World agriculture and Green Growth

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"Double green" revolution and green growth

(Photo F. Ramahandry)

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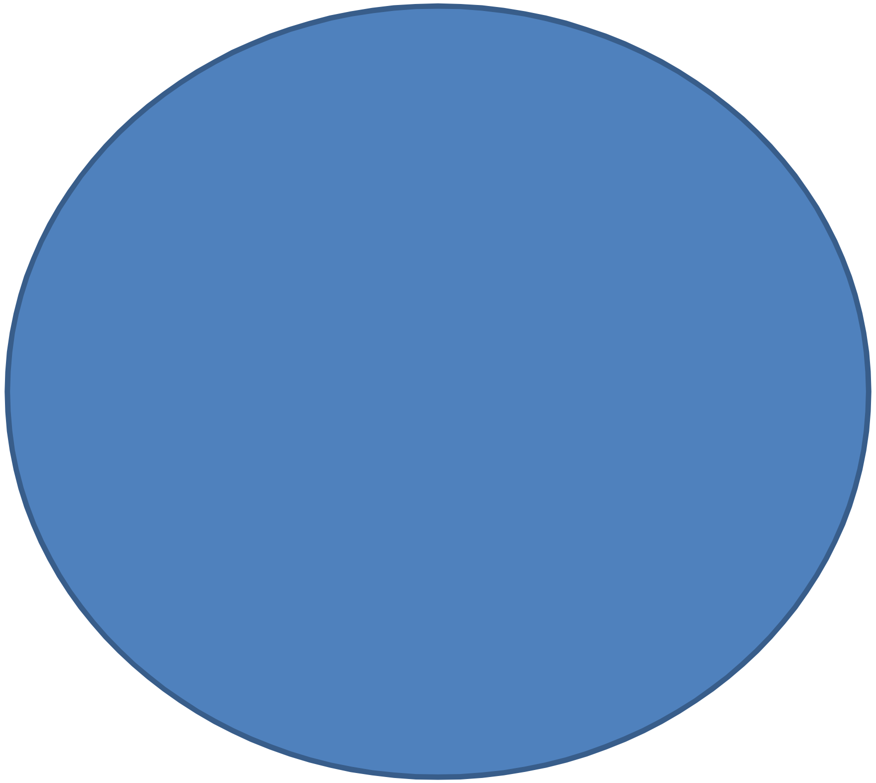
Global economic development



