International Symposium on Cocoa Research

Agronomic challenges for productive and sustainable cocoa production: taking stock and perspectives

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Lima, Peru

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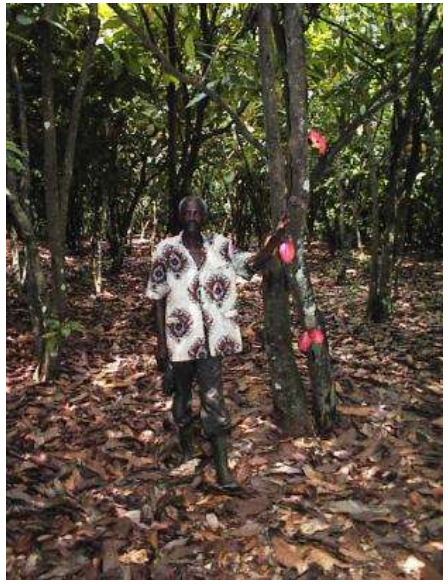
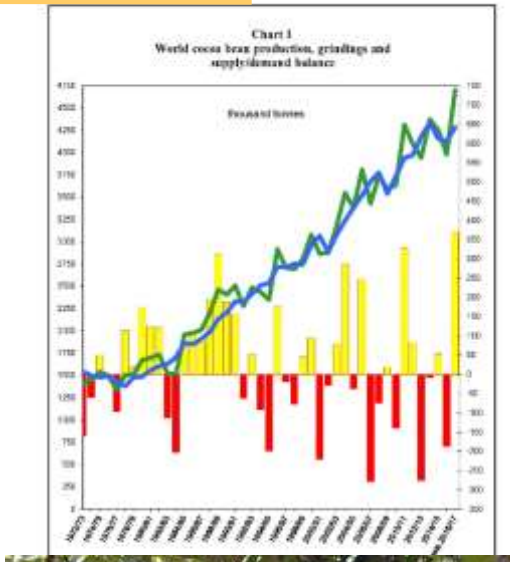
What are the challenges for Agronomy … and Producers?



Some Challenges

- To cope with an increasing demand
- To save and to enrich human, cultural heritages and know-how.
- To live decently on incomes from sustainable cocoa farms.
- To develop innovations to make cocoa cultivation more attractive for youth, more competitive and economically sustainable.



4.5 millions farmers, 4.7 millions mT/year, 10 millions hectares: is it sustainable? (today, 1 mT = 2,000 US$)

The farmers take always the right decision facing the situations and coping with the available reference(s)

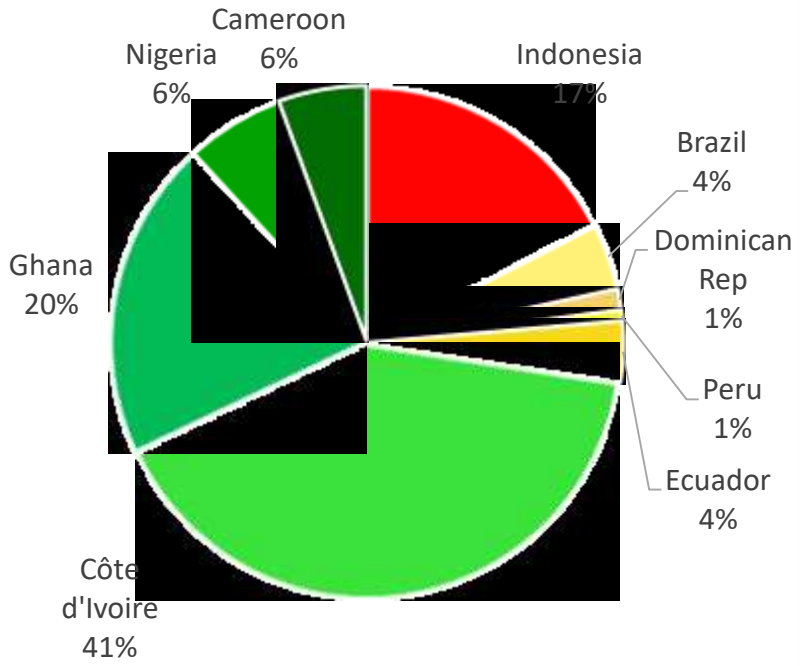
It will probably not be possible to grow cacao everywhere due to land pressure, soils and climate constraints and lack of interest for agriculture matters giving low revenues

