



# The Science of Sustainability in Environmental Education

*Managing the risks*

*APEC Conference on Sustainability and Environmental Education  
for Post Disaster (APEC SEE-PD)  
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Cirad, Jakarta



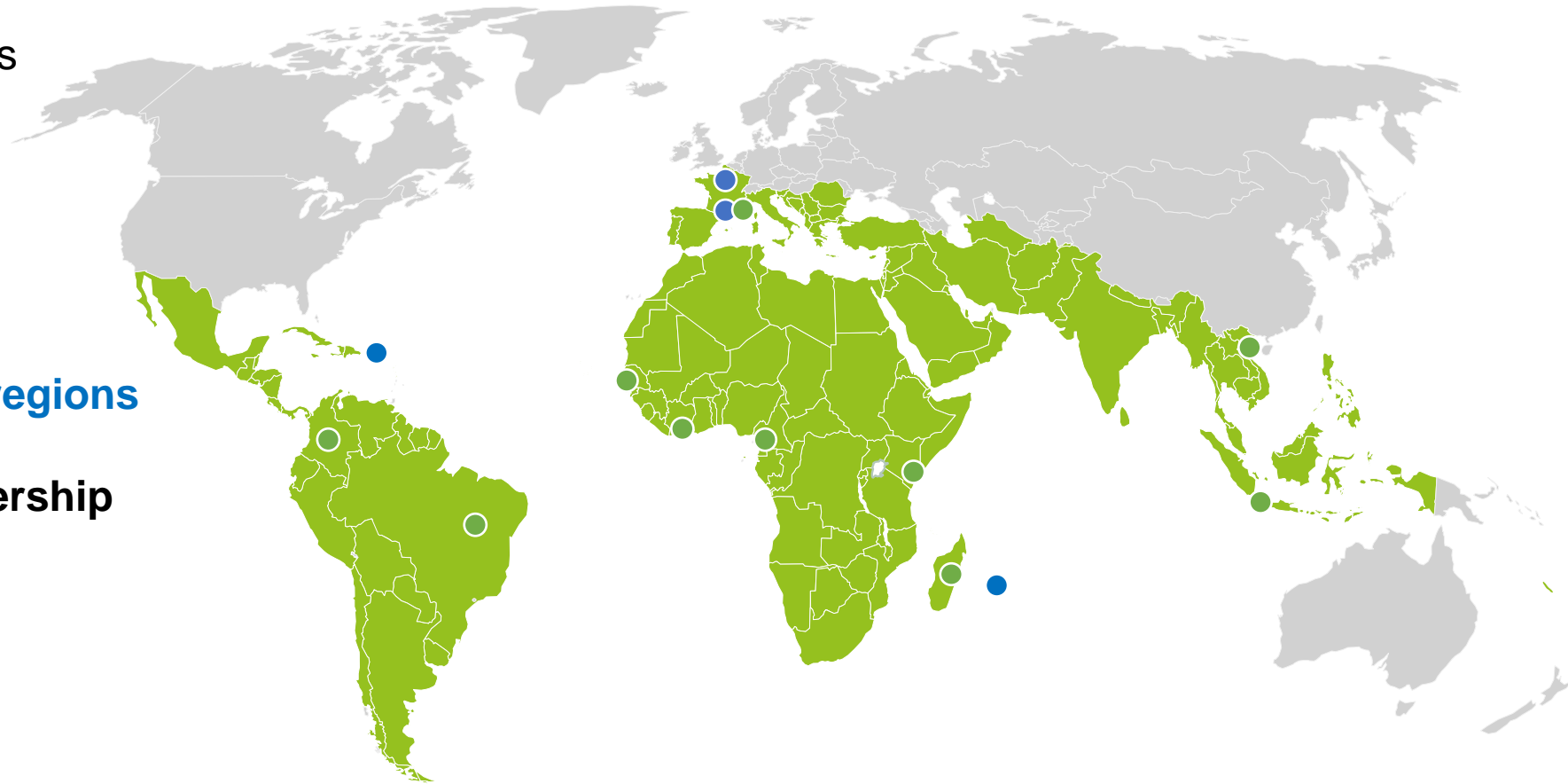
**CIRAD is the French agricultural research and international cooperation organization working for the sustainable development of tropical and Mediterranean regions.**