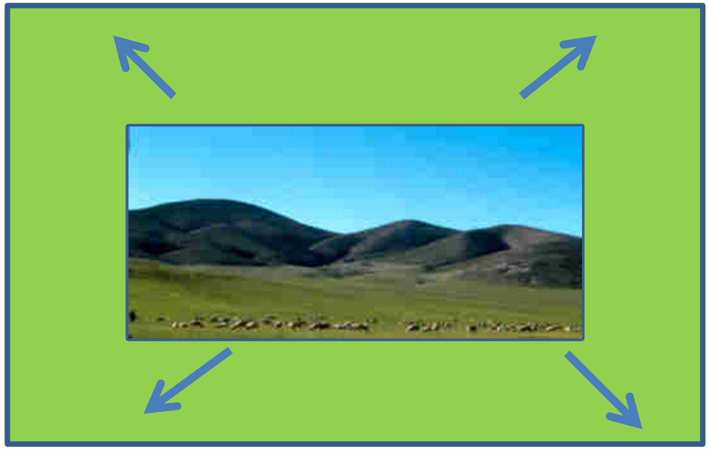
Global economic development

Agriculture triggers or allows global green growth

Or

Agricultural production

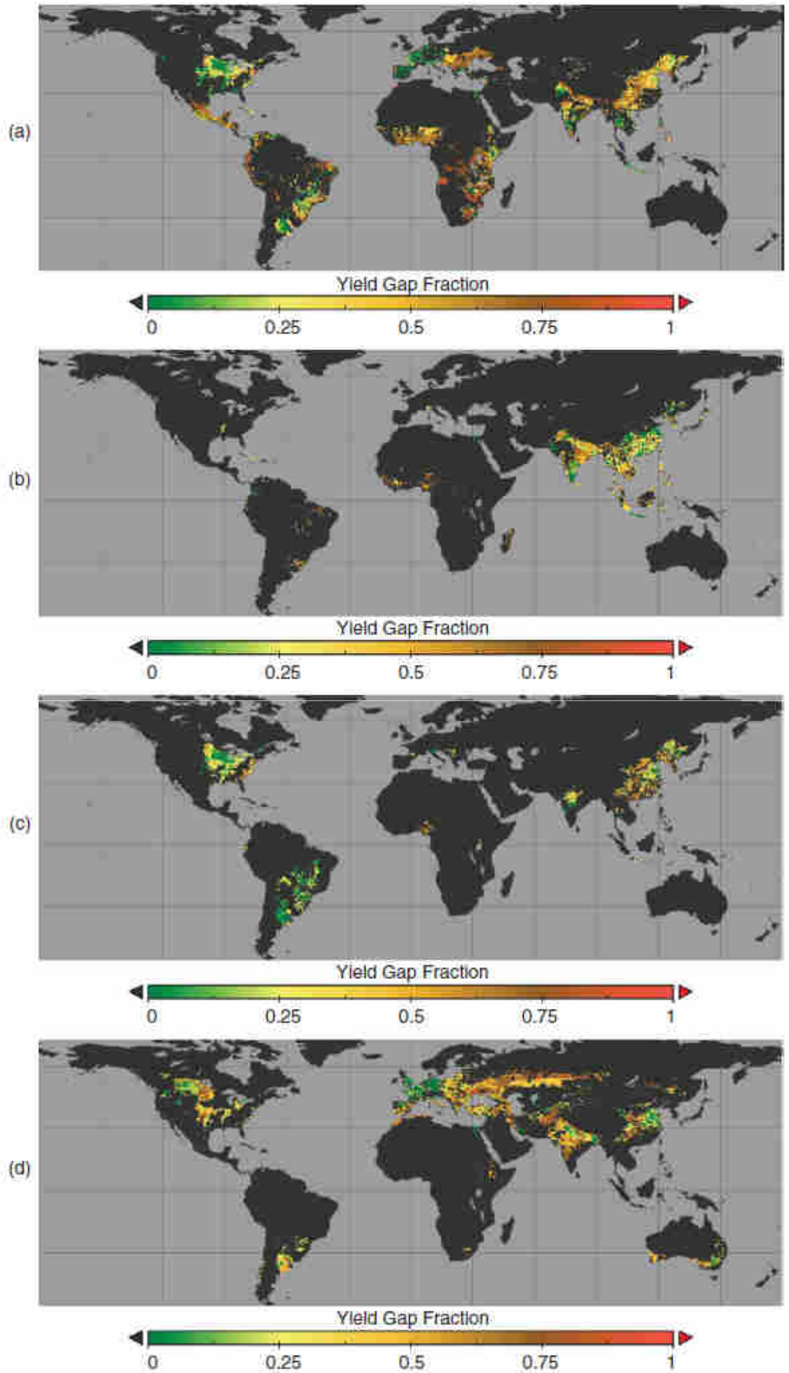
Agricultural production



Agriculture growth must be green

Four main points:

- Which growth and where?



Yield gap fraction values on a 5′ grid with an equirectangular projection for (a) maize, (b) rice, (c) soybean, (d) wheat.

Maize

Rice

yield gap fraction = 1 − (actual yield / climatic potential yield)

Soja

Wheat

(Licker *et al.*, 2010)

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- **FA0 : agricultural production must be increased by 70%**
- **Michel Griffon : agricultural production must be increased by 50%**

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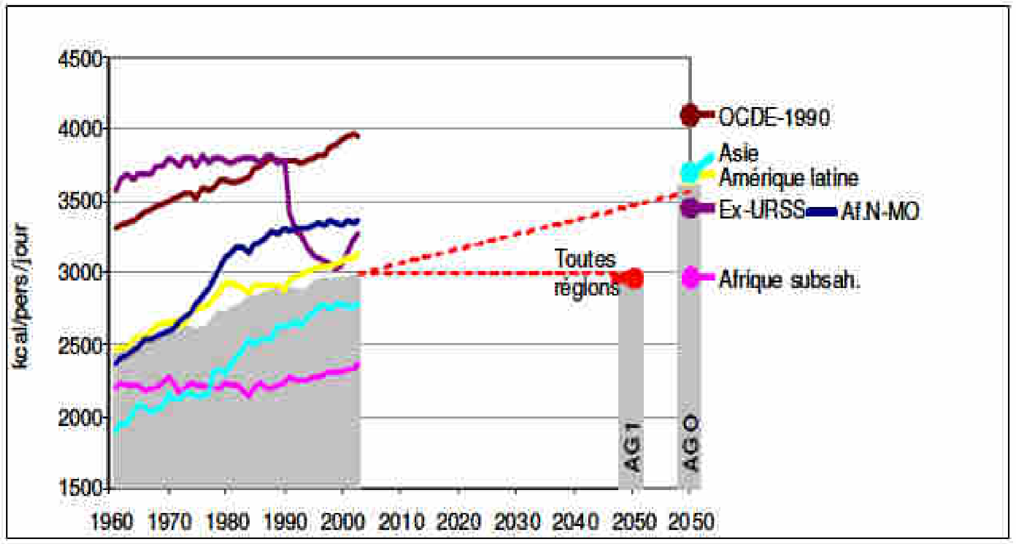
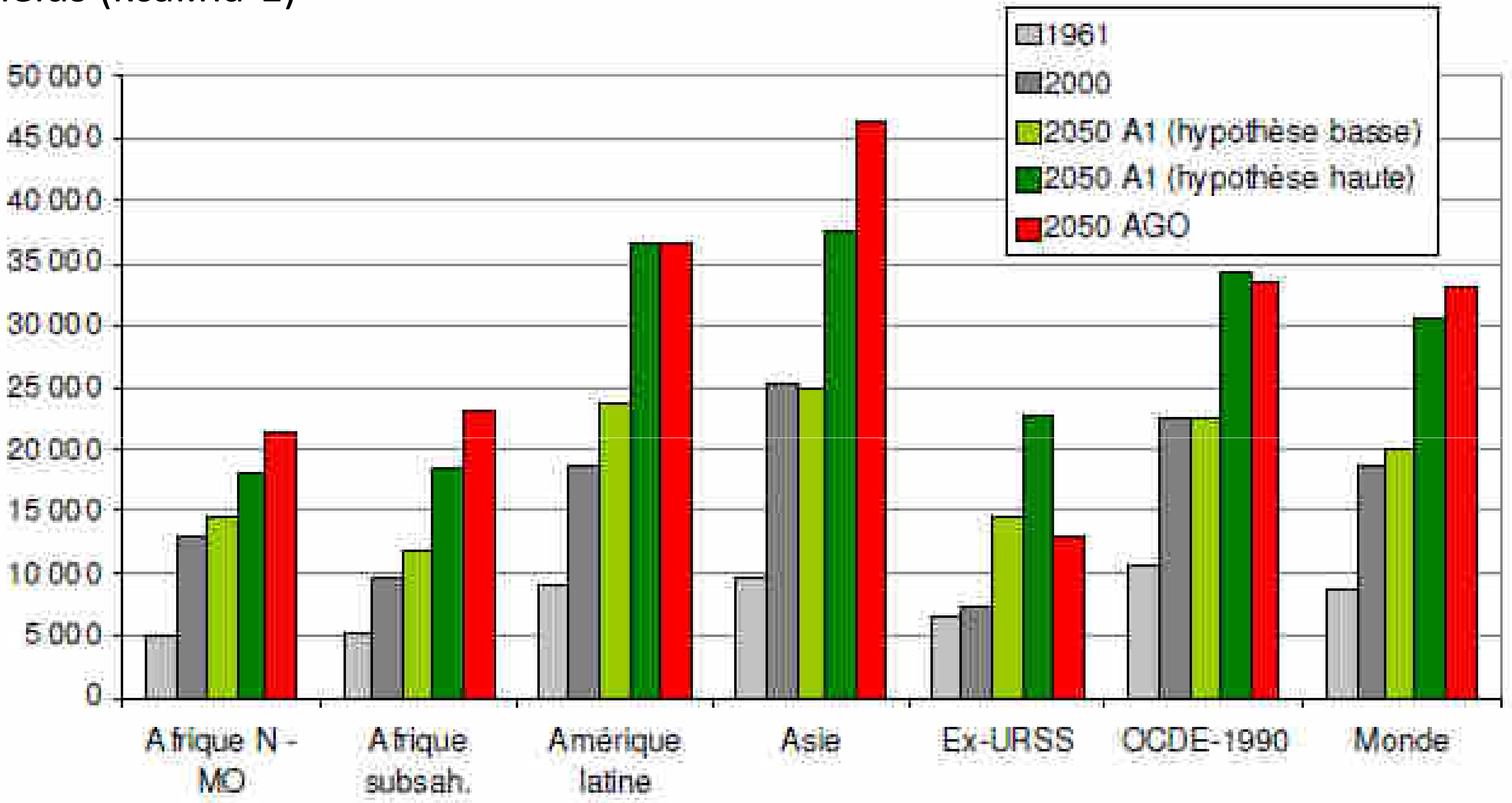
- **Agrimonde**



