

A to Z of *Jatropha curcas* L.

2. Claims and Facts on *Jatropha curcas* L.

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Introduction

- Jatropha curcas Evaluation Program
- Claims and Facts



Jatropha curcas Evaluation Program (2006-2010)

- Investigate claims
- Collect and characterize
 - Genetic resources
 - Passport data
- Genotype x Environment
- Identify and Map traits for future breeding
 - Ranking differs!
- www.jatropha.wur.nl

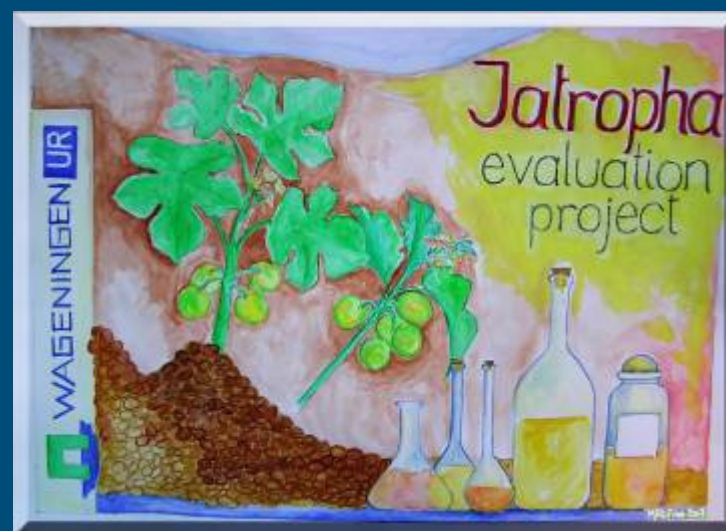
Drought tolerant

Reclaims marginal soils

High (oil) yields

No competition with food crops

Tolerant to pests and diseases



People: Positive social effects

Jatropha curcas

- enables local / rural development
- creates jobs / labour needed
- generates income
- does not compete with food production

Claims



Planet: Positive environmental effects

Jatropha curcas

- reclaims marginal soils
- conserves, protects and improves soils
- protects against erosion
- production of CO₂ neutral bio-fuel

Claims



Planet: Crop requirements are low

Jatropha curcas

- has low nutrient requirements
- grows well under saline conditions
- is drought tolerant
- has low water use (high water use efficiency)
- is tolerant or resistant to pests and diseases

Claims



Profit: Crop outputs are high

Jatropha curcas

- is an energy crop
- grows seeds with high oil contents
- provides oil of high quality
- ...provides high oil yields

- → Unfounded extrapolation...

Claims



Extrapolation, assumption & misunderstanding

- Yield claims



Mother trees

- Solitary trees
- Old and Mature
- No competition effects
 - Radiation
 - Water
 - Soil fertility
- No pressure
 - Pests
 - Diseases
- Abundance of seeds



Seeds



- Seed weight
0.1-1.0 g seed-1
- Seed oil content
15 - 45%



Extrapolation, assumption &

misunderstanding

Seed Yield (8 kg tree⁻¹)?

X

Seed oil content (45%)?

X

3.6 kg oil tree⁻¹

2500 trees ha⁻¹ (?)

X

9000 kg oil ha⁻¹

45 MJ kg.oil⁻¹

X

400 GJ ha⁻¹

2*10⁹ ha marginal land (?)

=

800 EJ

1. Solution of energy crises

2. Big Business

Old and Mature tree?

Genetic? Pressing efficiency?

Optimum? Competition? Inputs?

Pests and diseases?

What is marginal land?

Water, Fertility, Labour needs, Logistics

For whom are we producing?

