

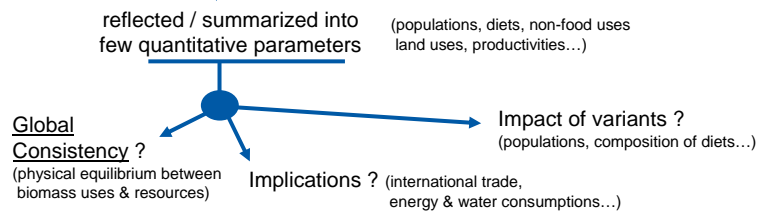
Aims & architecture of Agribiom

A quantitative module designed for facilitating collective explorations and debates as well as hybrid modeling relating to global productions, trade and uses of biomasses

1 The ambition for Agrimonde

Having a quantitative tool for :

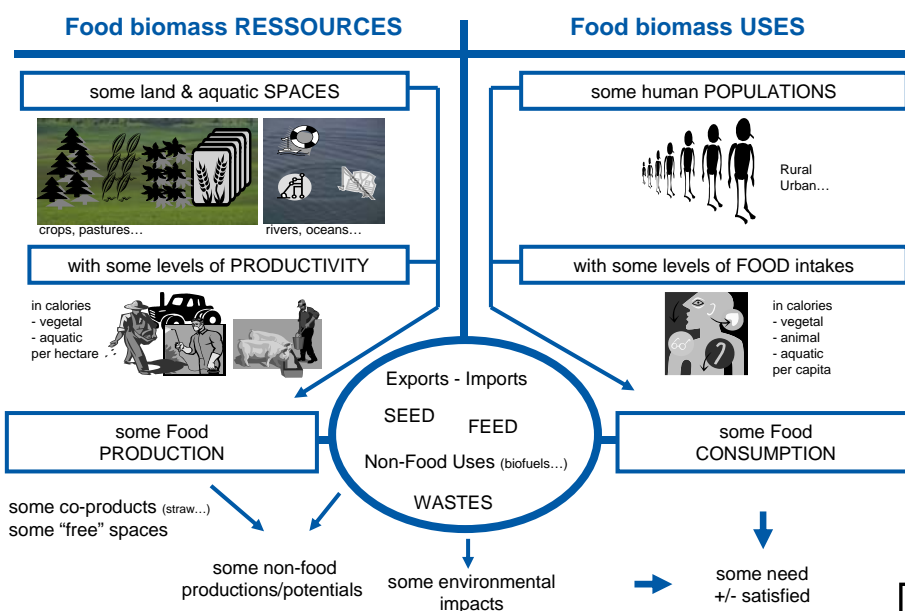
- (1) revisiting the past, better understand it (with new estimates, new models...)
- (2) debating the future ...from scenarios description (own or external qualitative conjectures)



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2 The engine

S/U physical equilibriums of food biomasses reconstituted (1961-2003, out of FAOSTAT commodity balances in metric tons) and/or simulated (2030, 2050...) on more than 97% of the world land surfaces (149 basic «regions»)



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3 The items

■ 5 « compartments » of food biomasses (only...)

■ Other productions (non-food...)
Fibres, Tobacco, Rubber... Fodders ...Wood



PLANTS (VEGE)

Cereals : wheat, rice, barley, maize...
Sugar crops : sugarcane, sugar beat...
Pulses : beans, peas...
Oilseeds : soybean, groundnut, coconut...
Roots & tubers : cassava, potato...
Fruits & vegetables : apple, onion...
Stimulants : cocoa, coffee, alcohol...



GRAZING ANIMALS (RUMI)

Meats : bovines, goat, mutton...
Milk, Butter, Animal fats...



Non-GRAZING ANIMALS (MONO)

Meats : poultry, pig...
Eggs...



FRESH WATER (AQUA)

Fishes...



MARINE (MARI)

Demersal & Pelagic fishes... *Fats*...

