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For quality of life

Feeding the world in 2050
–
back to basic ecological principles

Prem S. Bindraban

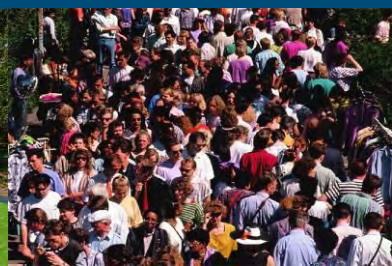
Food and Sustainability

Foodfirst Floriade Conference

8 May 2012, Venlo







Resource Use – Our ecological footprint

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Grain Equivalents

- Vegetarian diet:

  1 - 1.5 kg/person/day

- Affluent (“meat-rich”) diet:

  4 - 4.5 kg/person/day

Land requirement diets

- European diet (appr. 4.5 kg grain eq./p/d
- Current land required appr. 3000 m^2/p/d
- ±9.000.000.000 people
  - ± 3 billion ha (current EU27 yield level)
  - ± 2 billion ha (Netherlands yield level – close to potential)
  - > 9 billion ha (Organic / current yields sub Sahara Africa)

World = 13.5 billion ha

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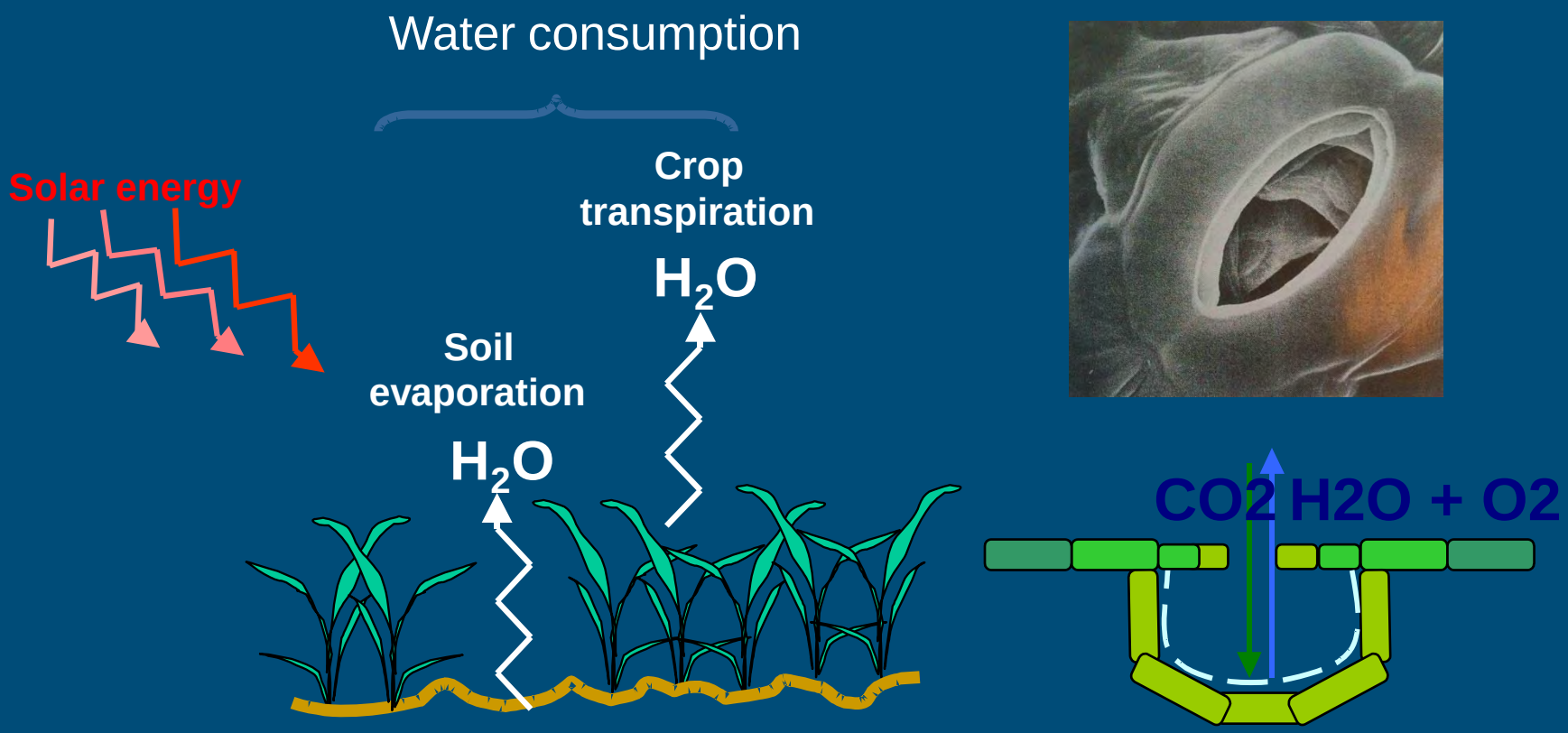
Water requirement in agriculture



Theoretical minimum transpiration ± 600 liter/kg grain →
Practice evaptranspiration ± 1300. (1000 liter – rule of thumb)