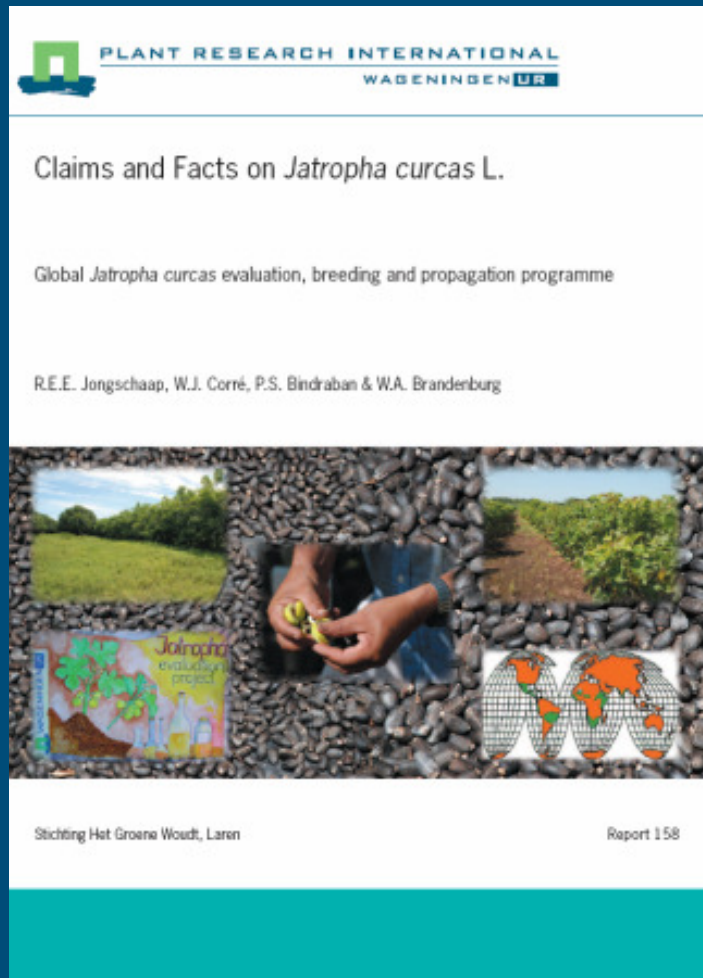


Conclusions 'Claims and Facts on *J. curcas* L.'

- Claims are **correct** for **traditional use**
 - Inputs and requirements
 - Environmental effects
- Claims are **incorrect** for **high oil production**
 - Inputs and requirements (water, fertility, labor)
 - Pest and diseases (mono-crop, plantations)
 - Yield components



Claims and facts on *Jatropha curcas* L.



- Position Paper
Expert seminar March
2007
(Daey Ouwens *et al.*,
2007)
- Plant Research
International Report 158,
October 2007
(Jongschaap *et al.*, 2007)
- People Planet Profit

Marginal lands

- What are marginal lands, why are they marginal?
- How do they look like?
- Where are they?



Marginal lands

- Since 1945 extent of soil degradation by human activity:
2 Billion ha (= $2 \cdot 10^9$ ha = 2,000,000,000 ha) \approx 17% Earth surface
- \approx 750 M ha (38%)
 - **lightly degraded** (small decline in agricultural production, potential to recover)
- \approx 910 M ha (46%)
 - **moderately degraded** (great reduction in agricultural productivity; restoration only through considerable financial and technical investment);
- \approx 300 M ha (15%)
 - **severely degraded** (no agricultural utility under local management systems; reclaimable only with major international assistance)
- \approx 9 M ha (0.5%)
 - **extremely degraded** (incapable of supporting agriculture and unreclaimable).



Jatropha curcas marginal land reclamation

- Perennial
 - Use as re-forestation species in remote areas
 - Cropping system design
- Drought tolerant
 - Survives dry years
- Deep roots
 - Soil exploration for water and nutrients (recycling)
 - Senescent root material as Organic Matter in soil profile
- Canopy covers soil
 - Anti-erosion



Facts of soil improvement by *Jatropha curcas*

- Increase of soil aggregate size
- Increase in soil organic matter content
- Decrease of soil bulk density



System approach

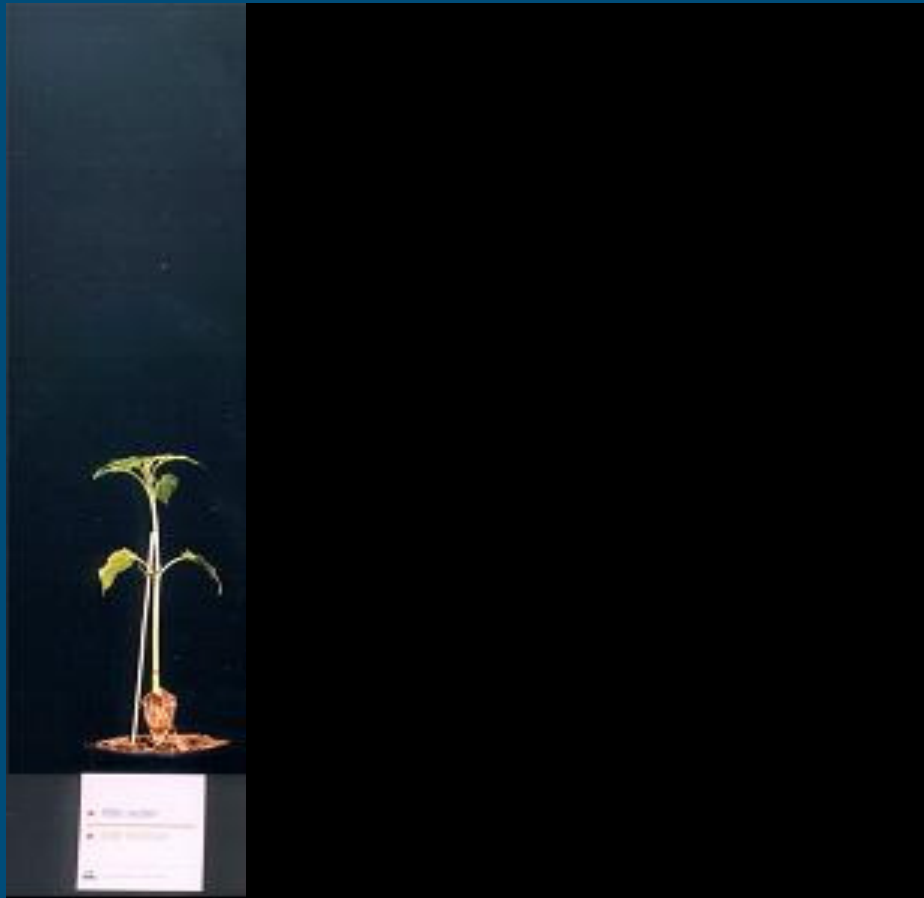
- Understand processes on lower levels to explain or evaluate results at higher integration levels