1961-2003 : 120 product lines of Faostat1 (SUA - Commodity Balances)

4 The unit of account

■ Food **CALORIES**

(or equivalent for oilcakes, molasses...)

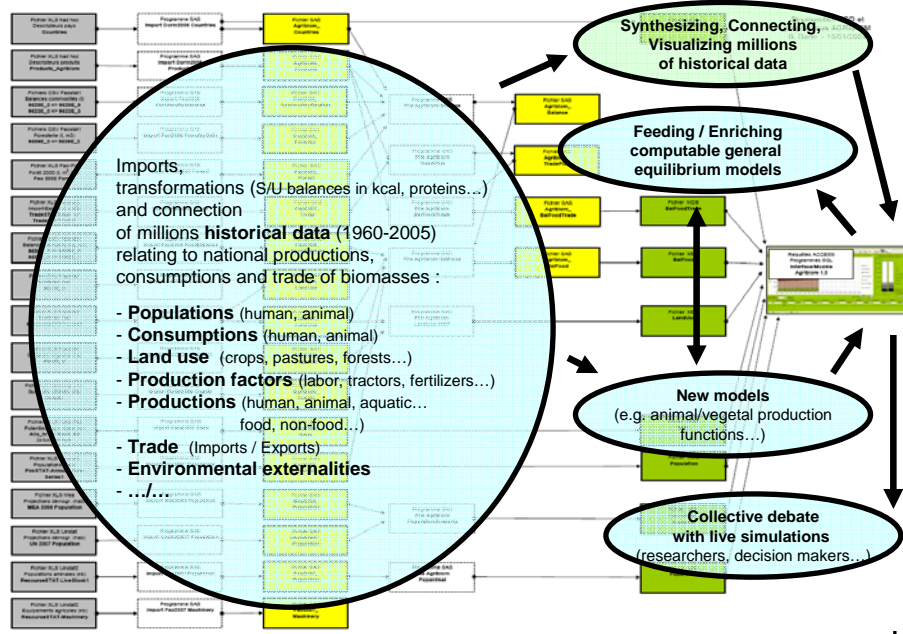
Total Calories = Carbohydrates (4 kcal/g)
+ Proteins (4 kcal/g)
+ Fat (9 kcal/g)

■ Tonnes (ou m³) of DM

- Fibres, rubber...
- Crop residues...
- Fodders...
- Wood (fuel or industrial wood)

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5 A convergence on an interactive interface



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6 A 1st set of robust models

Cross-country animal production functions

(B. Dorin + T. Le Cotty)

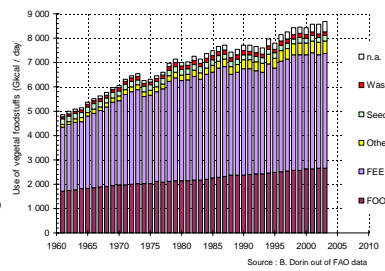
■ A model with 2 interdependent functions

- $\text{Prod_Rumi (Gkcal)} = f(x_1, x_2, x_3, \dots, \text{Prod_Mono})$
- $\text{Prod_Mono (Gkcal)} = f(x_1, x_2, x_3, \dots, \text{Prod_Rumi})$

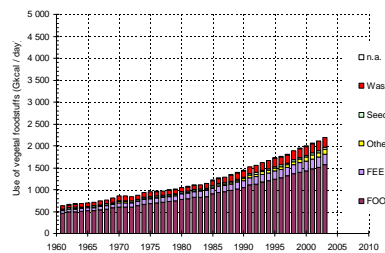
■ Key explaining factors (x_1, x_2, x_3, \dots) :

- **Feed of vegetal origin** (Gkcal)
- **Feed of animal origin** (Gkcal)
- **Pasture area** (1 000 ha)
- Agricultural active population (1,000 cap)
- Tractors (units)
- .../...