**Its remit is to help build more resilient farming systems, food systems and forests, for a more sustainable, inclusive world.**



# CIRAD worldwide

- CIRAD works in more than **50 countries** across the tropics and the Mediterranean.
- From its regional offices, **two in mainland France**, **two in the French overseas regions** and **ten elsewhere**, it conducts **research in partnership** with more than 100 countries.



# CIRAD, a scientific and technical expert in tropical agricultural value chains

Recognized expertise in 15 value chains:

Banana and plantain



Cocoa



Coffee



Sugarcane



Coconut



Cotton



Fruit and vegetables



Rubber



Dairy



Oil palm



Animal production



Forest resources



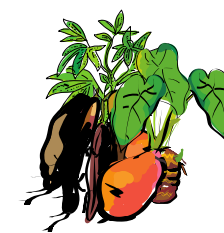
Rice



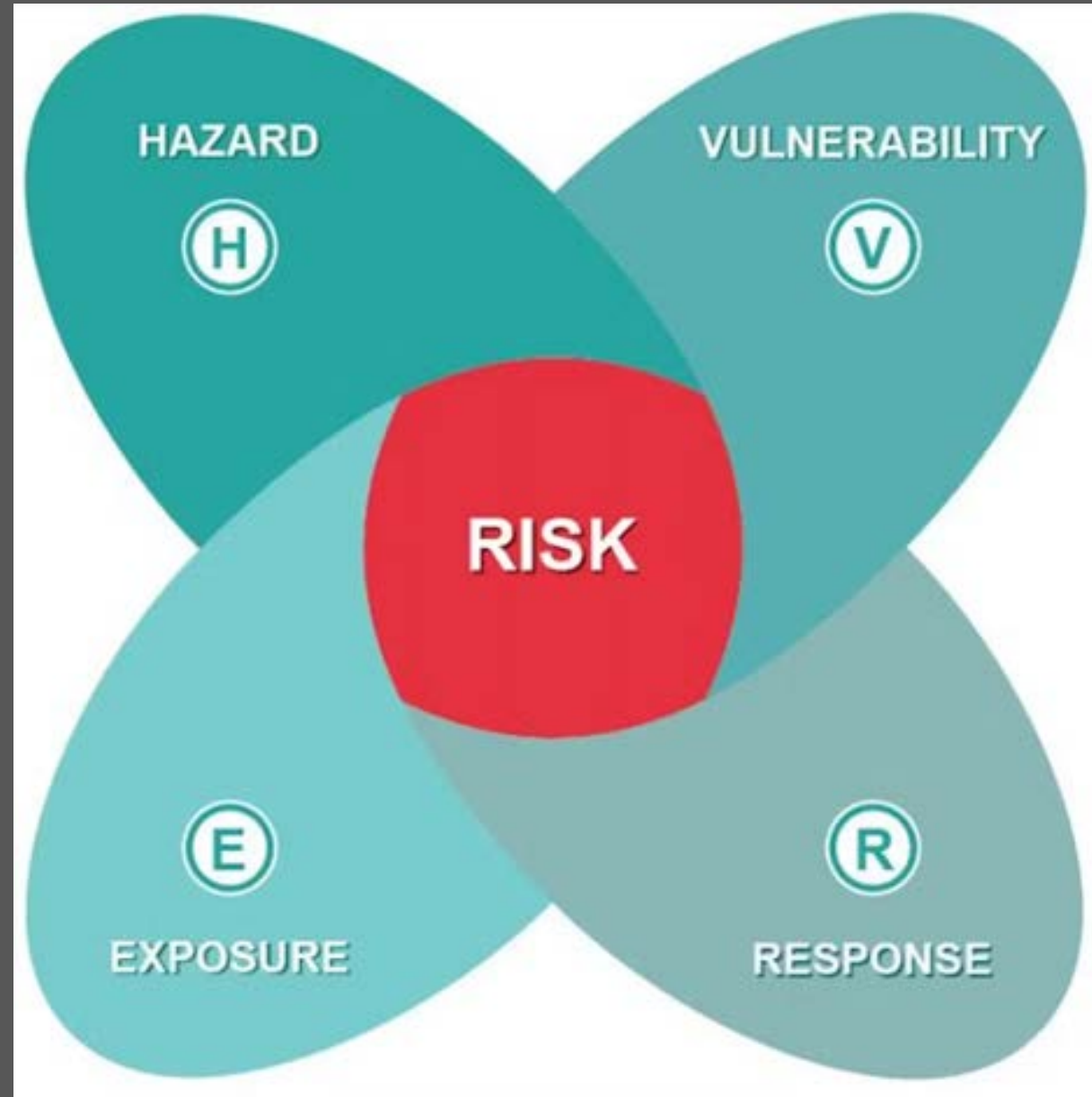
Sorghum



Roots and tubers







**risk**

/risk/

*noun*

a situation involving exposure to danger.  
"flouting the law was too much of a risk"

Risk Probability is the determination of **the likelihood of a risk occurring.**

High or low.

This likelihood can be based on historical project information, does the risk typically occur?

## HAZARD

VS

## RISK

A **HAZARD** is something that has the potential to harm you



**RISK** is the likelihood of a hazard causing harm





## Risk Analysis

*['risk ə-'na-lə-səs]*

Assessing the likelihood of an adverse event occurring that may negatively affect a business, investment, or project.



## Risk Management

*['risk 'ma-nij-mənt]*

The process of identification, analysis, and acceptance or mitigation of uncertainty in investment decisions.