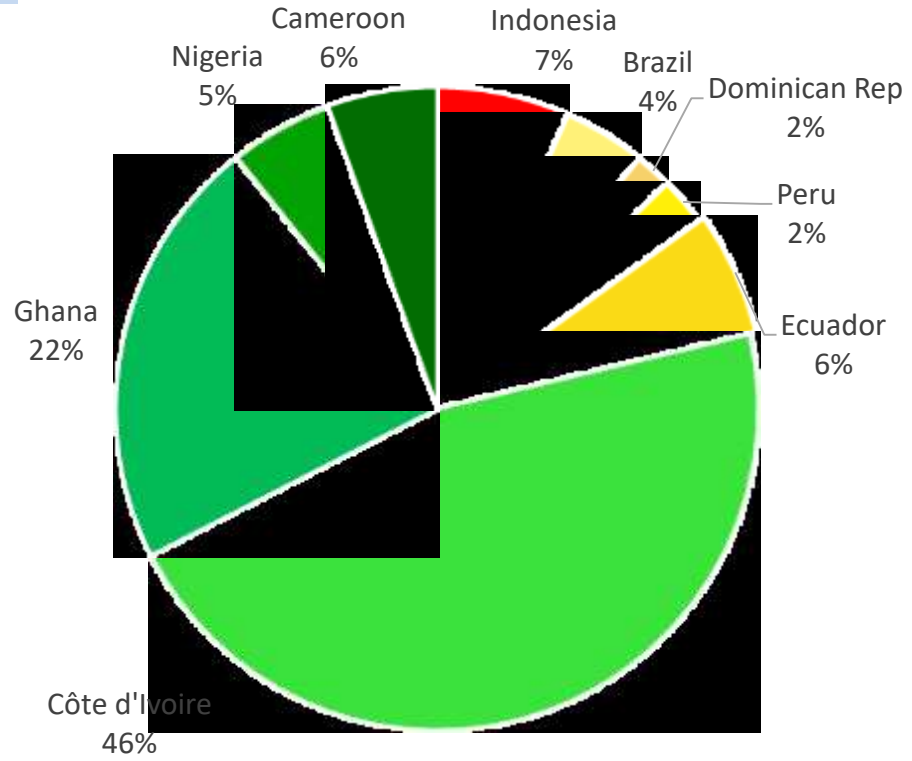
Cocoa Producing World is changing

2006-2007: 3,379,000 mT

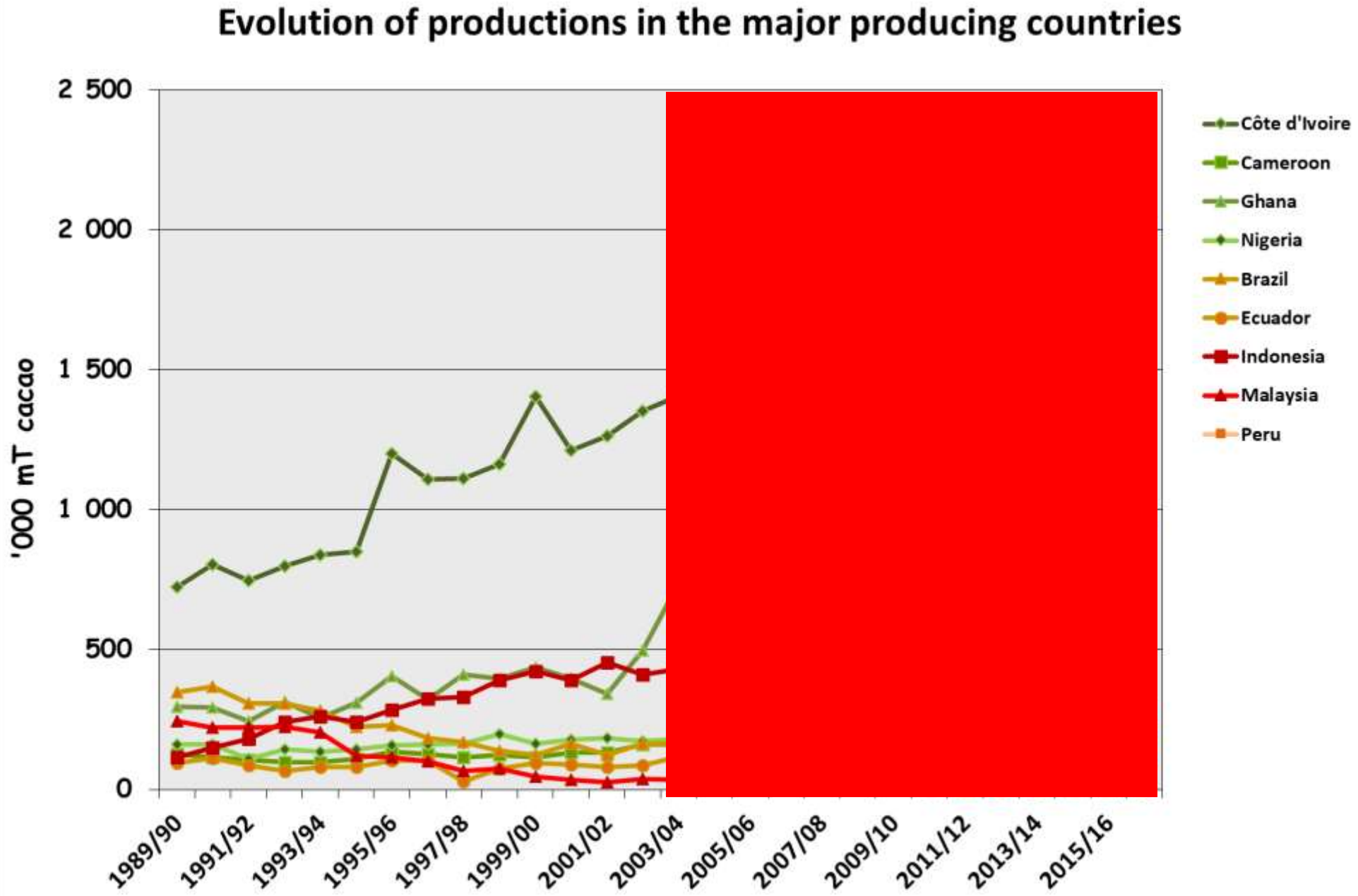
In 10 years: + 38%

2016-2017: 4,700,000 mT

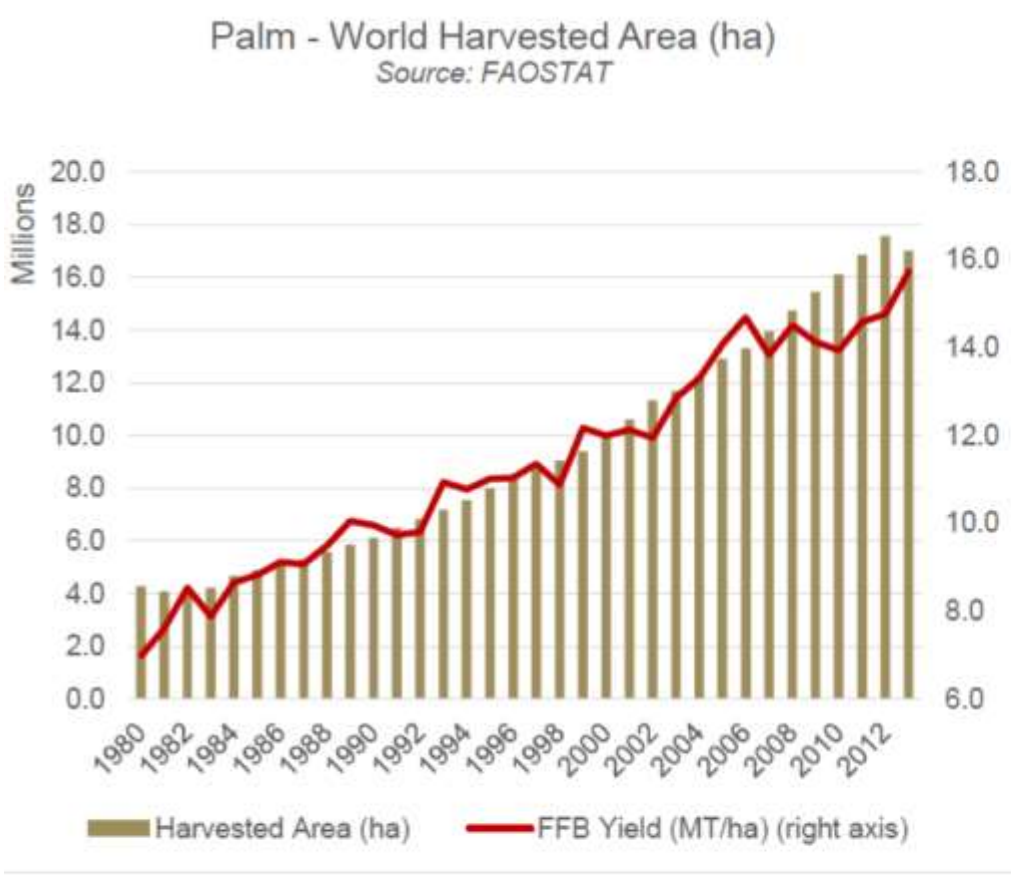


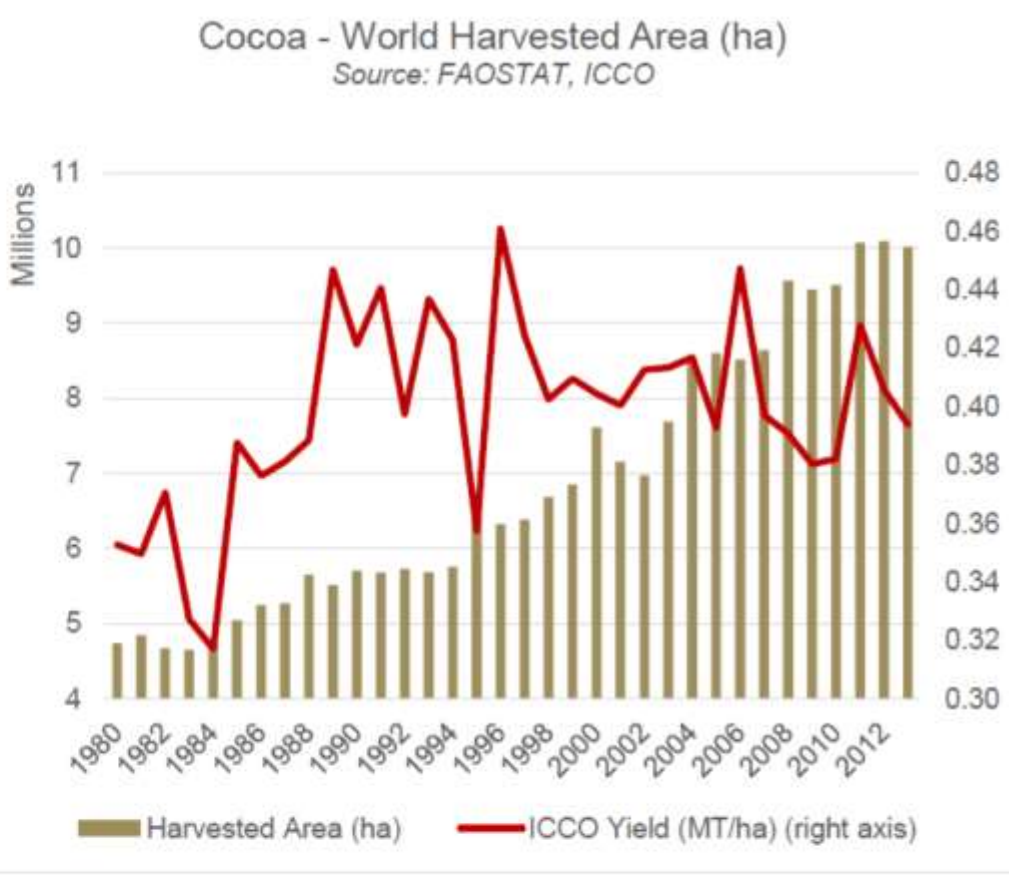


	2006-2007	2016-2017	
Africa	**2336**	**3505**	50,0%
Americas	**409**	**757**	85,1%
Asia & Oceania	**585**	**379**	-35,2%


Evolution of productions in the major producing countries
'000 mT cacao
2 500
2 000
1 500
1 000
500
0
1989/90
1991/92
1993/94
1995/96
1997/98
1999/00
2001/02
2003/04
2005/06
2007/08
2009/10
2011/12
2013/14
2015/16
Côte d'Ivoire
Cameroon
Ghana
Nigeria
Brazil
Ecuador
Indonesia
Malaysia
Peru

Comparing Yields and Surfaces Evolution





Yields have increased by more than 3x in last 30 years

- Over 30 years average yields have increased only marginally while planted area has risen steeply

from Hardman Agrobusiness 2015

Two « opposite ways »

yields from 1 to 50

Traditional

Produce better to get more money

Innovative

Produce more to get more money

Productivity, Inputs, Costs

What are the good responses, the right keywords?

Yields, Climate change, Sustainable development, Dynamic or conservative Agroforestry systems, Environmental services and biodiversity, Livelihood conditions, secured revenues.