OECD
SSA
(Sub-Saharan Africa)



(in 2003, the OECD cattle ate 3 times as much foodstuff as the SSA human population did)



■ Several models now available :

- **linear** / quadratic
- CalTot / **CalPro** (unit for the feed and for the outputs...)
- with/without «**Dummies**» (region, years...)
- with/without «**Trend**» ("technical progress")
- «**Region-based**» (MEA regions...) or «**Type-based**» (agricultural/industrial, extensive/intensive...)
- .../...

■ Results :

- replicate very-well the past 40-year of national/regional/global animal productions
- "on-line" tests and modeling (choice of model, change of parameters/coefficients, simulations...)

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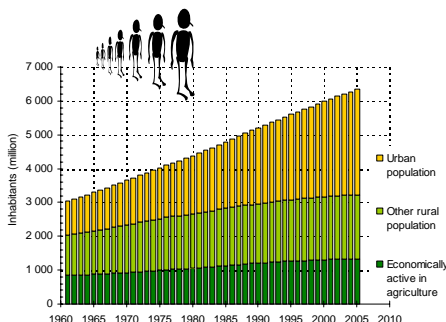
Part II

From past trends to scenarios

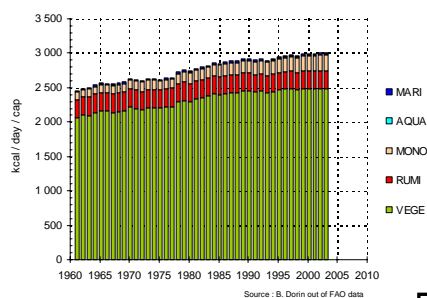
A 1961-2003 brief overview of the world food economy through Agribiom eyes...