- Socioeconomic risks
- Financial risks
- Climatic risks
- Agricultural risks



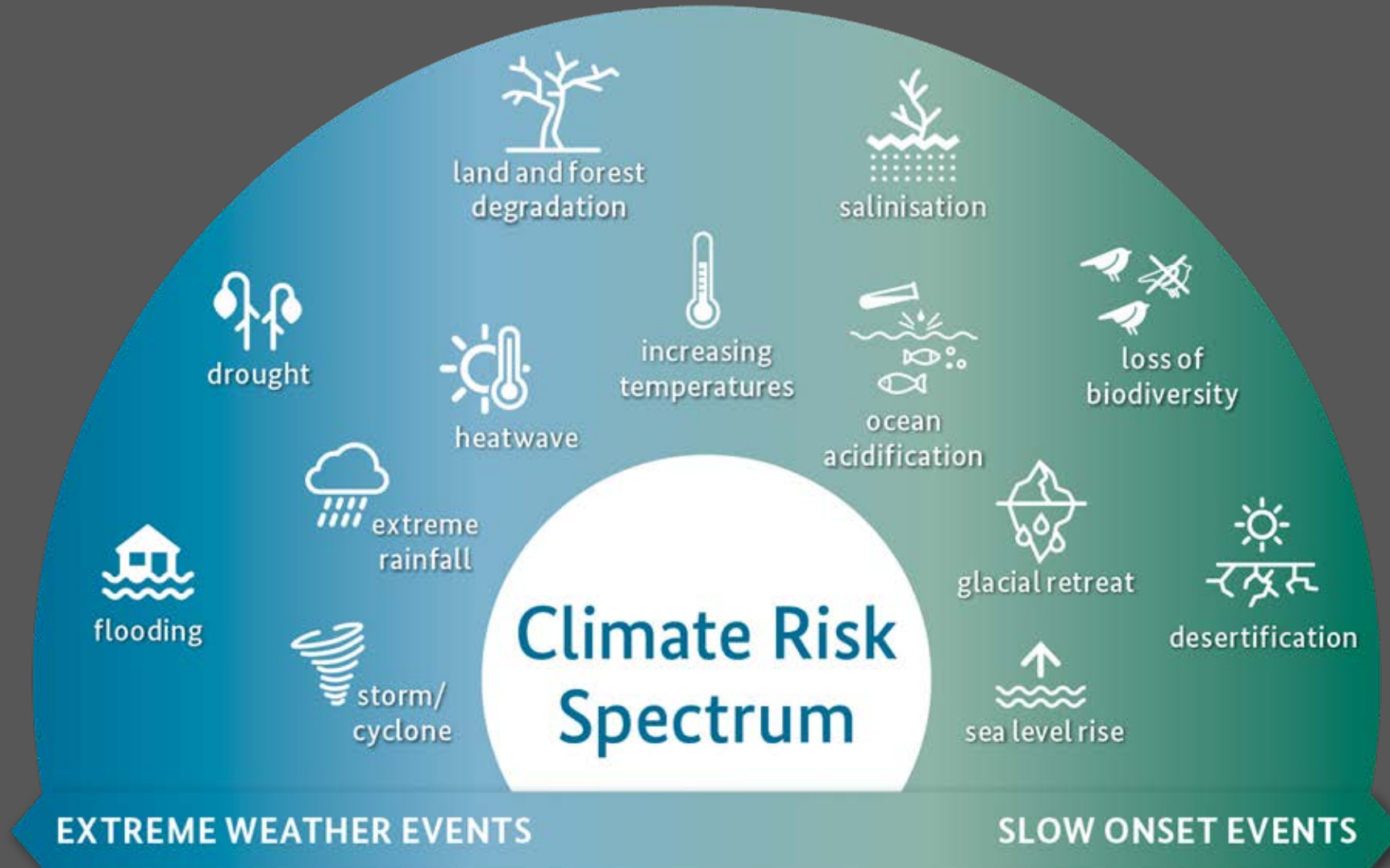
Climate risk is the potential for climate change to create adverse consequences for human or ecological systems.