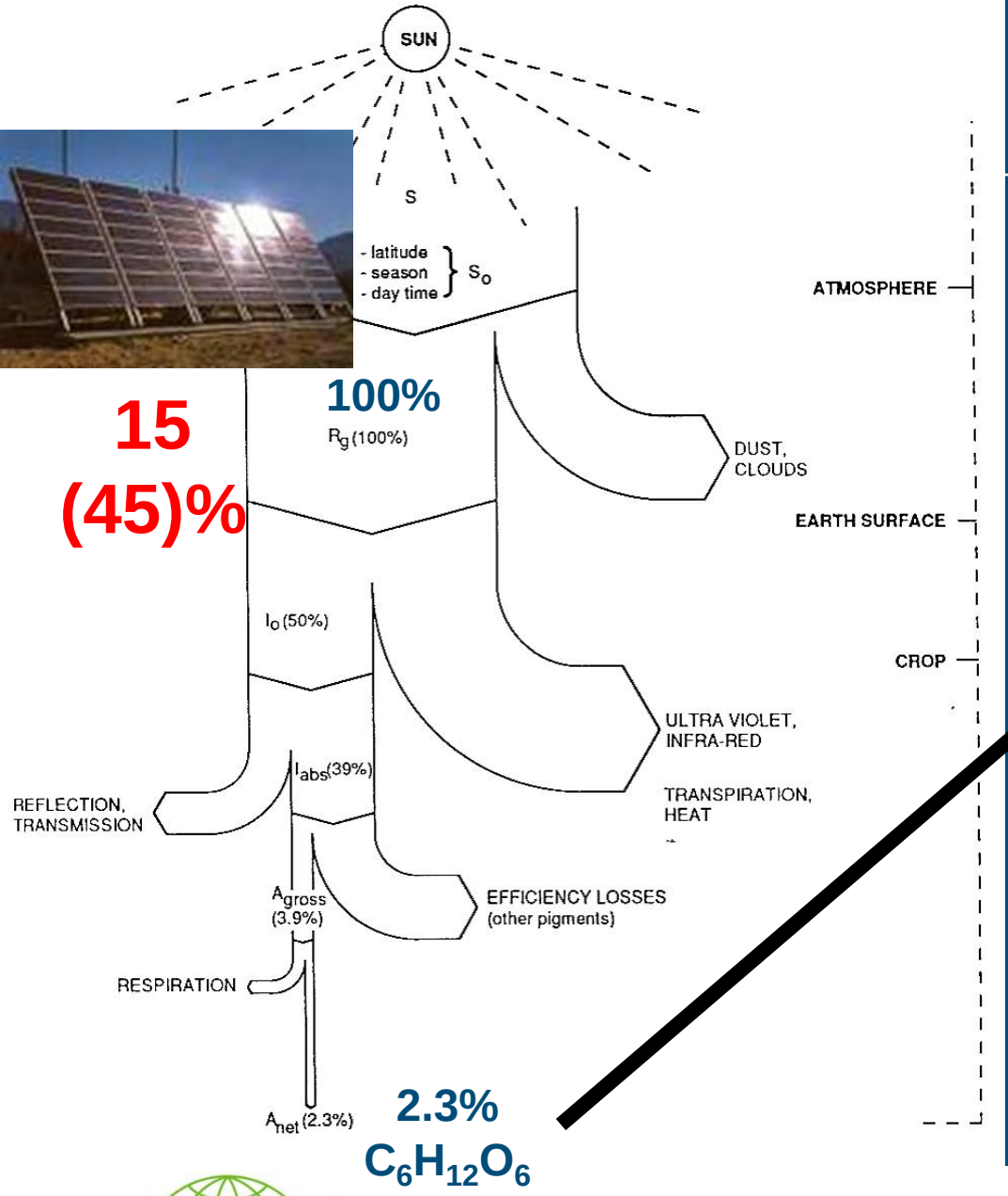
Claims on natural resources

- Vegetarian diet
  - 1 - 1.5 kg grain eq./person/day
  - 1000 - 2000 l water/person/day

- Affluent (“meat-rich”) diet
  - 4 - 4.5 kg/person/day
  - 5000 - 6000 l water/person/day

+ other resources

Energy efficiency



15 (45)%

100%

R_g (100%)

2.3%

$C_6H_{12}O_6$

Annual actual efficiency

0.5% temperate – 2.5% year round

Gross

0.2 – 0.8 % net energy

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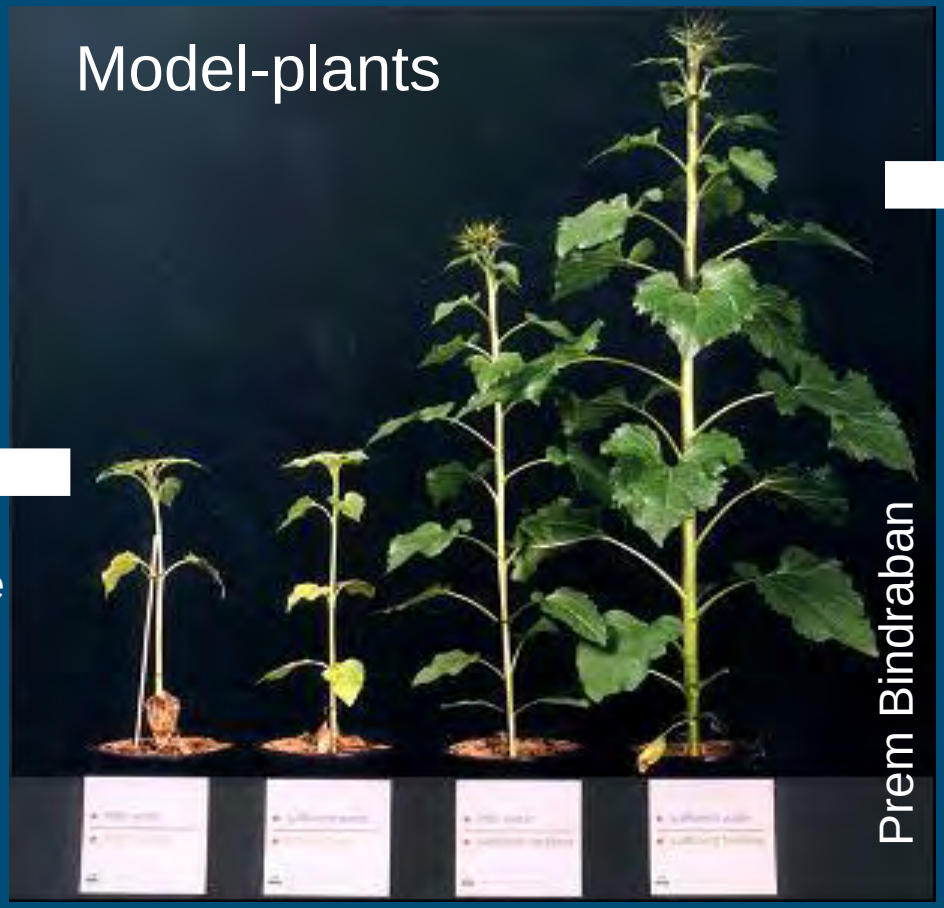
Basic production ecological principles