1 From average world increases...

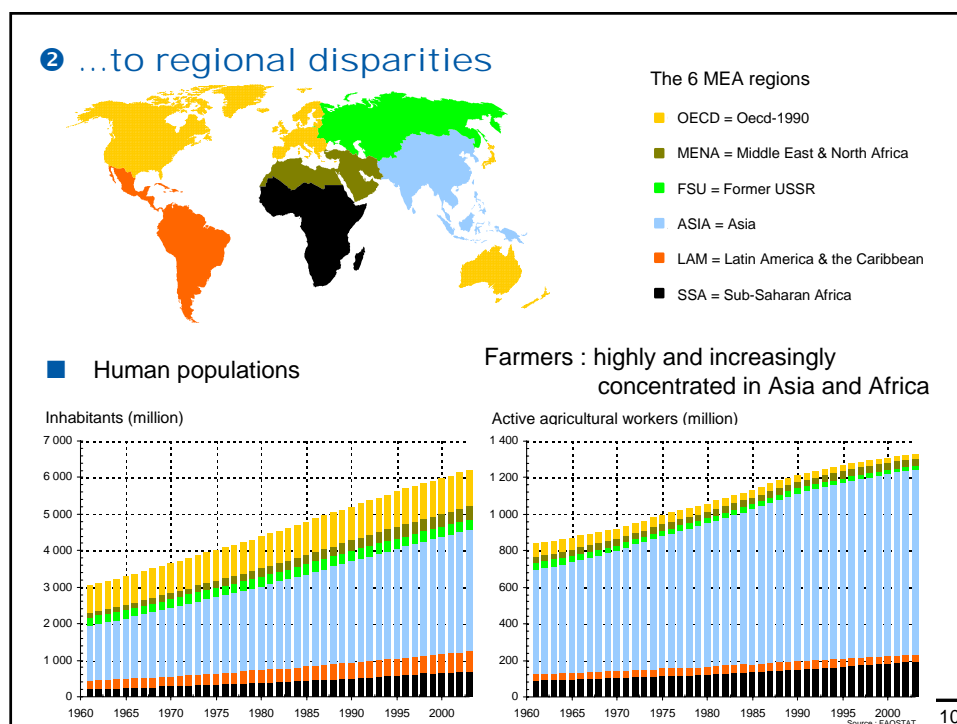
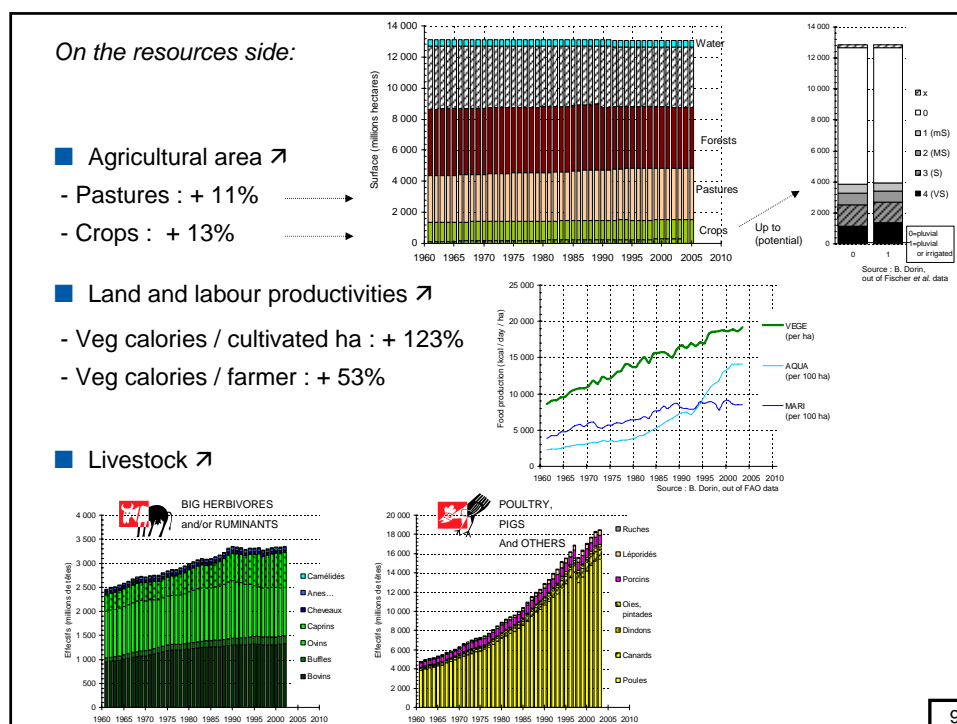
■ The population doubled



■ The per-capita food availability increased too...



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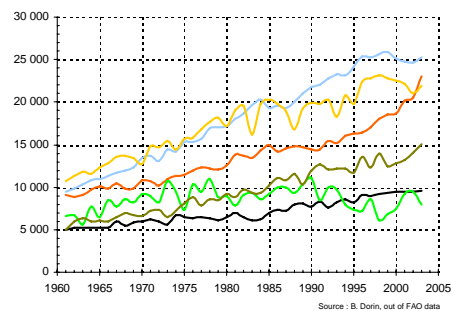


■ Highest land productivity in ASIA

Note : 10 000 kcal =
 ~ 2.4 kg of soybean
 ~ 2.8 kg of rice milled
 ~ 2.9 kg of pea
 ~ 3.0 kg of wheat
 ~ 15.0 kg of potato
 ~ 58.8 kg of tomato

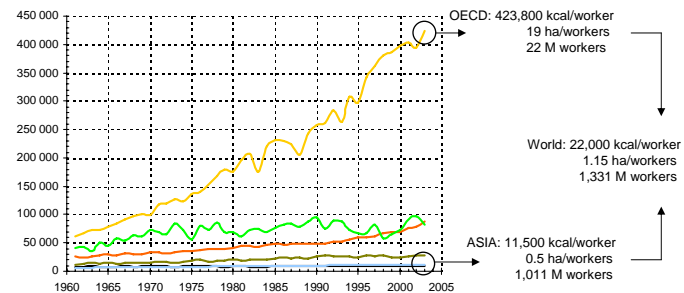
— SSA
 — LAM
 — ASIA
 — FSU
 — MENA
 — OECD