Ecuador


Côte d'Ivoire


Indonesia


Haïti

High productive Estate

Brazilian Cabruca

Model of Extractivism

Traditional West African farm

Light shade and windbreaks with cover crop

Temporary shade with banana and Gliricidia

Full sun and fertigation system

Natural “permanent” shade

Crop Management and climate impact

Different ways of pruning … or not

Good water conditions … and drought effect

Intercropping and "Agroforestry" models

What we suppose or we think to know

“more than 90 % of 4,700,000 mT/year cacao is produced by smallholders”

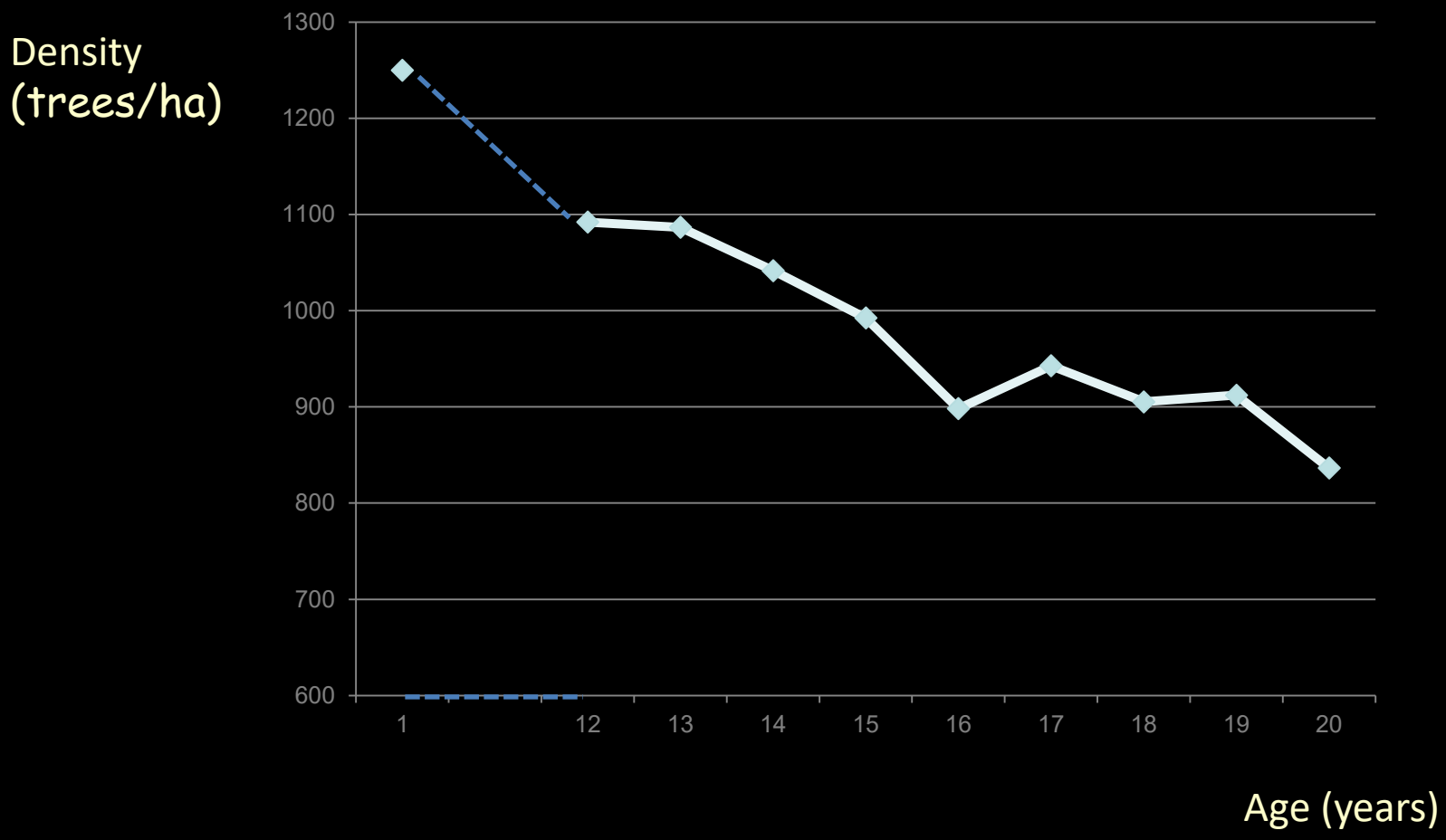
- Do we have reliable source(s) of data?
- What is the real cultivated area?
- What are the real yields and the sources of yield gaps?
- What are the impacts of pests and diseases?
- What kind of farms can we identify (structure, size, …)
- What are the key elements of the farmers’ choices?
- How to evaluate the impact of scientific progress?

What we suppose or we think to know

- **Most of the fields are planted with hybrids' seedlings and give heterogeneous trees on fields**
  - It leads to competitions between trees and impact on density and use of natural resources and inputs (fertilizers)
  - Are grafted clones a advantage and one of the solutions ?
- **Is a productive cacao tree can really produce for more than 50 years?**
- **What about the lessons learnt from other fruits crops?**
  - The main genetic improvement criteria seemed widely based on the relation vigour/production: is it efficient?
  - Research on other fruit trees aimed at domesticating trees to reduce tree size, increase density and increase fruit loads together.