Radiation use efficiency GROSS

0.5% temperate
– 2.5% year round

Radiation use efficiency GROSS

<< 0.5% temperate
– 2.5% year round

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Based on own experiments Prem Bindraban

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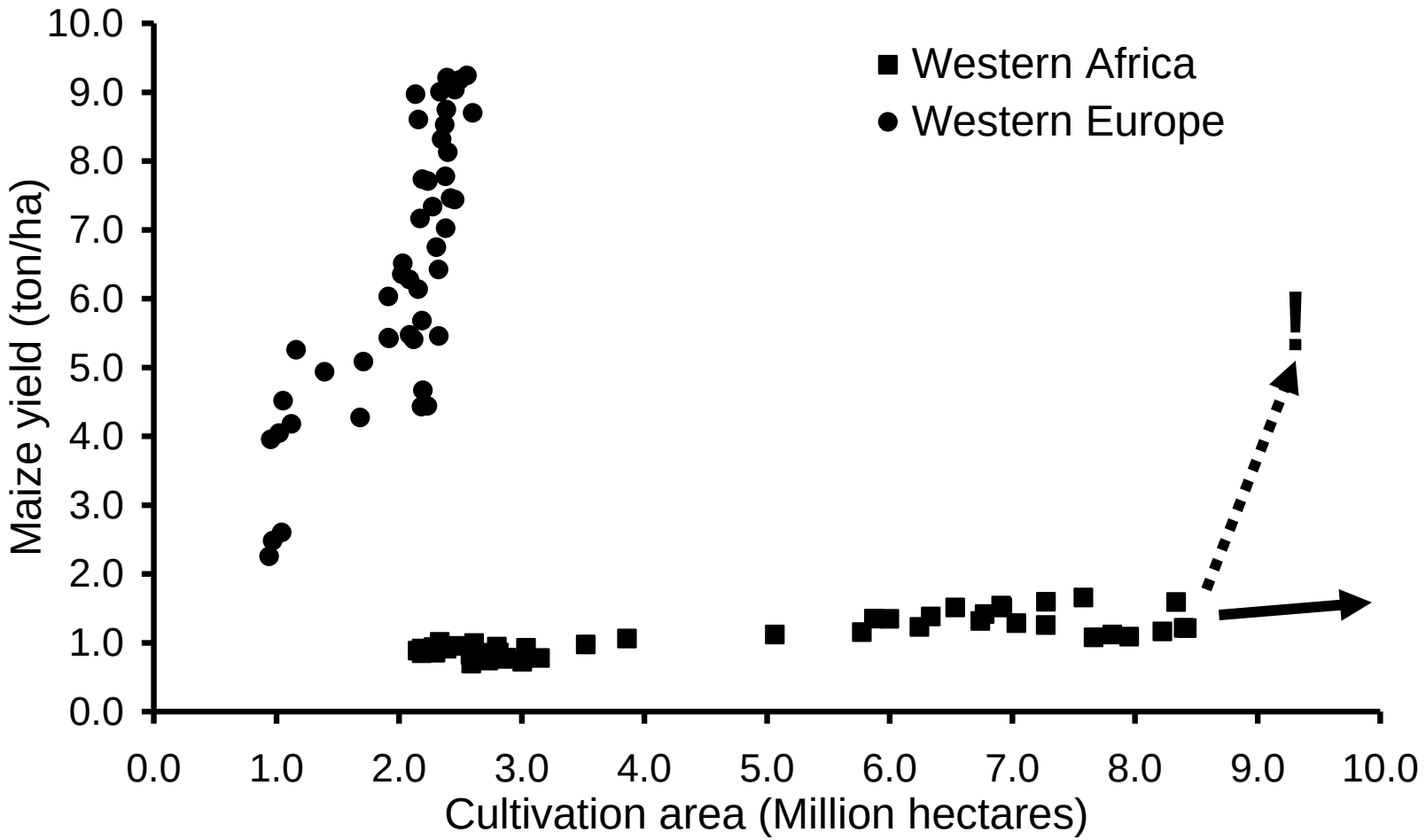
DON'TS

- Struggle to continue outdated forms of life
- Too much emphasis on maintaining interest of current (industrial/political) players
- Emotional

- Leads to
  - False reality (e.g. organic agriculture)
  - Counter productive solutions (e.g. biofuels)
  - Extreme unrealistic options (e.g. vegetarian diet)