Vegetal kcal / day / cultivated hectare



■ A labour productivity boom in OECD

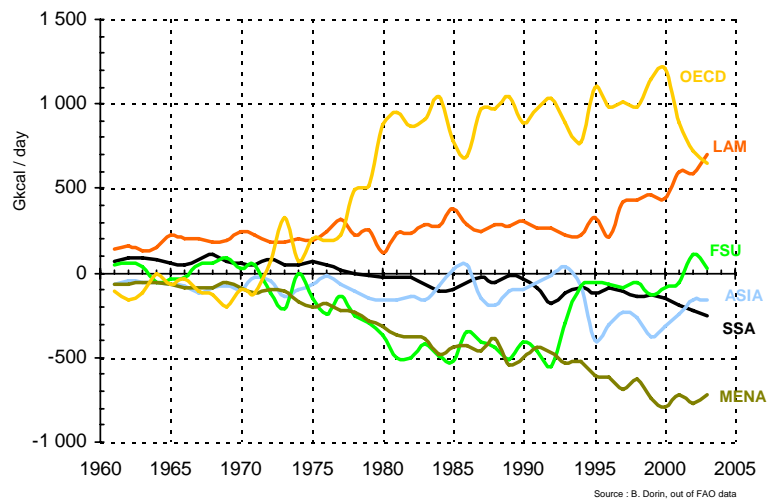
Vegetal kcal / day / agricultural worker



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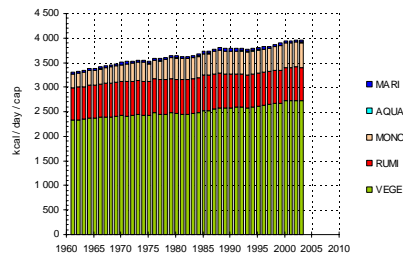
■ A boom of food trade to clear surpluses and fill in deficits

Net balance of vegetal food trade
 (Exports - Imports)



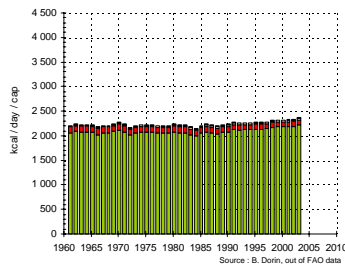
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■ But still very large disparities in per-capita food availabilities



OECD

- Animal proteins : 71 g / day on 125 (60%)
- Animal fats : 89 g / day on 165 (55%)



Sub-Saharan Africa

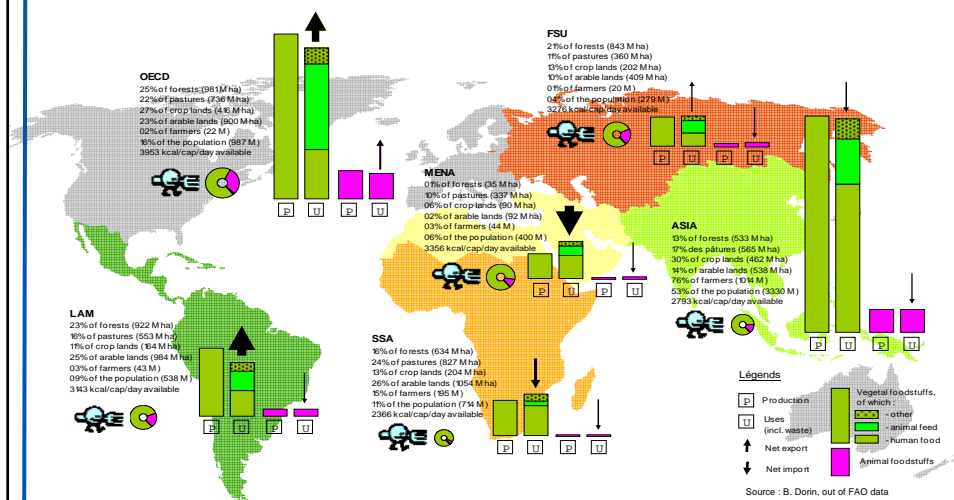
- Animal proteins : 12 on 60 g / day (20%)
- Animal fats : 10 on 48 g / jour (20%)

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③ Towards which new «equilibrium» in 2050 ?