AG0 crops: + 84%
animals: +97%

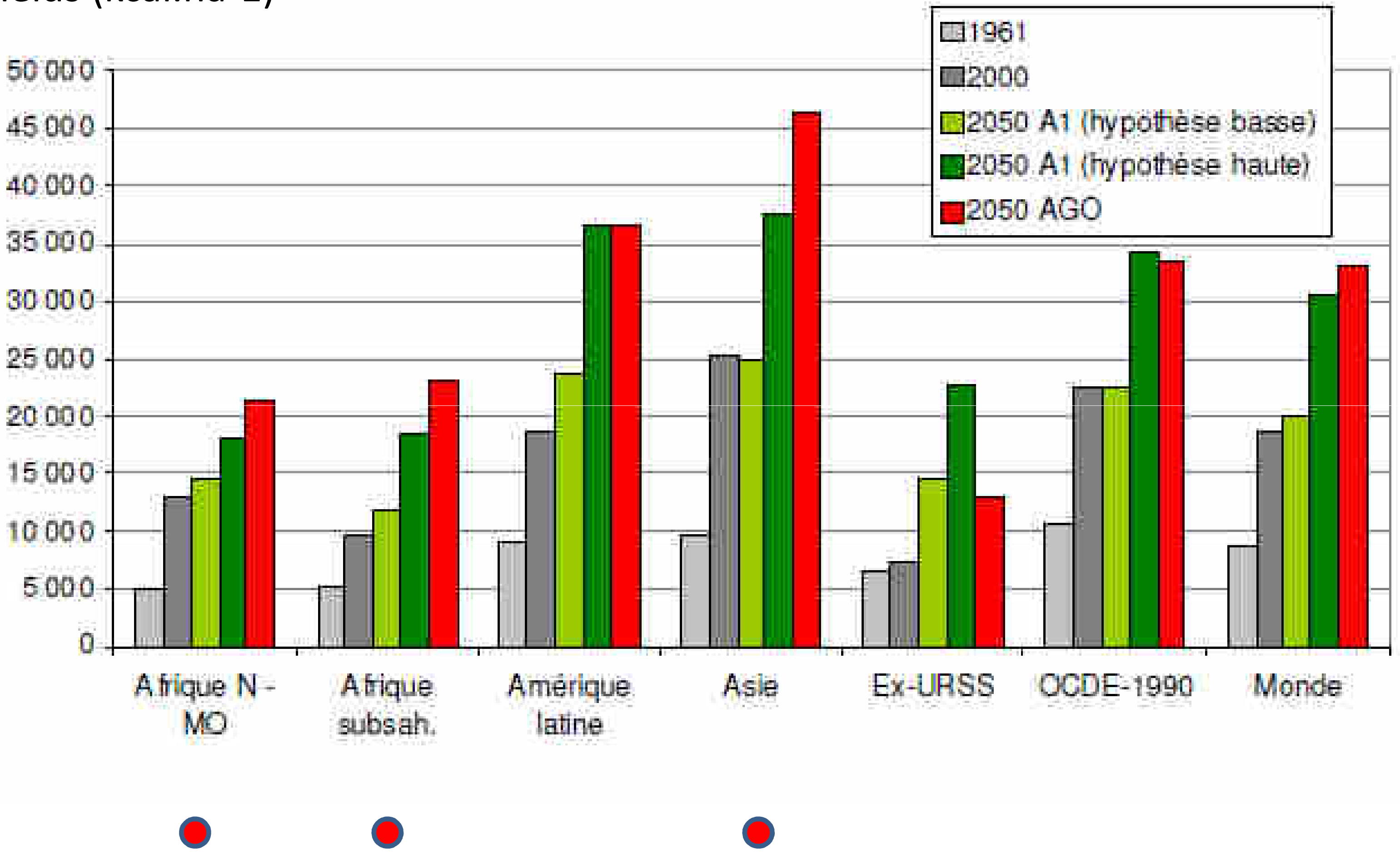
AG1 crops: +28%
animals: +21%

Yields (kcal.ha-1)