→ **Gives handles to interfere**

Comes back in Agronomy section



Crop growth limitations



- water + water - water + water
- nutrients - nutrients + nutrients + nutrients

- No such thing as plants growing without water, nutrients, CO₂, land, ...
- Low input – low yield
- Competing Claims on natural resources
HUGE!



Basics of crop production

Growth & yield defining factors

- Weather
- Crop genetic potential



Growth & yield limiting factors

- Water
- Nutrients



Growth & yield reducing factors

- Weeds
- Pests
- Diseases

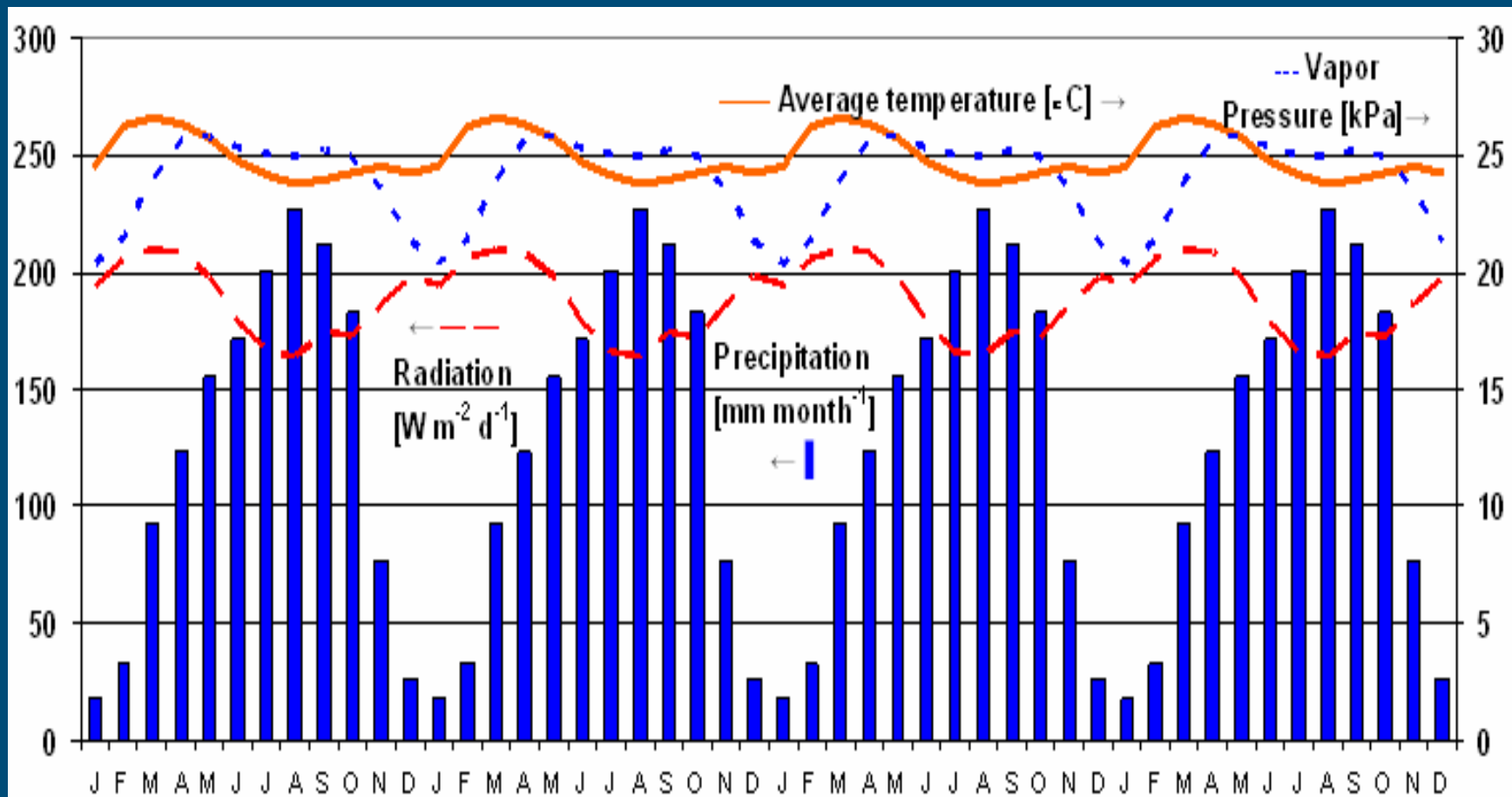