■ Resources, productions, trade and uses of food biomasses (2003)

<http://www.cirad.fr/upload/en/communiqu/Cirad-Inra-Agrimonde-GB.pdf>



■ Scenarios, hypotheses, collective debates... (2050)

Agribiom simulations

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Scenarios and challenges for feeding the world in 2050

Two first explorations by Agrimonde : the "AGO" and "AG1" worlds

1 Towards which new «equilibrium» in 2050 with...

- +/- **population growth** (7-11 billions inhabitants in 2050) ?
- +/- **incomes, incomes distribution and population migrations** (regional opportunities of decent incomes, self-subsistence...) ?
- +/- **change in food diets** (vegetal/animal, macro/micro nutrients...) ?
- +/- **demand in non-food products** (bio-energies, bio-materials...) ?
- +/- **economic liberalization and trust in international trade** ("sovereignty" in cereals / other basic vegetal foodstuffs / feed for animal productions / animal foodstuffs...) ?
- +/- **environmental regulations** (forests, greenhouse gases, biodiversity...) ?
- +/- **important crisis on present yield boosts** (fossil fuels, water, pesticides, phosphates...) ?
- +/- **climate change**
- .../...

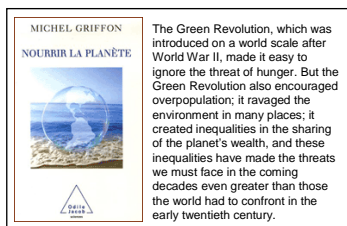
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2 The "AGO" and "AG1" worlds

Two scenarios "reprocessed"

The *Doubly Green Revolution* scenario

Source: Griffon M., 2006. Nourrir la planète. Pour une Révolution doublement verte, Odile Jacob, Paris



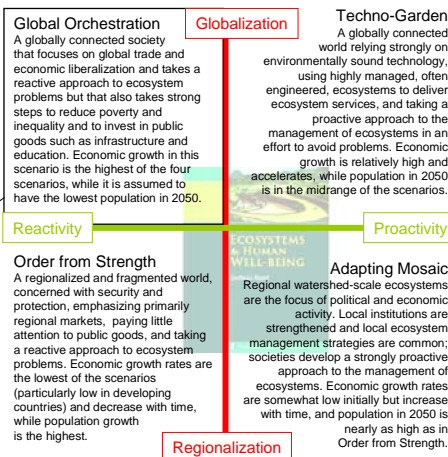
Agrimonde platform

The "Agrimonde 1" scenario (AG1)

The "Agrimonde GO" scenario (AGO)

The *Millennium Ecosystem Assessment* scenarios

Source: MEA, 2005. Ecosystems and Human Well-being: Scenarios, The Millennium Ecosystem Assessment, Washington DC.

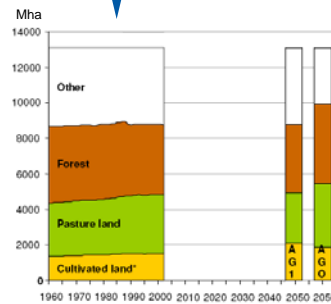
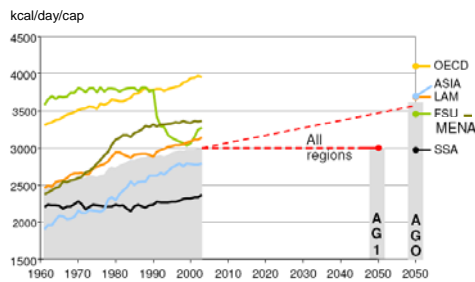
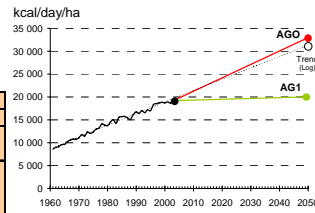