Evolution of cacao trees density with ageing

Example from a big estate (1.800 hectares) with hybrids

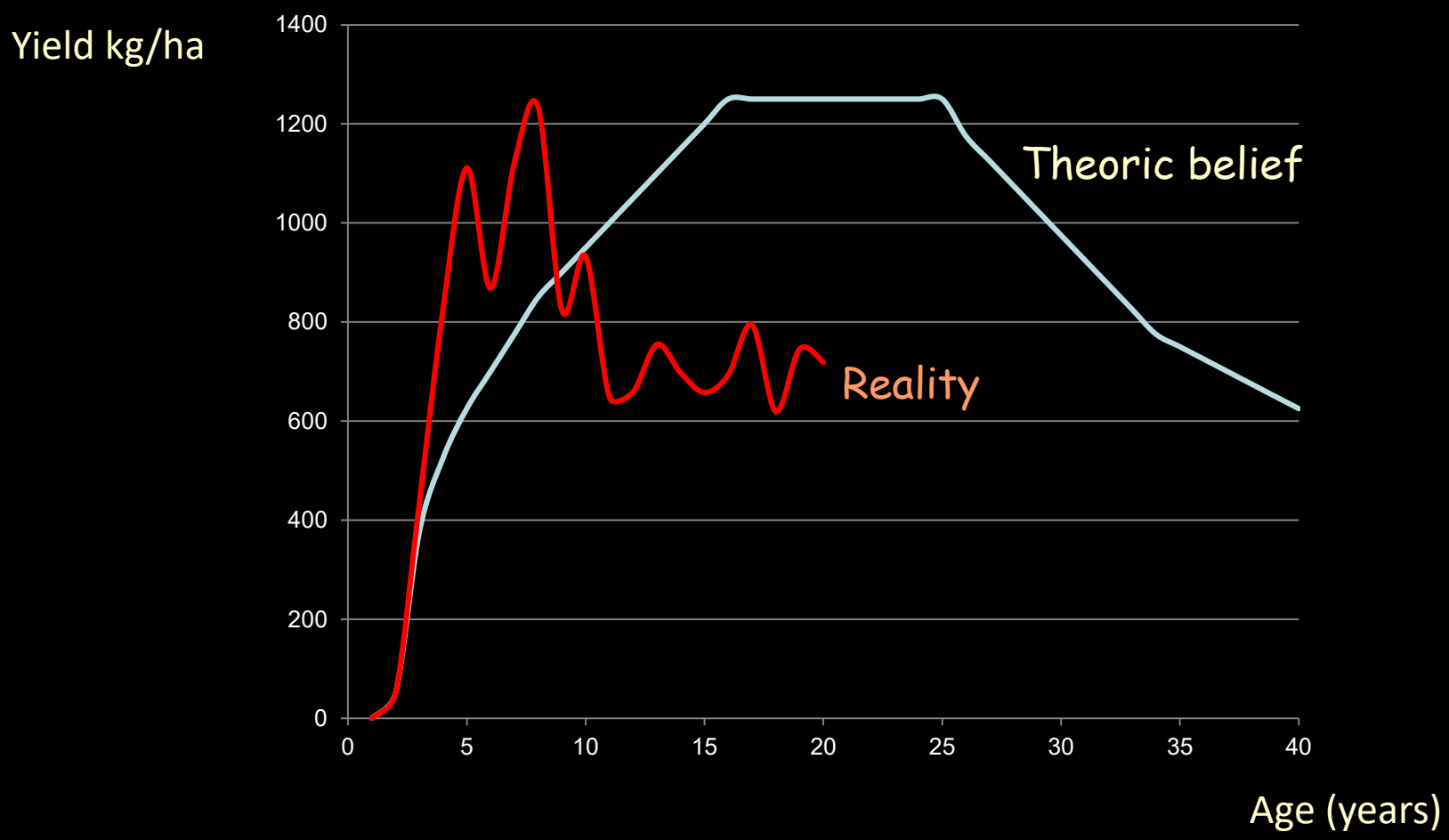


Density is decreasing with trees ageing.
In most of cocoa plots, the older trees « survivors » became bigger, more vigorous but not necessarily the most productive ones.

They are also high consumers of water and nutrients.

Evolution of production with tree ageing

Example from a big estate (1.800 hectares) with hybrids



The tree productivity optimum is reached between the 5th and 10th year after planting.