(Agrimonde, 2009)

Yields (kcal.ha-1)



(Agrimonde, 2009)

Four main points:

- Which growth and where?
- No future for universal solutions

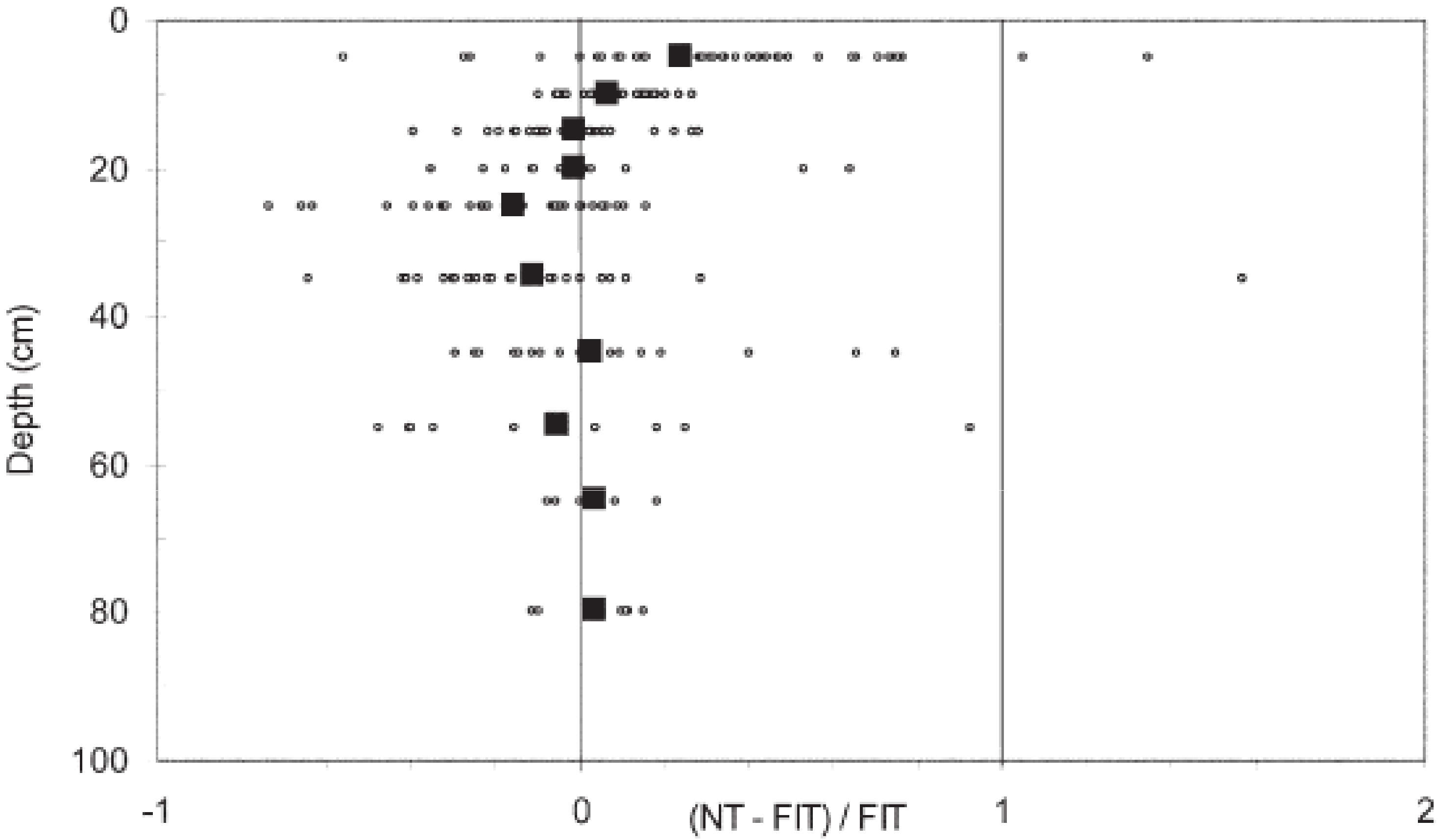
A wide range of Agroecosystems

Combined to a wide range of economic and social conditions

A wide range of Agroecosystems

Combined to a wide range of economic and social conditions

… which implies very different relationships between farming systems, agricultural production, ecosystemic services, and resources and environment protection