Example of system approach

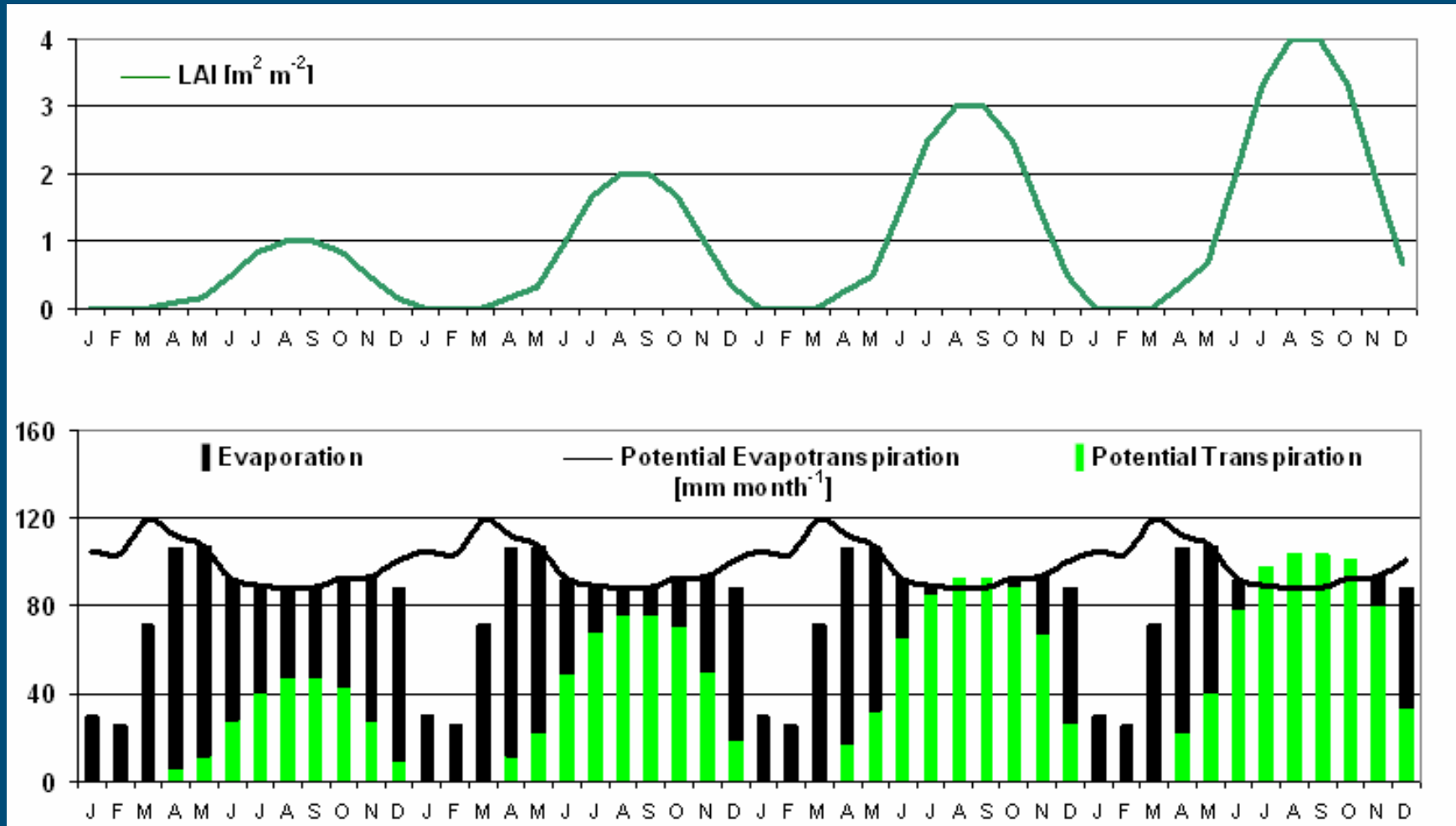
- 'Yield per hectare' (higher level) depending on sub-processes (lower integration levels)
 - **Radiation interception and radiation use efficiency**
 - Growing season
 - Interception capacity (Leaf Area Index, Plant density, Chlorophyll content)
 - Photosynthesis capacity
 - Carbohydrate assignment to organs (roots, stems, leaves, fruits, seed)
 - **Water availability and water use**
 - Precipitation
 - Soil characteristics, soil management
 - Root system penetration
 - Transpiration characteristics
 - Competition