- Intensions are honorable but means are mistaken

DO – Stimulate (optimized) intensification not organic agriculture



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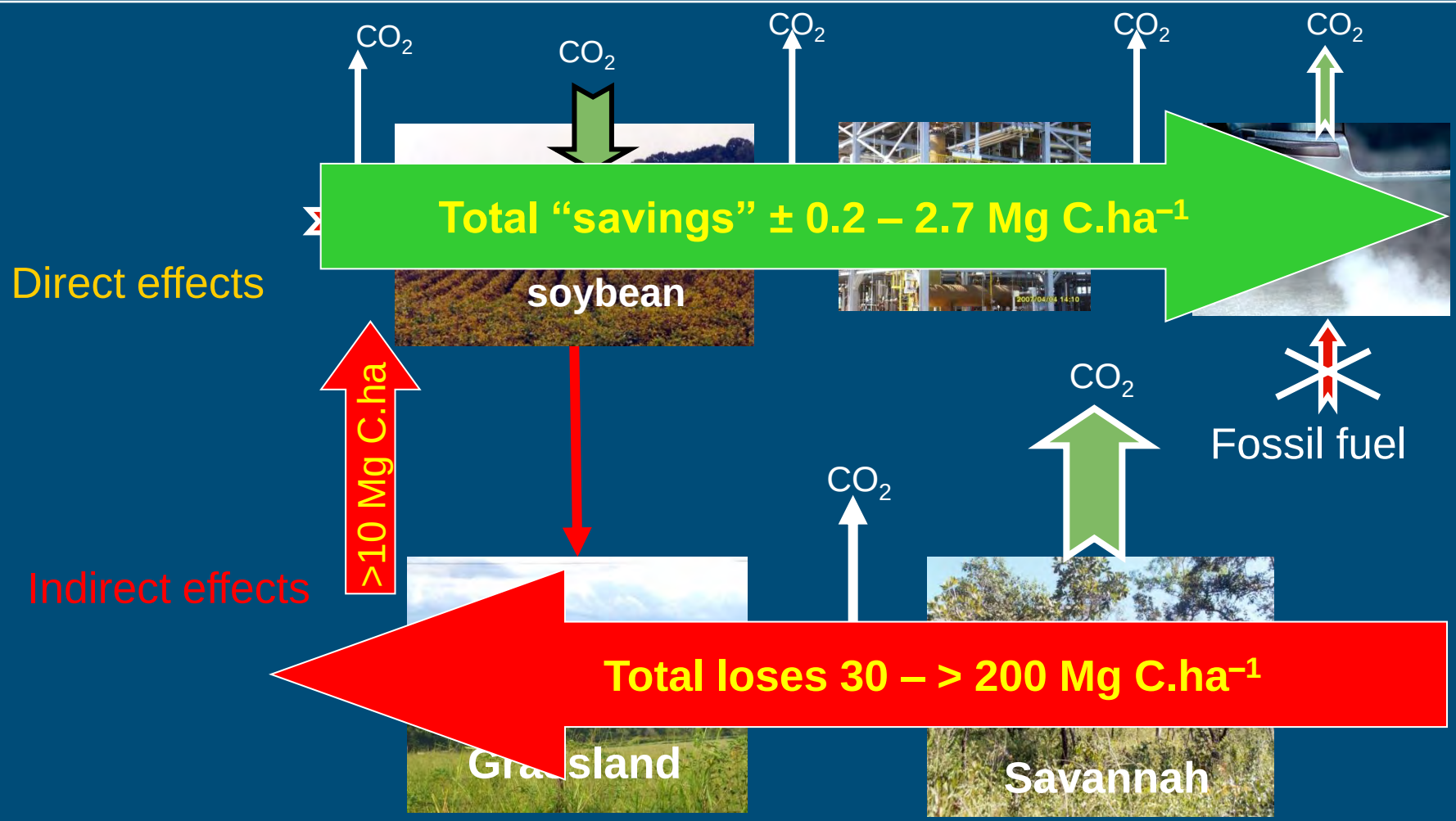
Use (artificial) fertilizers

Rainfed
+ fertilizers

Rainfed
- fertilizers

DON'T stimulate biofuels (both 1st/2nd gen)

Prevented CO2 emissions



15 – >150 years to make up for losses

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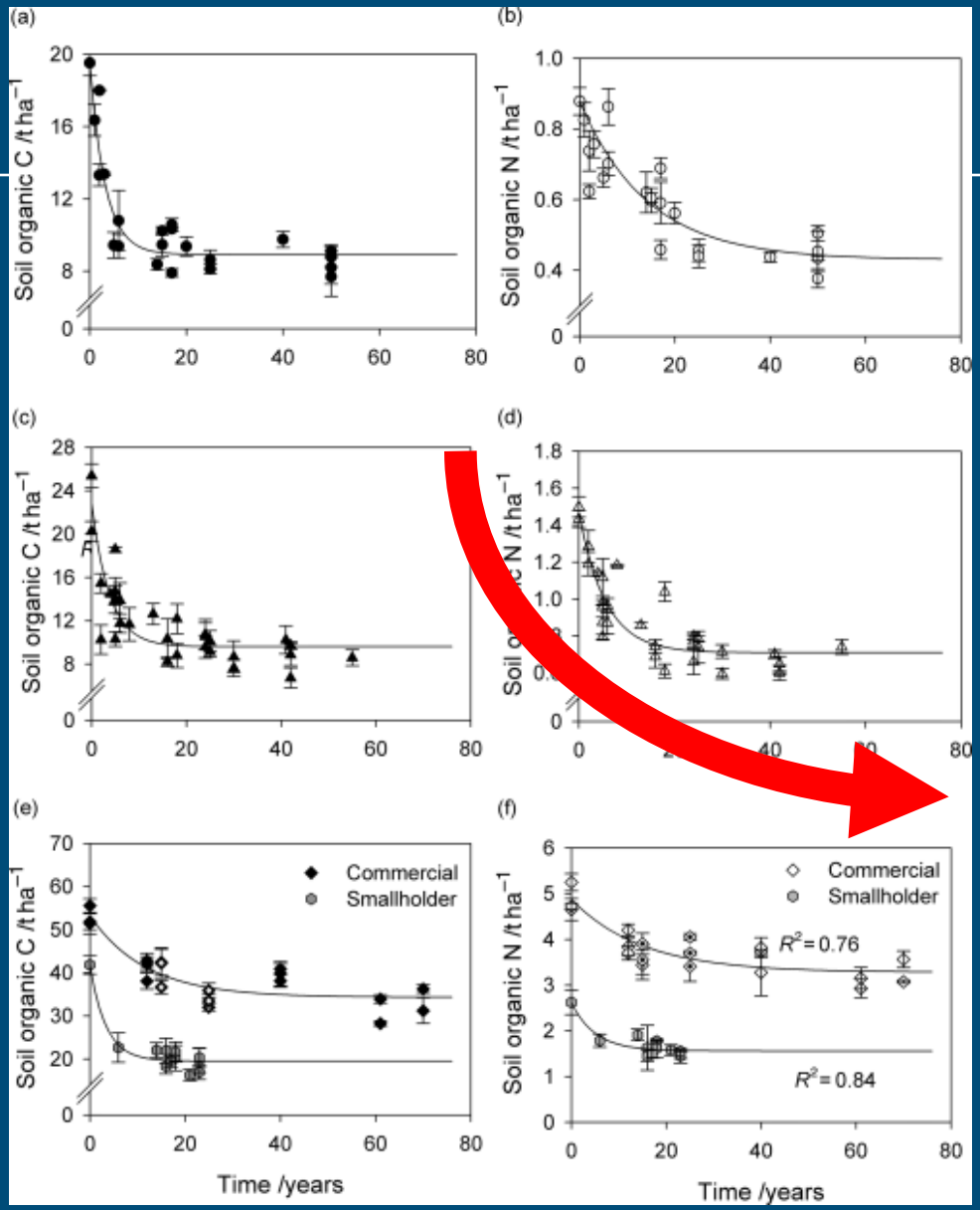