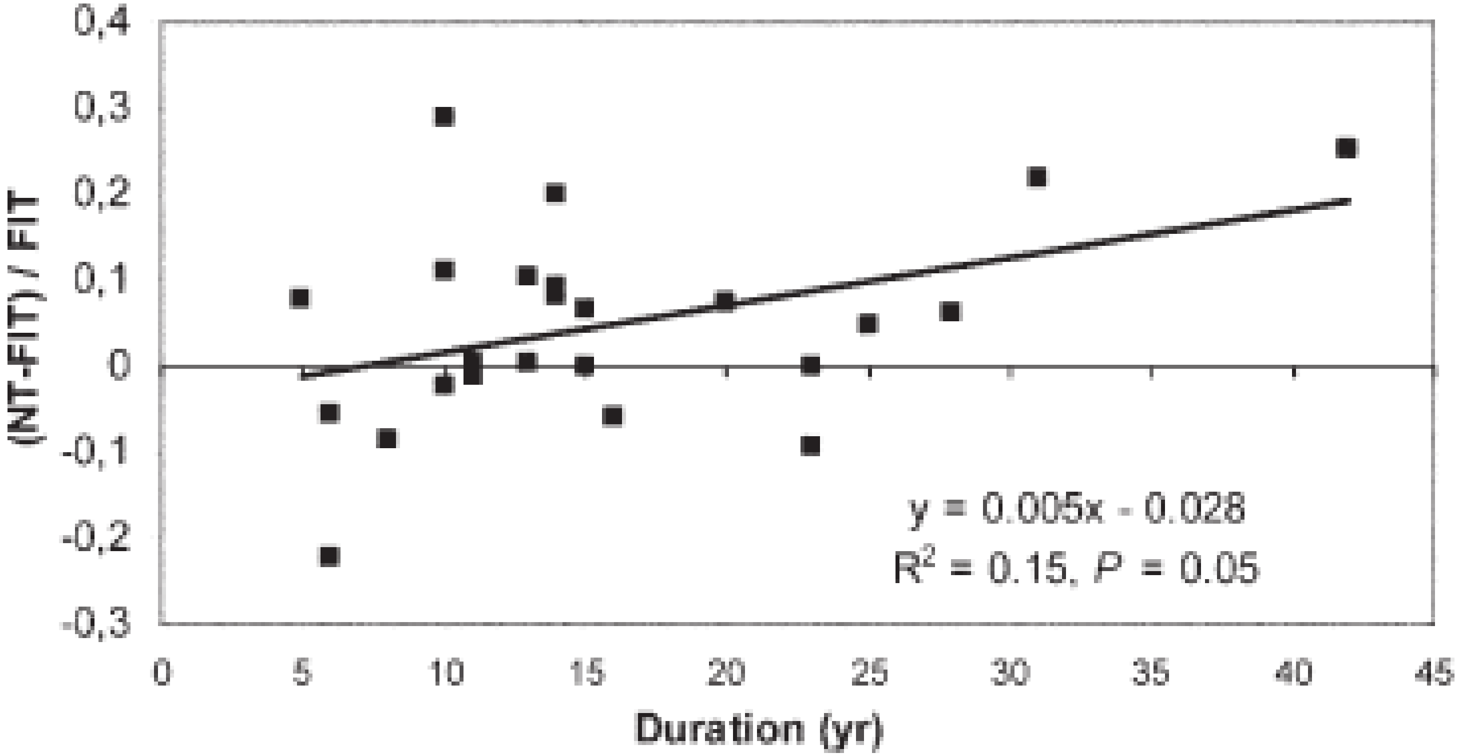


Relative change in soil organic C content under no-till (NT) compared with full-inversion (FIT) as a function of soil depth

(Angers & Eriksen-Hamel, 2008)

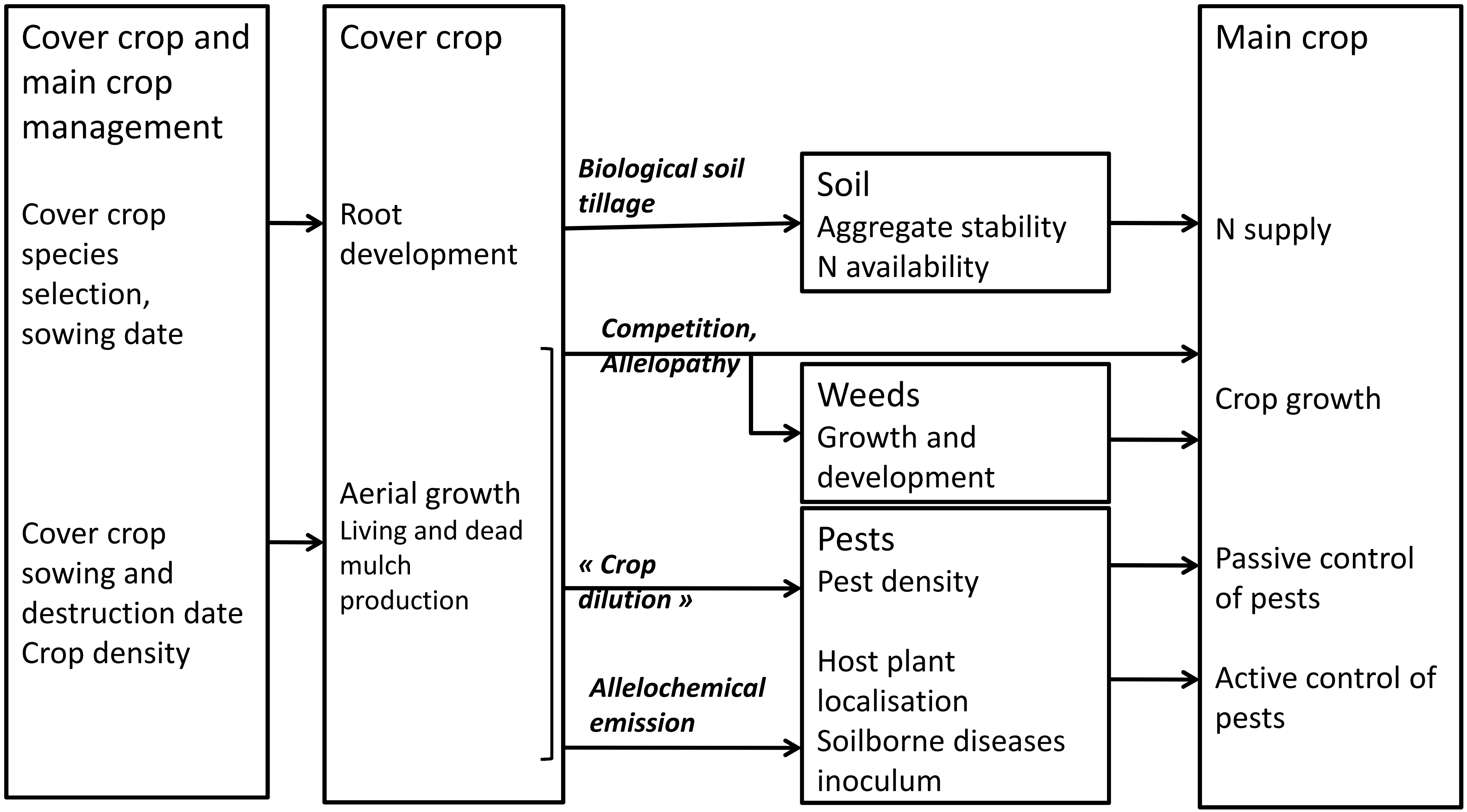
Changes in extra C storage assesment through no-tillage systems:

- Virto et al (com pers): 3.4 Mg C/ha
- Angers & Eriksen-Hamel (2008): 4.9 Mg C/ha
- West & Post (2002): 8.5 Mg C/ha



Duration effect on the relative change in soil organic C content under no-till (NT) compared with full-inversion (FIT)

(Angers & Eriksen-Hamel, 2008)



(Médiène *et al.., in press)

Four main points:

- Which growth and where?
- No future for universal solutions
- Mimicking the nature must be carefully examined

Natural ecosystems vs. agroecosystems

- Species richness
- Heterogeneity
- Perennial canopy
- Functional redundancies

Do these characteristics generate specific properties to natural ecosystems ?
Towards agrosystems that mimic natural ecosystems?

(Lefroy *et al.,* 1999)

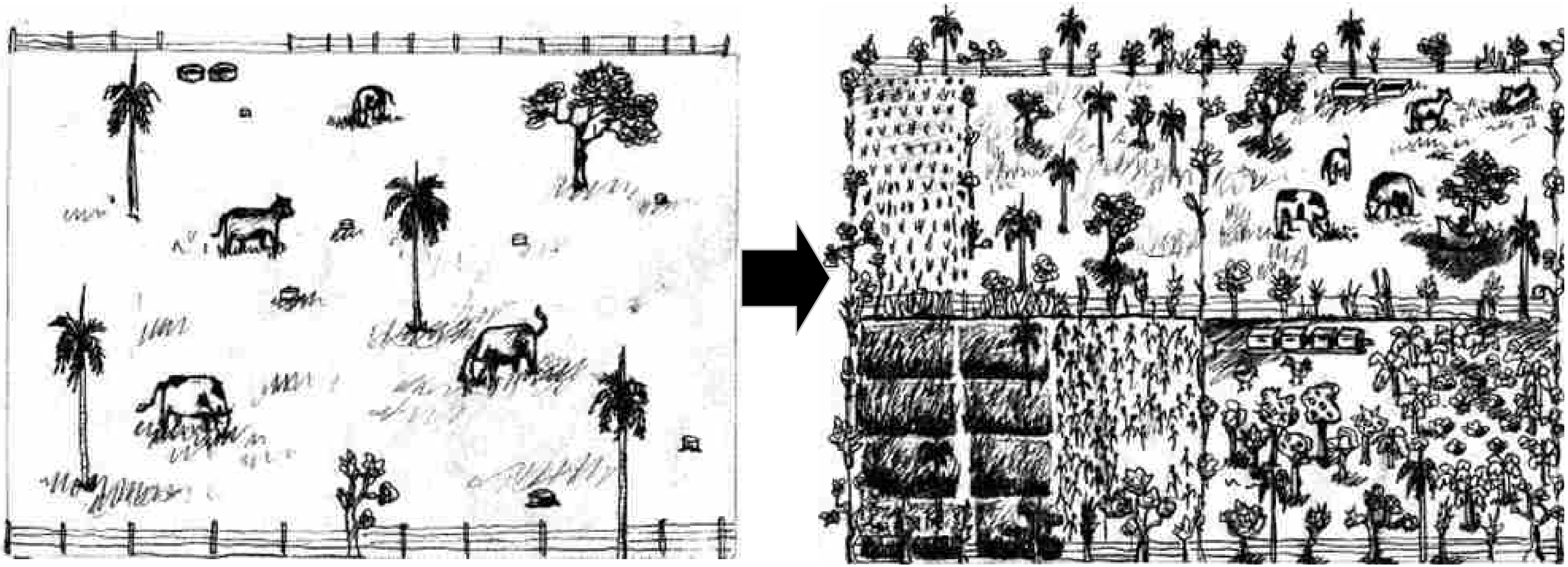
Two principles of the mimic theory

(according to Van Noordwijck &Ong (1999))

1. Mimic the structure and function of natural ecosystems existing in a given pedoclimatic zone

2. Try to mimic the diversity of species existing in natural ecosystems and hence contribute to maintain the original biodiversity

A **B**



Specialised dairy systems (before 1990)

Integrated crop-livetsock systems (since 1990's)

(Funez-Monzote *et al.*, 2009)

Three limits to the second principle

1. Functional composition more often controls ecosystem functioning than does species diversity

2. The interesting properties of natural ecosystems may rise from the spatial and temporal lay out of the species and not from their number

3. Mimicking the natural ecosystems will inevitably face the "aim problem"

An agenda for « mimicking » the natural ecosystems

- Select the functions agronomists attempt to improve (for example nutrient cycles management)
- Identify in natural ecosystems the structural characteristics (spatial heterogeneity, diversification of vegetation strata, variability of species in time and space, etc.) that modify these functions
- Make up the qualitative or quantitative relationships that link properties and functions
- Transpose these functions in agricultural conditions
- Use these functions for designing agroecosystems finalized by specified aims
- Check that the new agroecosystems express the targeted functions, and do not express unwanted properties.