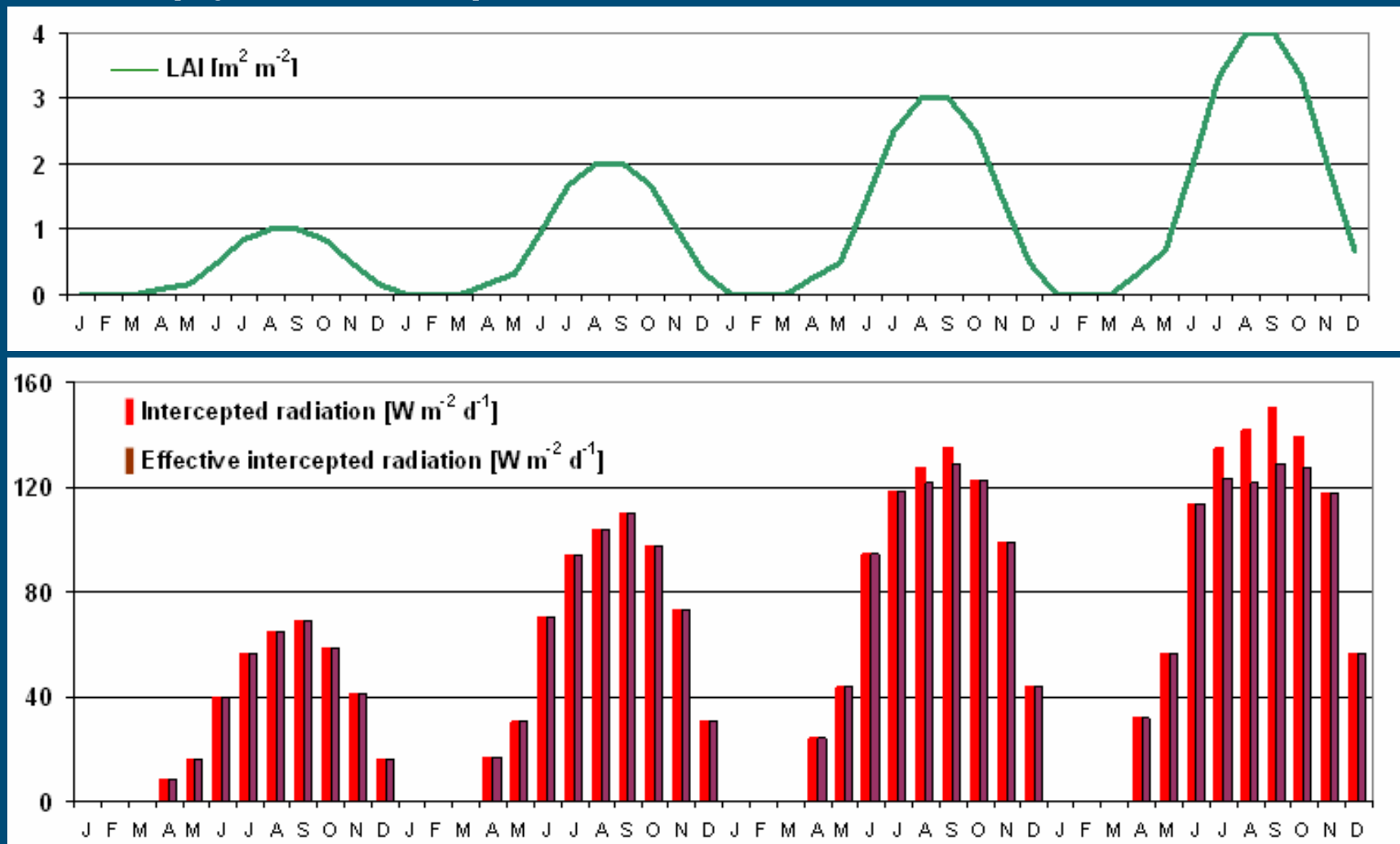
Weather conditions



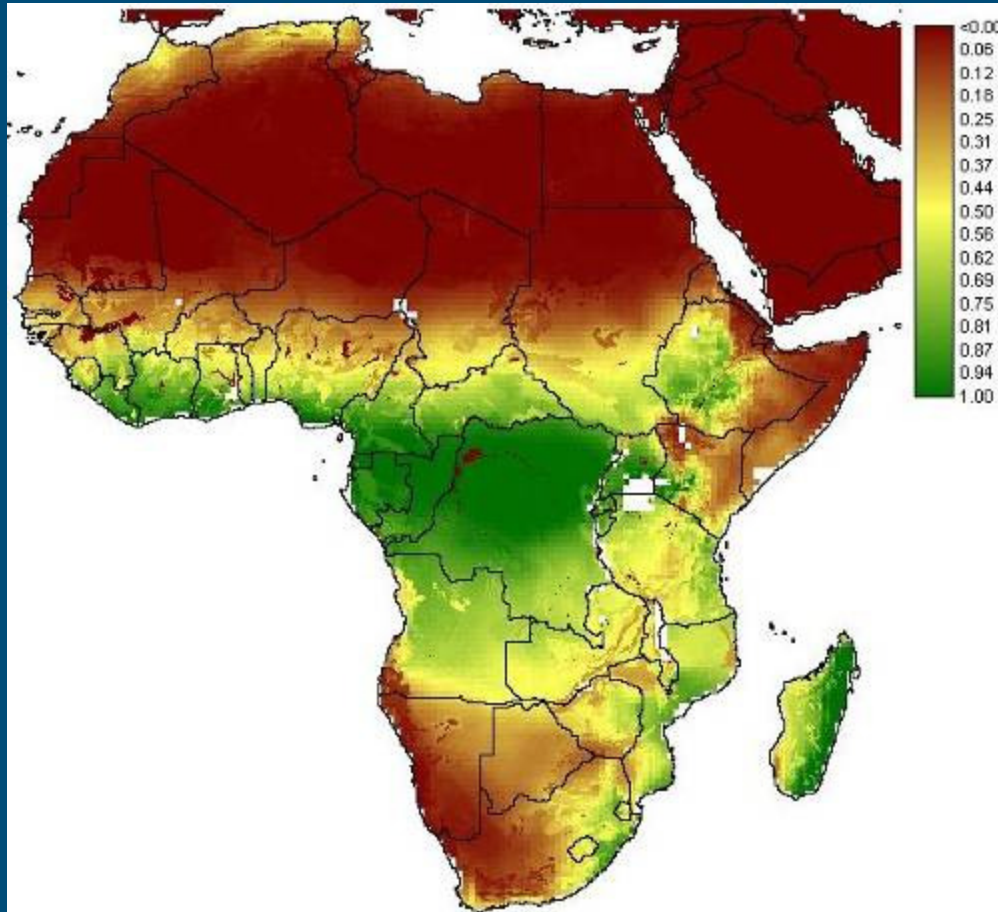
Crop development and water use