Field observation of soil organic carbon after clearing

Land clearing detrimental to soil carbon stocks

Extraction of residues decrease soil fertility

Zingore, et al., Europ J. Soil Sci 56: 727-736

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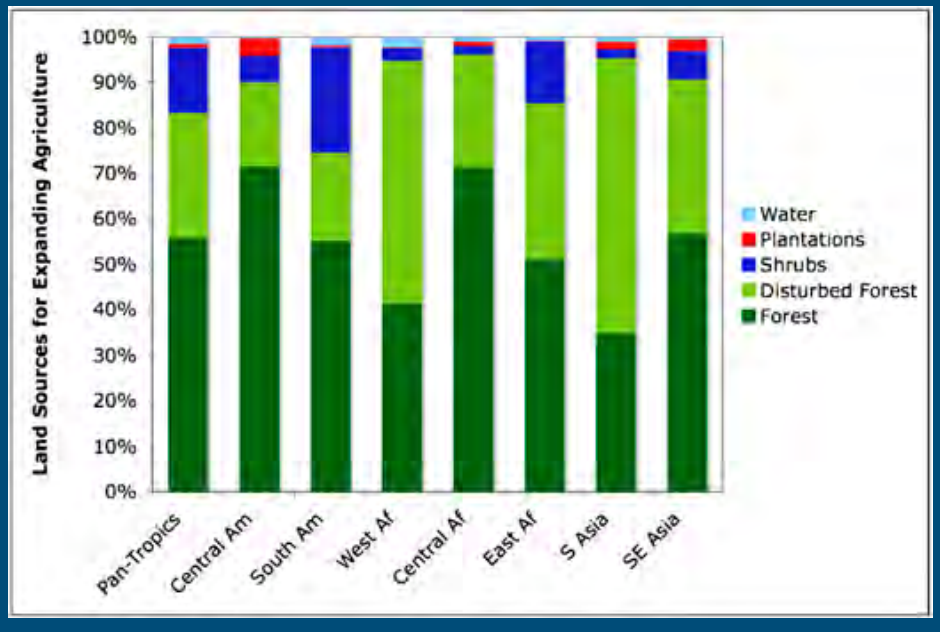
Marginal lands

Marginal yields
(Too) high investments needed
Irrigation, fertilization, etc
Infrastructure, Institutions lacking

Ultimate expansion into forests and savanna

1980s
and
1990s



biofuels

expansion of agricultural land appears to come from expansion into intact forest (55%), disturbed forest (28%) and savannah (8%)