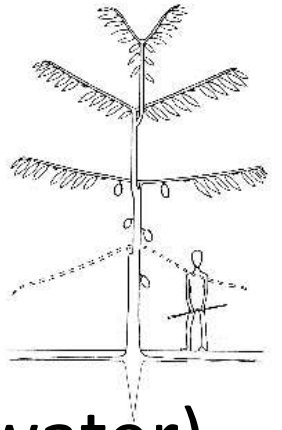
From the 10th year, due to high competition for light, water and natural nutrients, crop management has to be optimized to maintain a high level of productivity.

To go forward, a short review of tools and methods to reduce yield gaps

With ageing, cacao plantations become less productive and more difficult to maintain.

The main reasons are:

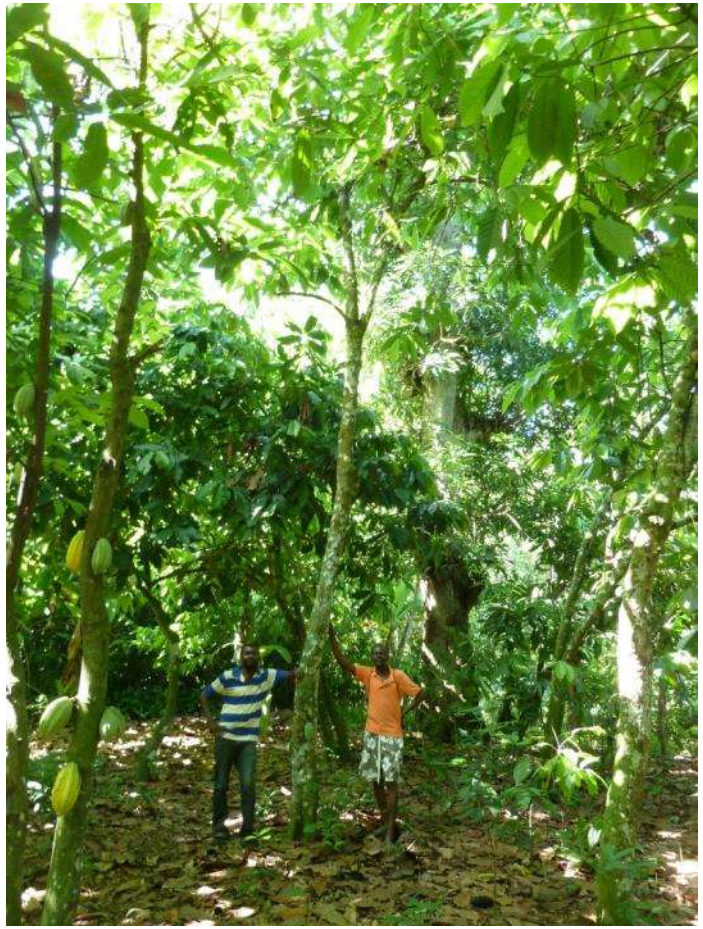
- Gaps in productivity and high heterogeneity within plots;
- Genetic incompatibility and poor pollination efficiency;
- Poor resistance to pests and diseases;
- Bad control of vegetative development and architecture;
- Inadequate linkage with environment (soil, climate, shade, water).



… and a few more questions to answer

What are the real efficiencies of fertilisers, phytosanitary treatments, shade and water requirements onto huge undomesticated trees?

- T. cacao is a tree with an high imbalance between an important vegetative growth and a low fruit production (*carbohydrates allocation*).
- Are the cacao trees really uniform in behaviour and use of water and nutrients uptake ?
- At the end of the day, do we feed a timber-tree or a fruit-tree ?