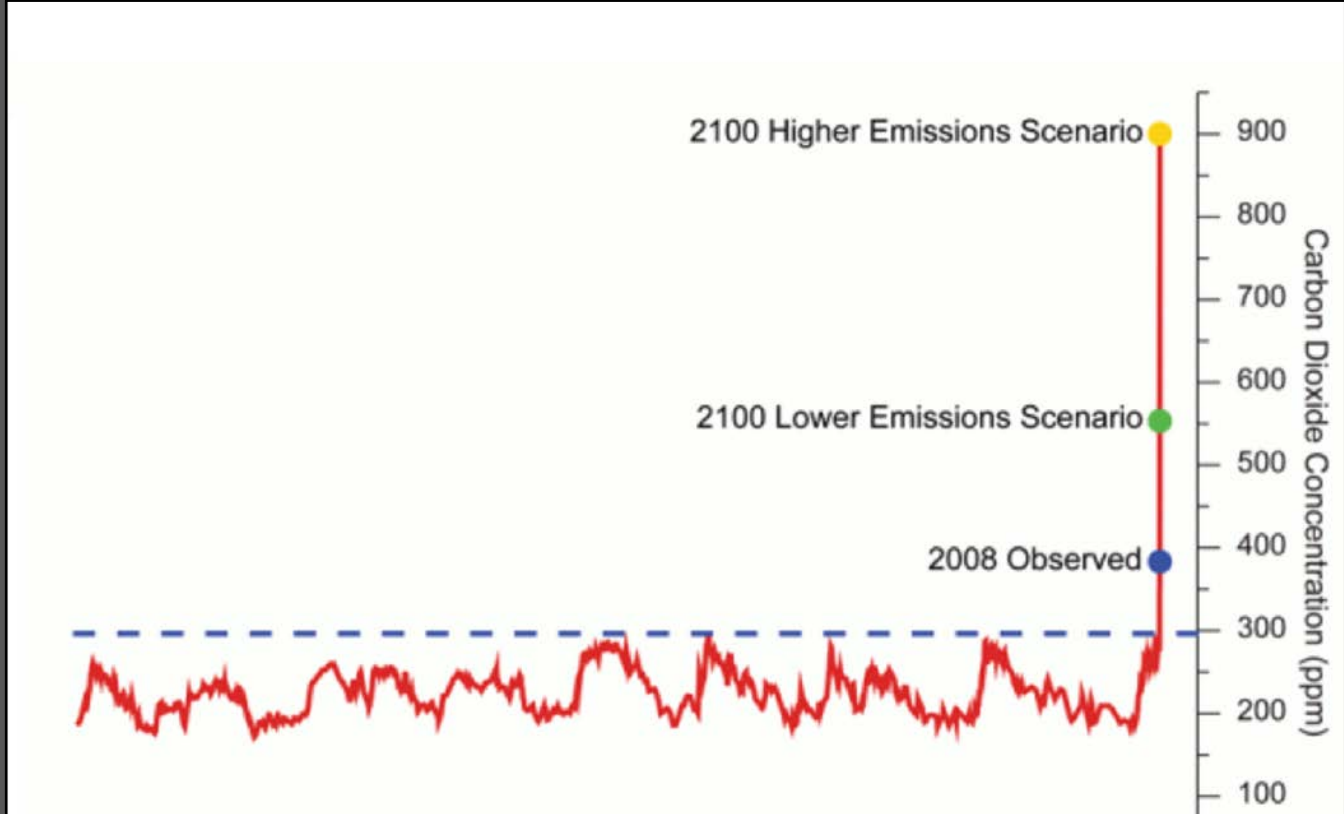