H. K. Gibbs, et al., 2010. Tropical forests were the primary sources of new agricultural land in the 1980s and 1990s. PNAS, 107 (38) 16732–16737.

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Google-E


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Colo


2007/11/26 12:44


aMetrics
©2006 Google
100% Eye alt 14.18 mi
100% Eye alt 62.41 mi
Eye alt 594.50 mi
Eye alt 1911.26 mi
Eye alt 3634.80 mi
Eye alt 12244.74 mi

Back to basic

1

We have a food problem !
We have no energy problem !

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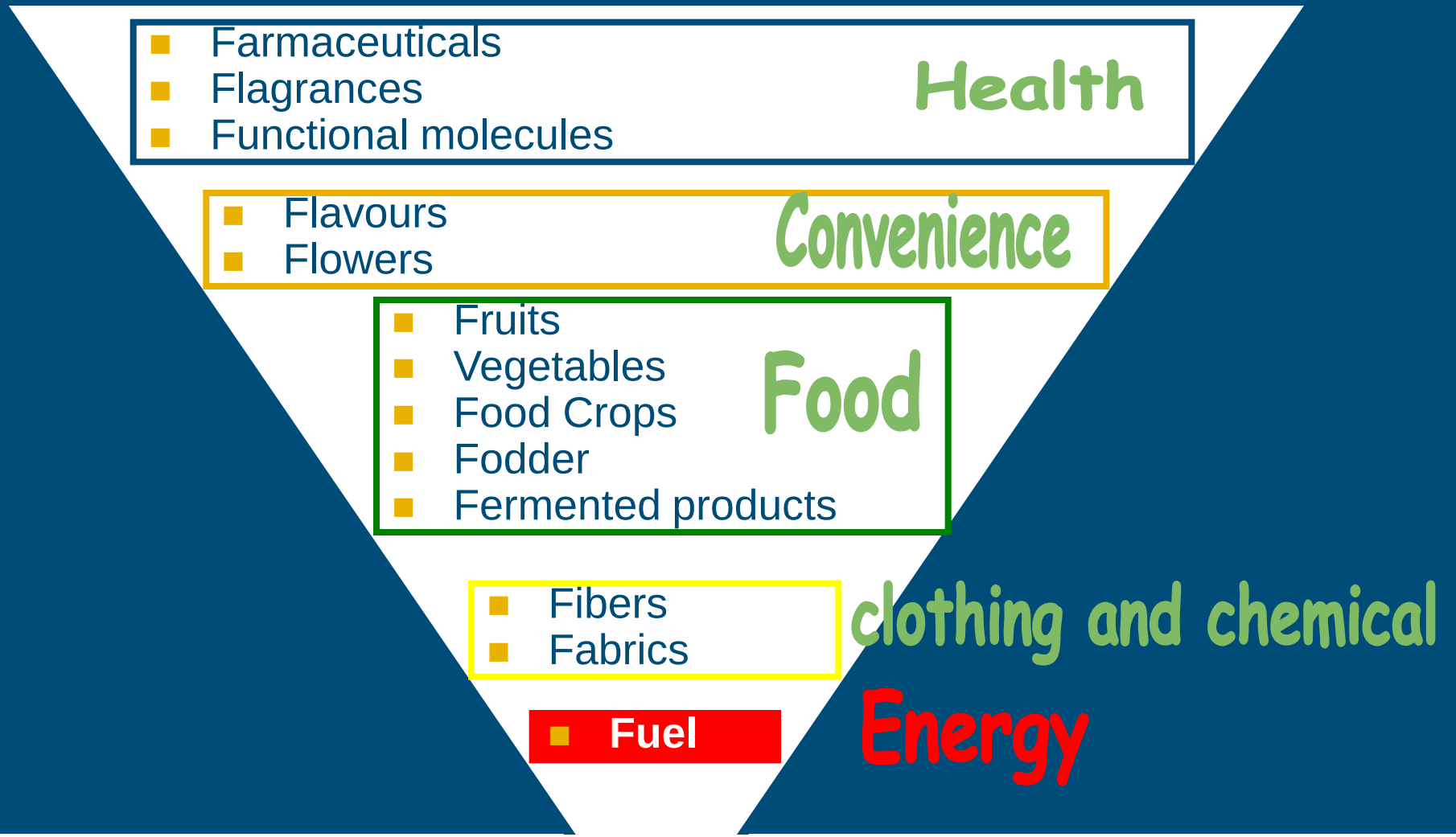
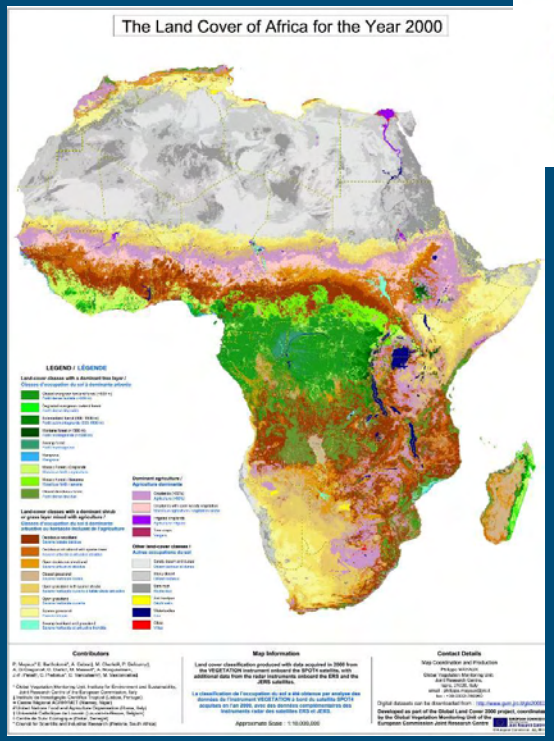
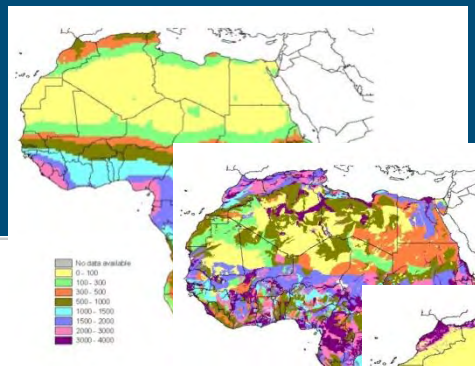
Bio-based economy – From food to fashion