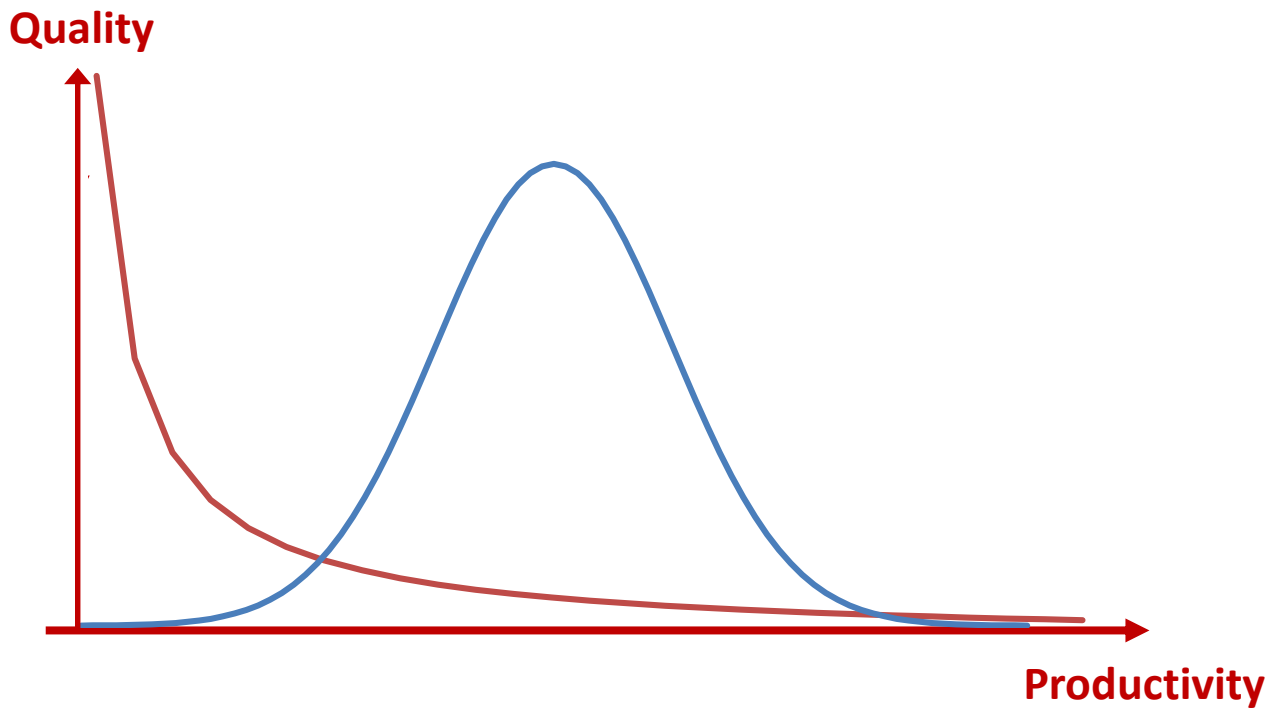
What we suppose or we think to know

Relationship between Yield and Cocoa Beans Quality

Who knows about quality (organoleptic traits) and pods setting?

Is cacao a very special fruit crop ?

Generally, in fruits crops Quality depends on sugars content and yields



To summarize: What we know from the fields

Tree Productivity very variable:

From 3 to 200 pods per tree

Word Average: ± 400 kg cacao/ha

Production Costs very variable:

From 100 to 5,000 USD/ha/year

Technical knowledge very diverse:

From picking pods to estate management

It is time now to call into question dogmas and empiricism to go forward to cope with the new challenges for future to make cacao a profitable and sustainable fruit crop.

Many factors influence or can be influenced by cocoa cropping systems

Technical
Practices
Management

Socio-Economical
Environment
Labour forces, land access

Biotic constraints
Pests & diseases

Abiotic Constraints
Soil – climate
Global warming

Social and economical
Performance
Revenues and Livelihood conditions

Environmental
Performance
Land use, impacts on natural resources

New criteria for genetic improvement ?

Keywords: physiology, interaction with environment, domestication

- A range of trees well adapted to the environment variability
- A better efficiency of PS and a better use of assimilates
- A better ability to use soils and climate resources in a context of an increasing climate change effect
- Smaller trees with shorter internodes easier to manage
- Tolerance – resistance – to pests and diseases



Better management of trees

- Make the 100% investment in planting fully productive
- Architecture and biomass: improving compromises
- Pruning: on the right place, on the right time

- Water use: limiting waste and managing competition
- Soil and fertilization: using formulas adapted for both soils and tree species (based on soil diagnostic and evolution)
- Integrated Pests and diseases control

Improvement of farm management

- Choice of landscape, climate and soils environments
- Choice and availability of planting material with adapted densities and biomass management

- Diversify sources of incomes (associated trees and crops)
- Use of a set of -best or efficient?- practices based on a basket of references (fully documented models with costs- benefits studies).

- Identification of prerequisites to adopt innovations.
- Reinforcement in basic knowledge in economics (farmer = entrepreneur)

Agronomy : next steps *Keywords: productivity, sustainability, profitability*

What is important ?

- To get 100% of productive cacao trees in farms
- To increase pods and productive units per hectare
- To facilitate farm management and labour organization
- To improve quantities **and** qualities

Items to be improved

- ✓ Scientists to share experiences and to work more closer to farmers.
- ✓ To increase the basic knowledge on this fruit-tree named *T. cacao.*
- ✓ To better manage the biomass/density balance, soils, water and shade.
- ✓ To develop access to adapted genetic material and propagation methods.
- ✓ To get data on productive life cycle in cocoa crop systems.
- ….

To be continued



Thank you for your attention