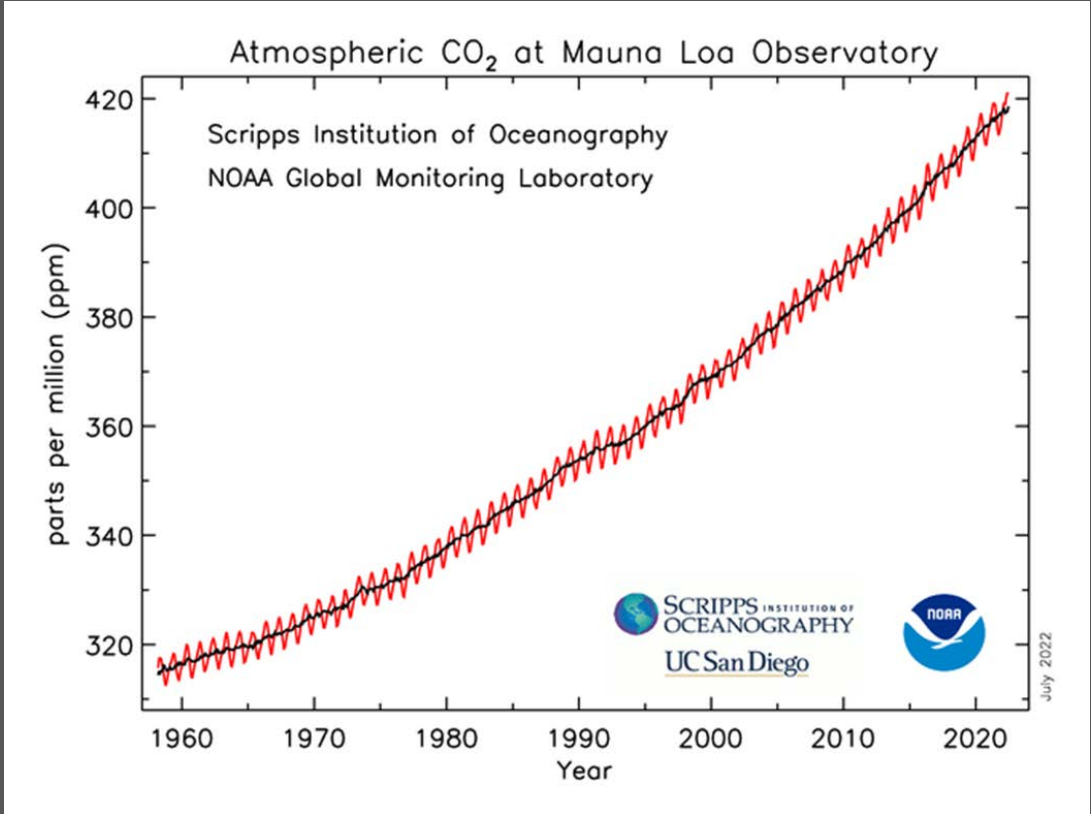
This includes impacts on:

- lives, livelihoods, health and wellbeing, economic, social and cultural assets and investments,
- infrastructure, services provision, ecosystems and species





# The rising CO<sub>2</sub> context





## Sources of risk

- Risk affects production such as changes in the weather and the incidence of pests and diseases.
- Equipment breakdown can be a risk as can market price fluctuations.
- Borrowing money can also be risky with sudden changes in interest rates.
- Risk also occurs as a result of changes in government policies



# What is sustainability?

In Ecology, **sustainability** is the capacity to endure; it is how biological systems remain diverse and productive indefinitely.





# The Sustainable Development Goals

- On September 25th 2015 in New York, the United Nations adopted a set of 17 goals to **end poverty, protect the planet, and ensure prosperity for all** as part of a new sustainable development agenda.
- Each goal has **specific targets** to be achieved over the next 15 years.
- For the goals to be reached, **everyone needs to do their part:** governments, the private sector, civil society and people like you.

# The Global Goals for Sustainable Development

**1** NO POVERTY



**2** ZERO HUNGER



**3** GOOD HEALTH AND WELL-BEING



**4** QUALITY EDUCATION



**5** GENDER EQUALITY



**6** CLEAN WATER AND SANITATION



**7** AFFORDABLE AND CLEAN ENERGY



**8** DECENT WORK AND ECONOMIC GROWTH



**9** INDUSTRY, INNOVATION AND INFRASTRUCTURE



**10** REDUCED INEQUALITIES



**11** SUSTAINABLE CITIES AND COMMUNITIES



**12** RESPONSIBLE CONSUMPTION AND PRODUCTION



**13** CLIMATE ACTION



**14** LIFE BELOW WATER



**15** LIFE ON LAND



**16** PEACE AND JUSTICE STRONG INSTITUTIONS



**17** PARTNERSHIPS FOR THE GOALS



**THE GLOBAL GOALS**  
For Sustainable Development

# A French public research organization with an international vocation

- CIRAD is working towards the 2030 Agenda and the United Nations **Sustainable Development Goals (SDGs)**, particularly **SDGs 1 No poverty** and **2 Zero hunger**.
- Those goals will be achieved by means of **partnership and scientific cooperation (SDG17)**, enabling sustainable innovations and impacts for **responsible agricultural production and consumption (SDG12)**.
- CIRAD is also contributing to **SDGs 3 Good health and well-being**, **13 Climate action** and **15 Life on land**.





# What is sustainability?

Thus, sustainable development relies on the harmonious balance between its three major pillars: **People, Profit and Planet**.



# Sustainable Plantation Management

- Poverty alleviation
- People's rights
- Workers' rights
- Land grabbing
- Public policies
- Ethical investments
- Smallholders inclusion
- Public/private Partnership



- Agroecology
- Breeding
- Waste management
- Precision Agriculture
- Best agricultural practices
- GreenHouse Gas mitigation
- Integrated Pest Management
- Environmental services

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**ECOLOGICAL  
INTENSIFICATION**