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Four main points:

- Which growth and where?
- No future for universal solutions
- Mimicking the nature must be carefully examined
- Changes in agriculture will be knowledge-based

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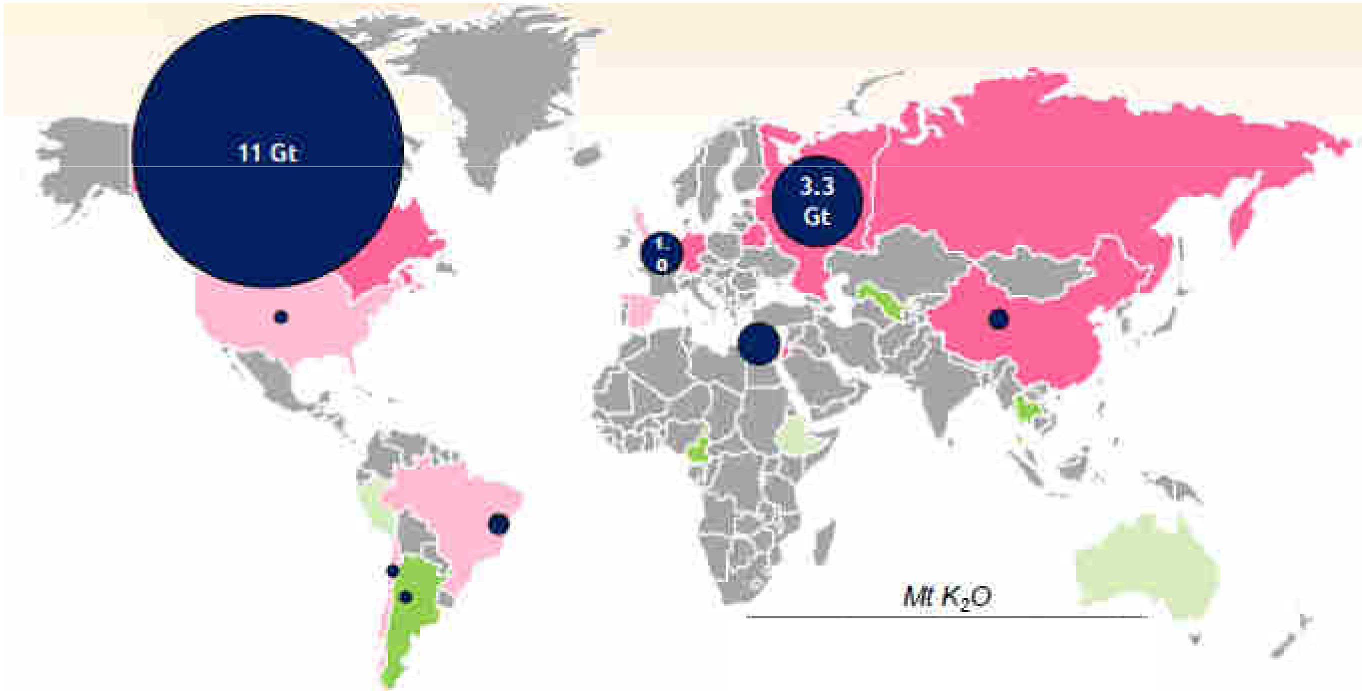
Knowledge:

- For a better use of agricultural inputs

Mt P_2O_5

	2007 Production	Stock
Chine	62.7	13 000
EUA	30.2	3 400
Maroc	27.7	21 000
Russie	10.9	1 000
Tunisie	8.0	600
Brésil	6.1	370
Jordanie	5.6	1 700
Syrie	3.7	800
Israël	3.1	800
RSA	2.6	2 500
Egypte	2.5	760
Monde	176.1	50 000

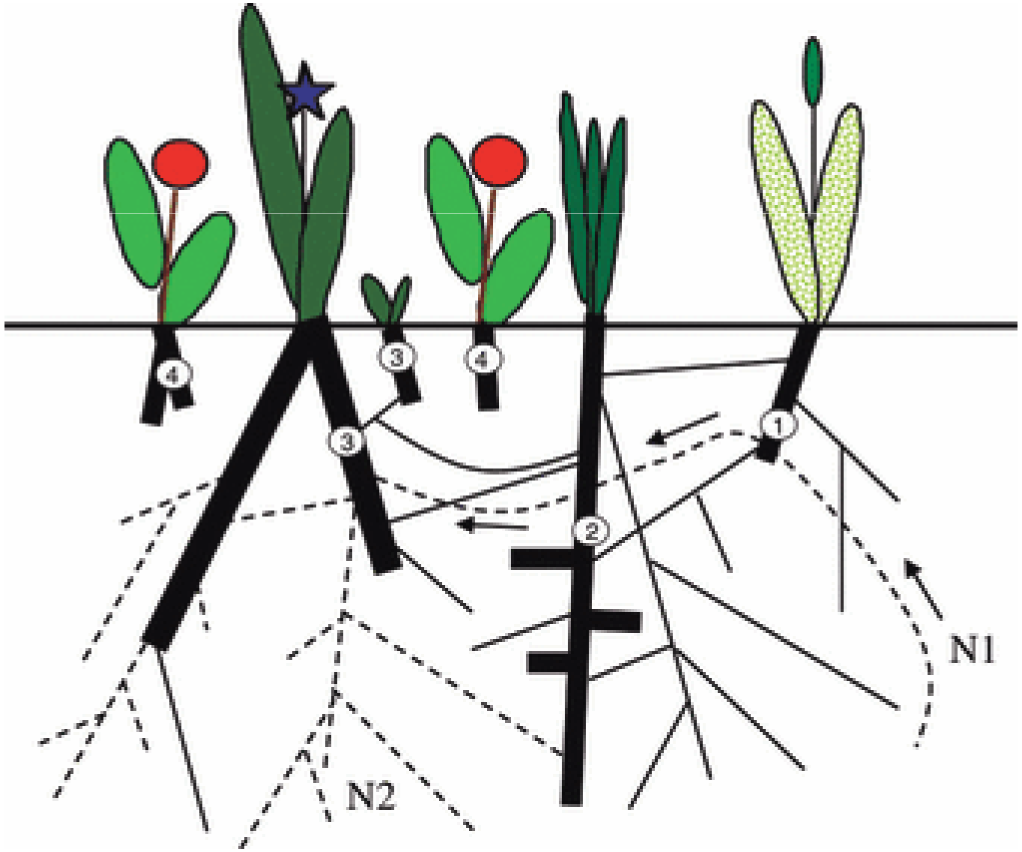


(IFA, 2009)