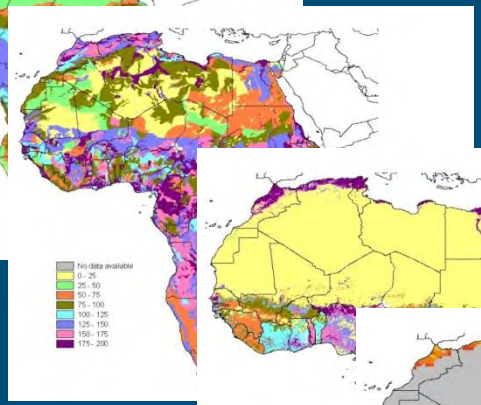


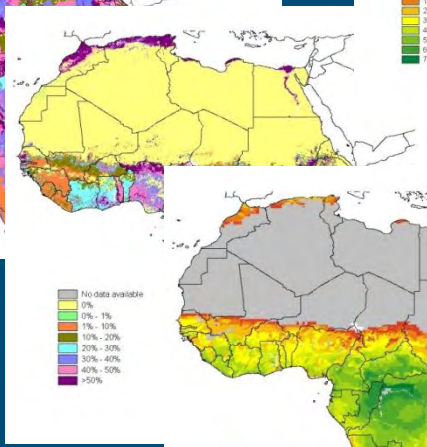
2

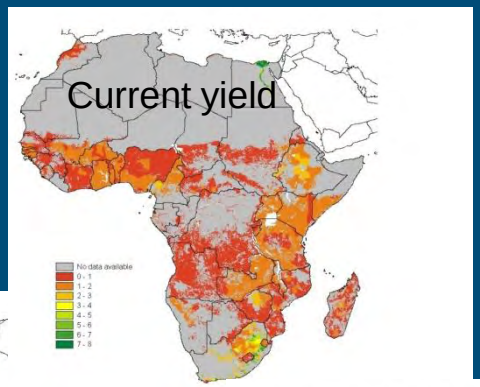
Production potentials African continent





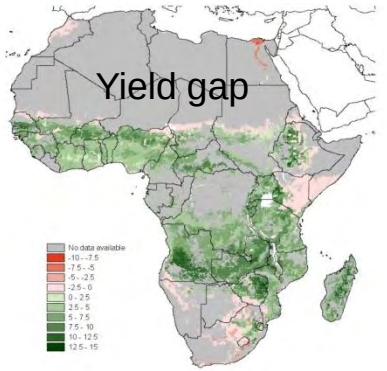






1-2 t/ha

4-5 t/ha



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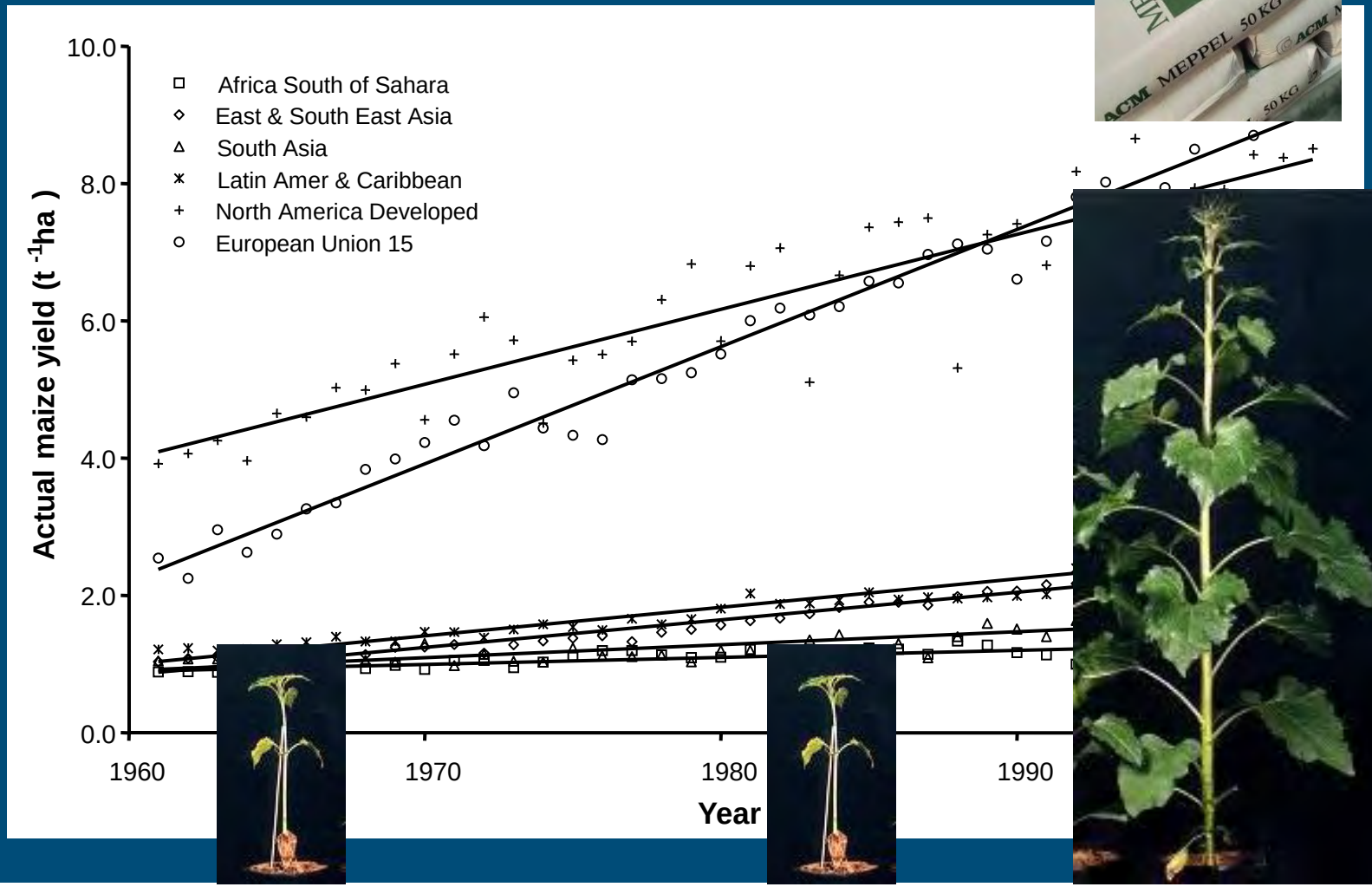
Conijn, J.G., et al., 2011 (in prep)
PRI, Wageningen UR.

Land productivity



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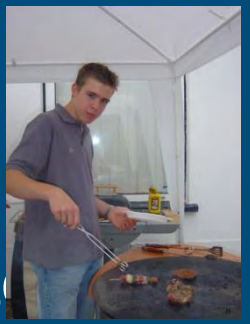
Bindraban et al. 2008. Int. J. Tech. Glob. 4 (3): 276–295

3

DO - Eat more beef

- Composition European diet (82 kg/p/y! - excessive)
  - Cropland vegetables (40%)
  - Cropland animals (40%) – pigs / chicken etc
  - Grassland (20%) – ruminants (cow, sheep, goat, etc
- Composition Africa diet (15 kg/p/y! - malnutrition)
  - Cropland vegetables (50%)
  - Cropland animals (5%)
  - Grassland (45%)



Better Utilize Grasslands for Food

Land and (rain)water (collection)

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Improvements not easily attained