Canopy development and radiation use



Water Use: Africa AET/PET ratio



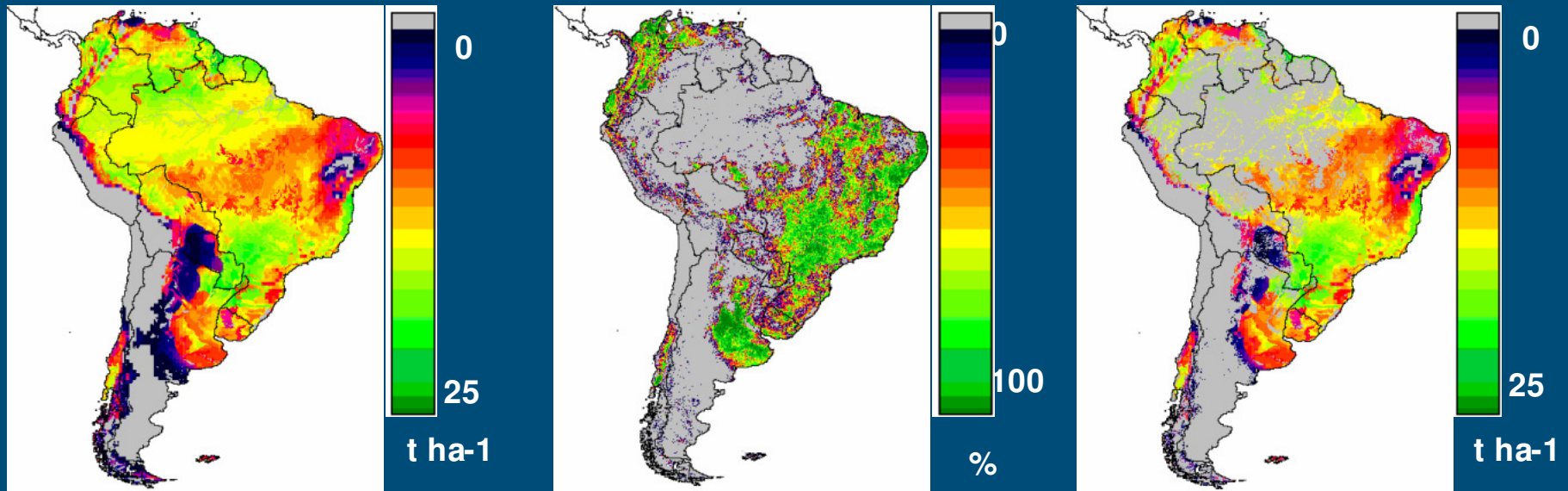
Based on (1960-1990):