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■ Main quantitative assumptions

	2003	2050 - AG1	2050 - AGO
Uses			
Population	6.2 Gcap	8.8 (+42%)	8.8 (+42%)
Human food	3,000 kcal/day/cap	3,000	3,590 (+19%)
Other uses	~14,440 Gkcal/day	17% Non-Veg Feed (Agribiom) + seed (3%) + waste (max 4%) + other (max 5%)	23% Non-Veg Feed (Agribiom) + seed (3%) + waste (max 4%) + other (max 5%)
Resources			
Food yields	~19,190 kcal/day/ha	~20,030 (+4%)	~32,940 (+75%)
Crop land - for N-Food	~1,530 Mha	~2,105 (+38%)	~1,860 (+21%)
Pastures	~3,330 Mha	~2,845 (-14%)	~3,585 (+8%)
Forest	~3,905 Mha	no change	+14% (?)

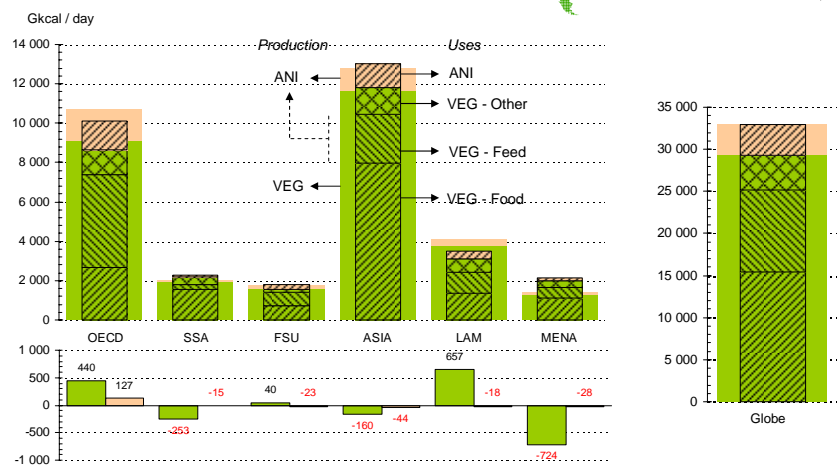
Trade : trade of plant food only (i.e. no trade of animal foodstuffs or by-products)
(hypothesis/variant n°1 written "h01")



