovation brokers
  - Mutliple scales: local, regional, national, global
    - Address them simultaneously…
  - Multiple dimensions : technological, organizational, institutional innovations
    - From a strategic entry point (a new technology, a new organization, a new rule / policy), expand scope of intervention as other dimensions become relevant /necessary
  - Address the (enabling) environment:
    - strenghtening individual institutions, coordination mechanisms, develop relevant policies, etc…

cirad

Supporting transition to SI systems 2/2

- No blue prints for internvetion, need for local adaptation of approaches, principles, tools
- Long time frames of intervention needed for fostering SI: at least a decade?
- External interventions need to build on local dynamics / ensure local actors are in the drivers' seat
- Building technical skills of all actors
- Building systemic capacity to innovate (Leeuwis et al., 2014; TAP, 2015)
  - capacity to design, experiment & test new alternatives
  - capacity to navigate complexities
  - capacity to collaborate
  - capacity to learn and reflect
  - capacity to engage in strategic and political processes

cirad

Some useful references

- Guillou, M, 2013. The agro-ecology project: Towards doubly efficient agriculture that reconciles competitiveness with respect for the environment. Short memorandum to the French Government.
- Griffon M, 2013. Qu'est ce que l'agriculture écologiquement intensive?. Editions Quae.
- Bennett M, Franzel S, 2013: Can organic and resource-conserving agriculture improve livelihoods? A synthesis. IJAS 11(3)
- Losch, B., Fréguin-Gresh, S., & White, E. T. , 2012. Structural transformation and rural change revisited: challenges for late developing countries in a globalizing world. World Bank Publications.
- Faure G, Gasselin P, Triomphe B, Temple L, Hocdé H (eds.), 2014. Innovating with rural stakeholders in the developing word : action research in partnership. Wageningen : CTA, Quae, 224 p.
- Triomphe et al., 2013: What does an inventory of recent innovation experiences tell us about agricultural innovation in Africa? Journal of Agricultural Education and Extension. 19(3): 311-324

cirad

Expectations about Sustainable Intensification can be overwhelming …

Merci de votre attention!

cirad