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Pictures Hugo v.d. Meer

4

Water management in rice

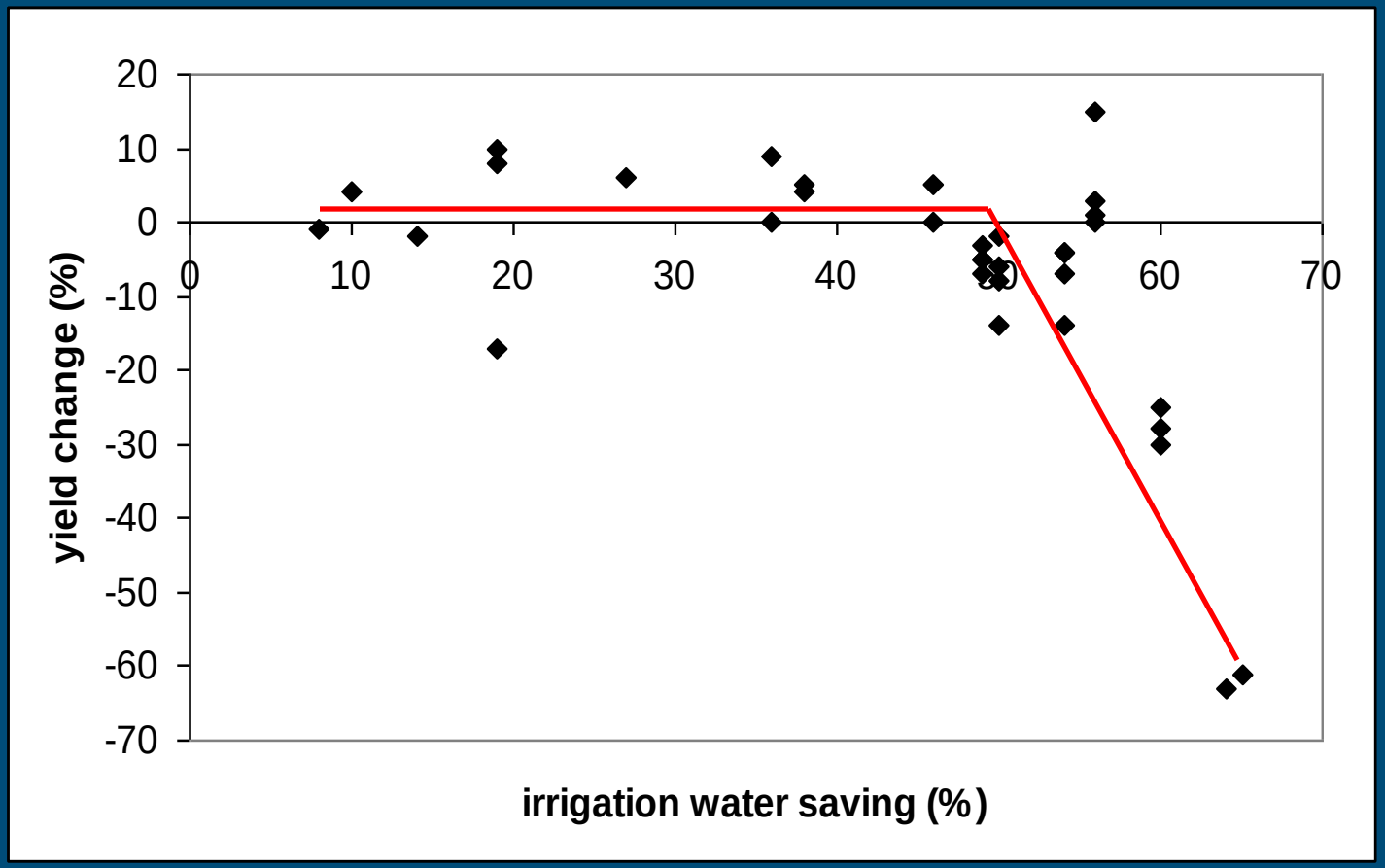
Conventional flooded

AWD irrigation

Raised beds and furrows

Aerobic rice

Results water saving rice growth



5

Precision (efficiency, risk reduction, ...)

- More precise data
  - Geographical
  - Temporal
  - (Agro-eco) System
- In order to (Develop smart fertilizers)
  - Apply right amount
  - Of the right composition
  - At the right time
  - At the right place
- How to collect the data?

Wiki-nomics

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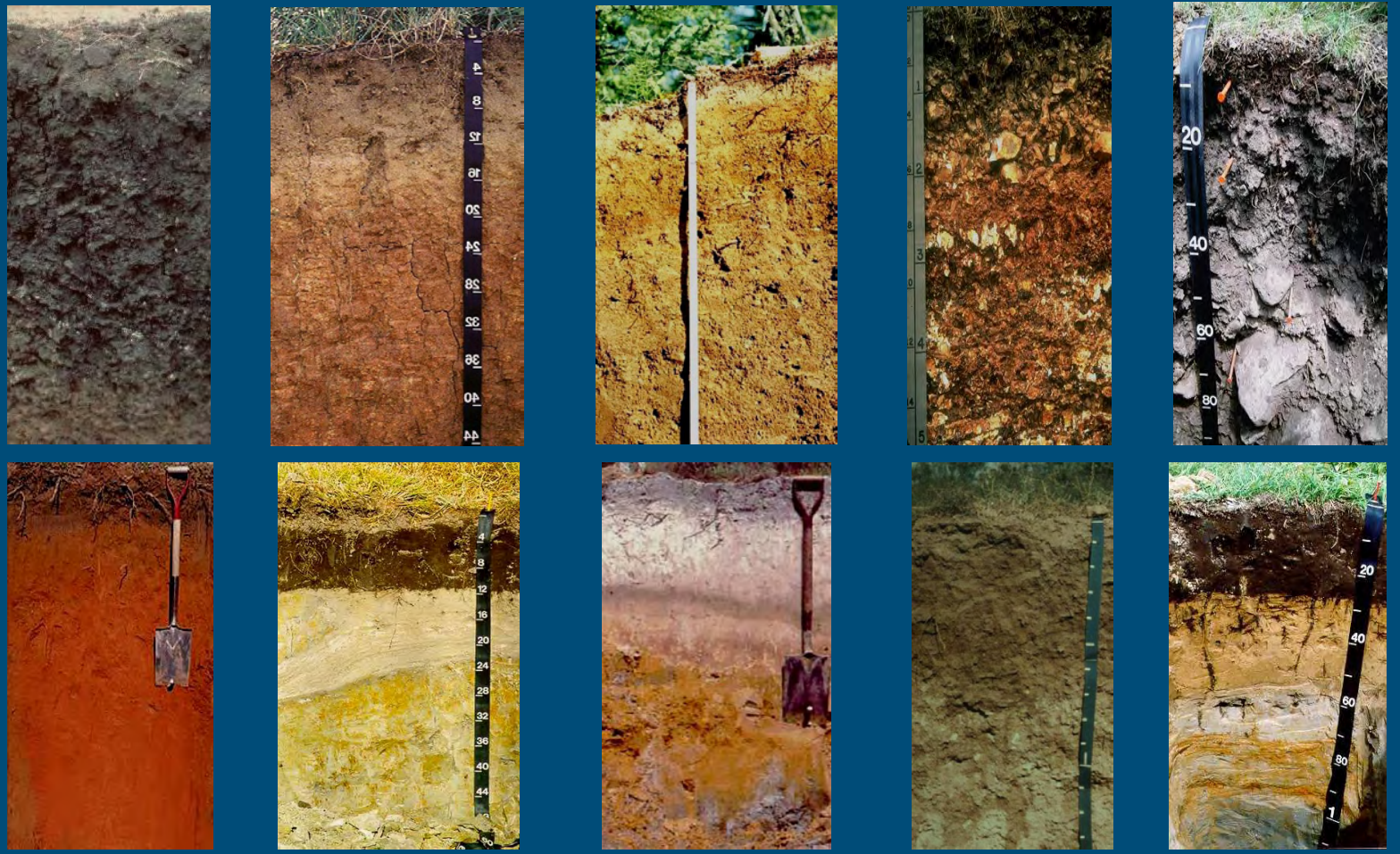
Soils



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6 etc

We kunnen zeker met z'n allen goed eten –

vandaag en in 2050

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