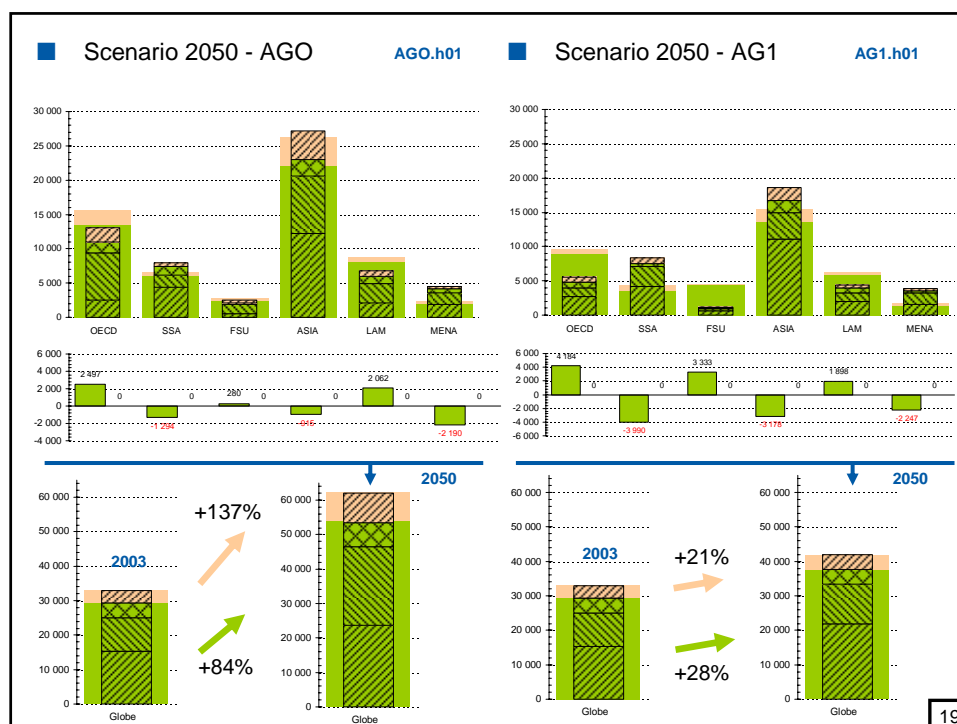
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③ Two new hypothetical equilibriums for 2050...

■ Base 2003



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④ Amongst conclusions...

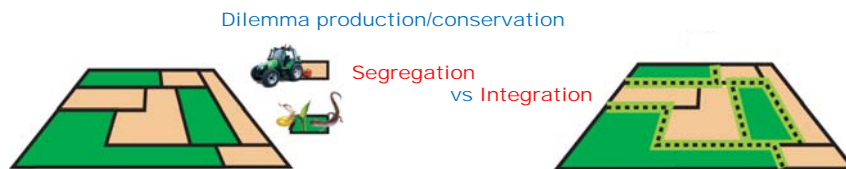
The planet can feed properly 9 billions people in 2050 but...

- What is in our plates (total calories, %Veg/Ani, macro/micro-nutrients...) is a key driver for:
 - preserving some ecosystem services (carbon sequestration, soil, water, pollination...)
 - and/or saving the use of some agricultural inputs (water, fertilizers, pesticides...)
 - reducing some important human health problems (from under-nutrition to obesity)
 - opening larger opportunities for non-food productions (bio-energies, biomaterials...)
 - and reducing substantially post-harvest losses and food wastes
 - maintaining a diversity of production systems, landscapes and environments
- Food trade can secure some regional food needs and avoid huge migrations, provided the net-deficit regions/populations can:
 - pay for their food imports (local opportunities of incomes?)
 - rely on a fair and transparent international trade regulation system
 - ...also aware of poor farmers incomes

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■ Preserving or improving agricultural yields calls for breakthroughs:

- (a) Need for much less polluting & less dangerous techniques (for workers, flora, fauna...)
founded on: - much better exploitation of ecosystem services (pollination, IP...)
- new technologies (ITC, genetics, monitoring...)
- mobilizing jointly scientific & local knowledge (social learning processes)
- (b) "Ecological intensification" might emerge as an interesting option
for sustainable biomass production and food security of poor farming families,
provided we don't stay locked-in a 50 year-old model of agricultural intensification
- (c) The yield/area dilemma might be an opportunity to overcome
usual boundaries between cities, wider countryside & natural areas:
- urban & peri-urban agriculture...
- agro-forestry, agro-ecology...
- stewardship of wet areas (...and not only draining them)
- complementarities between differentiated areas (...and not setting land aside)



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To follow up...

- Need to involve a large set of actors, stakeholders
...and academic disciplines into food production,
food security, food safety and food quality issues!
- Need to debate food and agriculture scenarios
at various regional levels (...with various stakeholders)
- Need to better simulate (with Agribiom and other quantitative tool)
- induced consumptions of fossil fuel and water
- GHG emissions/sinks (C, CO₂, CH₄, N₂O...)
- regional employments / incomes / migrations
- .../...

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