Knowledge:

- For a better use of agricultural inputs

Examples of CMNs between different plant species



(Van der Heijden & Horton, 2009)

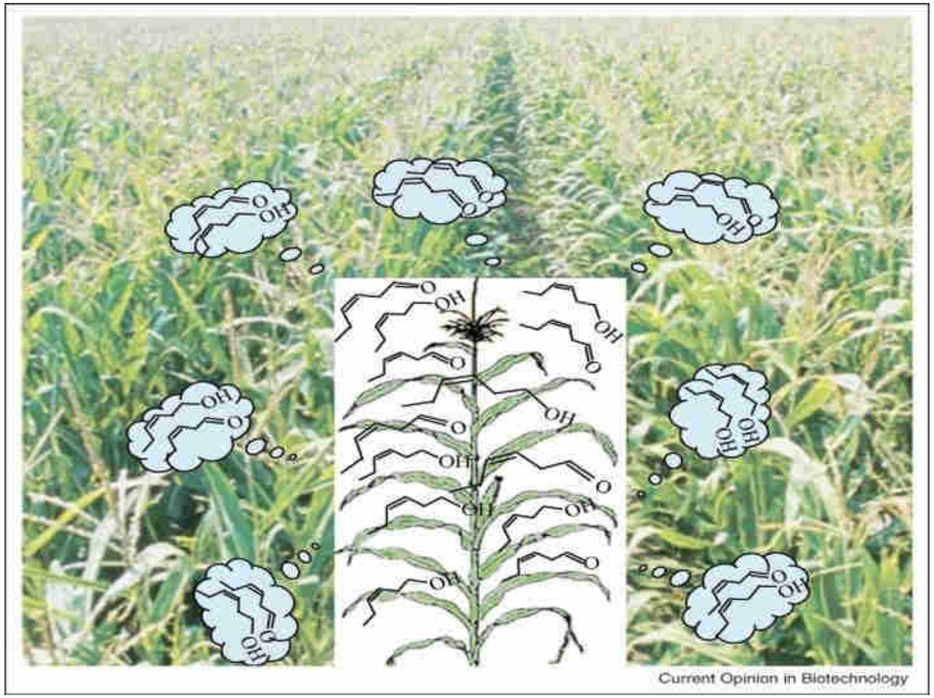
Knowledge:

- For a better use of agricultural inputs

(Photo V. Beauval)

Knowledge:

- For a better use of agricultural inputs
- Using plant sciences knowledge as well as agroecological knowledge



(Dudareva & Pichersky, 2008)

Knowledge:

- For a better use of agricultural inputs
- Using plant sciences knowledge as well as agroecological knowledge
- Making a better use of farmers' knowledge

(Photo F. Ramahandry)

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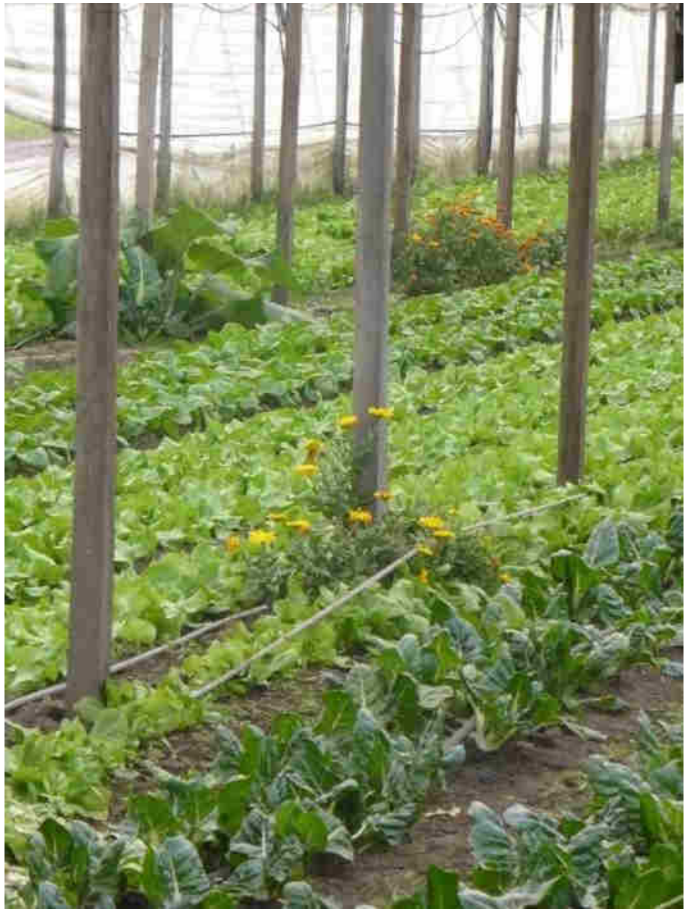
Conclusion

- We often only know the direction of variation and not a predictable quantitative assesement of the impacts of changes in agricultural systems , and despite we have to act
- As a result we do need thorough and frequent checking
- Double green revolution is the exact opposite of a uniform and well-known track. It will be a hard, local-dependant, imaginative but clumsy avenue – and should be a common strategy.

Many thanks



for your attention

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