- Radiation
- Temperature
- Wind speed
- Soil water availability

- Annual
- Growing season

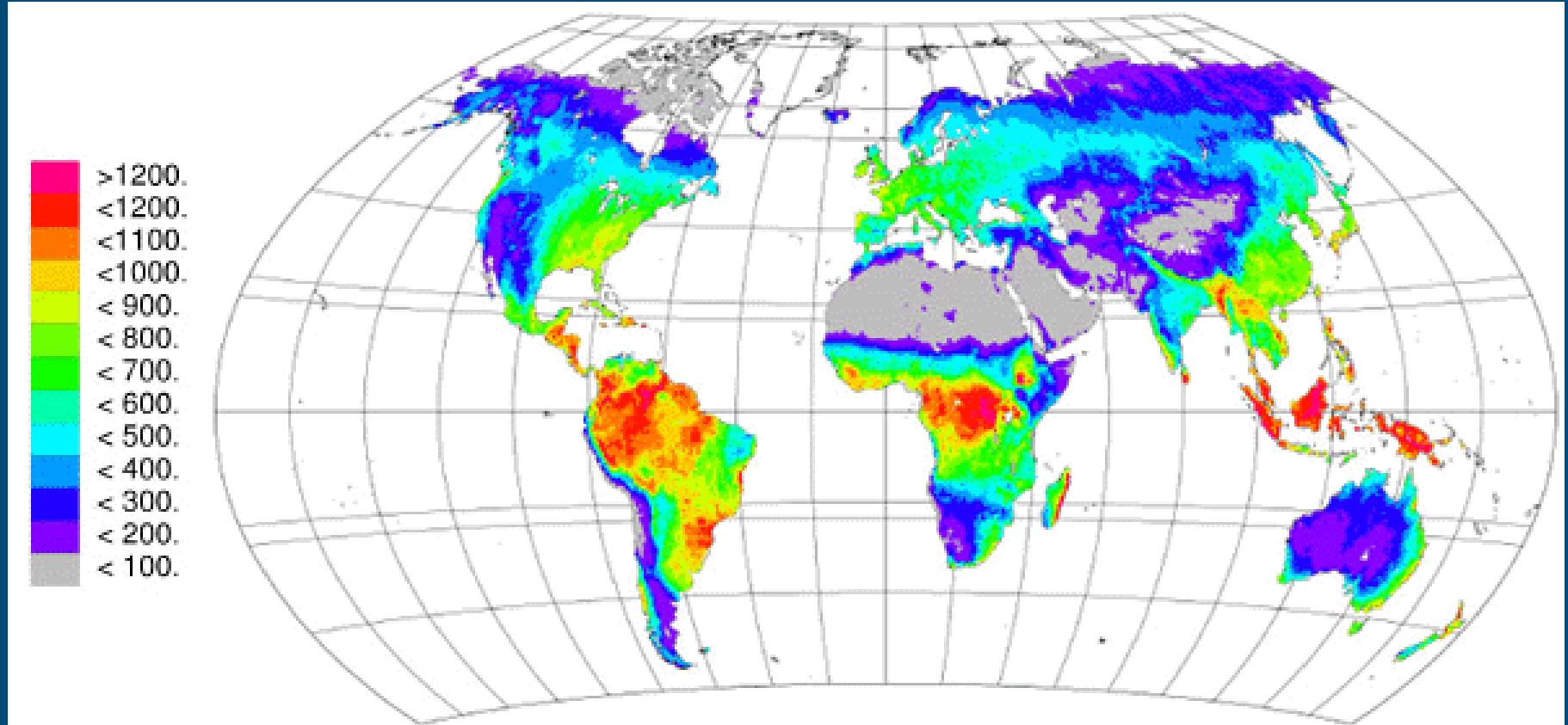


Rain-fed cereal production



Sophisticated integration of most recent spatial data on climate, soils and current land use combined with dynamic crop growth simulation modeling results in a realistic prospective on biomass production.

Yield estimation method



Annual net primary production (NPP, g C m⁻² y⁻¹) estimated by different simulation models (Sahagian & Hibbard, 1997).

('Claims and Facts on *Jatropha curcas* L.' available at

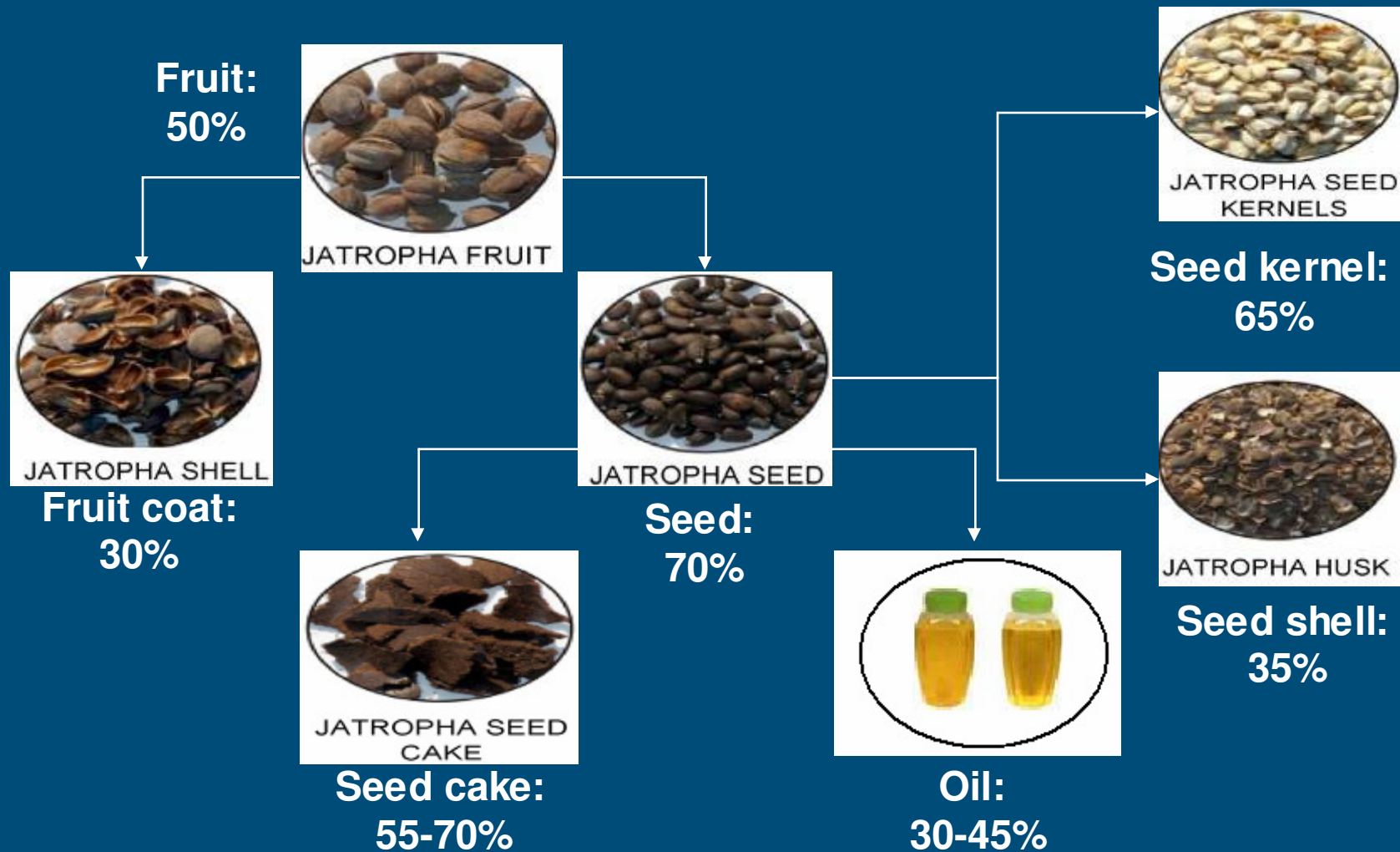
www.jatropha.wur.nl



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Sahagian, D. L. and K. Hibbard, 1997. GAIM
The first five years: Setting the stage for
synthesis, IGBP/GAIM Report Series, Report 6,

Dry matter distribution



Yield estimation method (cont'd)

- **MAX** 1000 g C m⁻² y⁻¹ equals 10 ton C ha y⁻¹
- 47.5% C in dry matter: 22.2 t dry matter ha y⁻¹
- 25% leaves, 25% stems: 50% fruits: 11.1 t ha y⁻¹
- 70% seed in fruit: 7.77 t seed ha⁻¹ y⁻¹
- 35% seed oil content: 2720 kg oil ha⁻¹ y⁻¹
- 75% pressing efficiency : 2040 kg oil ha⁻¹ y⁻¹
- 0.92 kg oil liter⁻¹ → 2220 liter oil ha⁻¹ y⁻¹



Tolerance to pests and diseases

- The claim that *Jatropha curcas* is tolerant to pests and diseases is **not** sustained by reality
 - **Not** in plantation/monoculture
 - **Not** under humid conditions



Conclusions

- Base your expectations on solid knowledge
- Science is needed
- Science is costly, but a good investment



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End module 2

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