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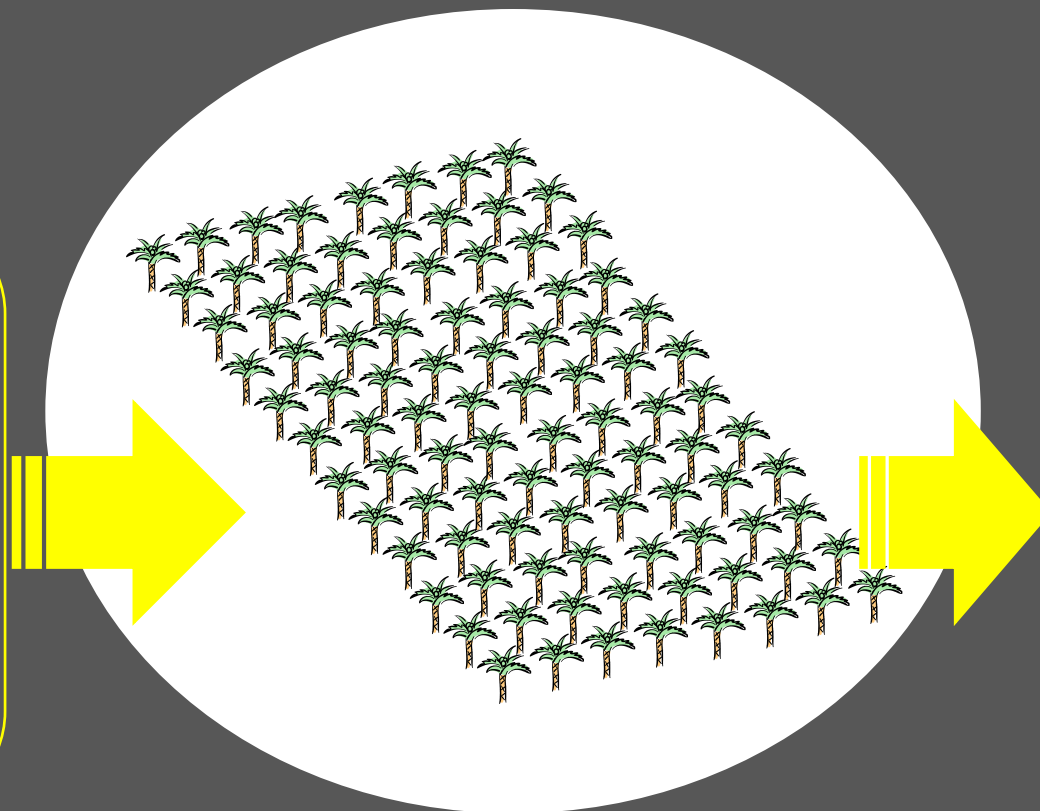
## Agroecology

- A cultivated area is considered as an ecosystem in which inputs and outputs are balanced
- All living organisms inside the system are taken into account:
  - ✓ *The crop: oil palm, rubber, cocoa, coffee...*
  - ✓ *Its enemies: fungi, bacteria, insects, herbivores ...*
  - ✓ *The farmer's choices and practices*



## INPUTS

- Planting material
- Water
- Pesticides
- Workforce

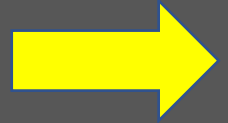


## OUTPUTS

- Fruits
- Palms
- Trunks
- Contaminants

## ENVIRONMENT

- Crops
- Natural ecosystems
- Human activity



## Environmental services

- Beneficial organisms living inside or around the agroecosystem are used for:
  - ✓ Pollination of flowers : *Elaedobius cameronicus* on the oil palm
  - ✓ Contain erosion and fix Nitrogen: *leguminous cover crops*
  - ✓ Attract parasitoids of crop pests: *wasps on leaf eating caterpillars*
  - ✓ Control rodents proliferation: *installation of barn owls*
- Environmental services are free of charge and renewable
- They are sensitive to environmental conditions







- Agroecology
- ➔ **Breeding**
- Waste management
- Precision Agriculture
- Best agricultural practices
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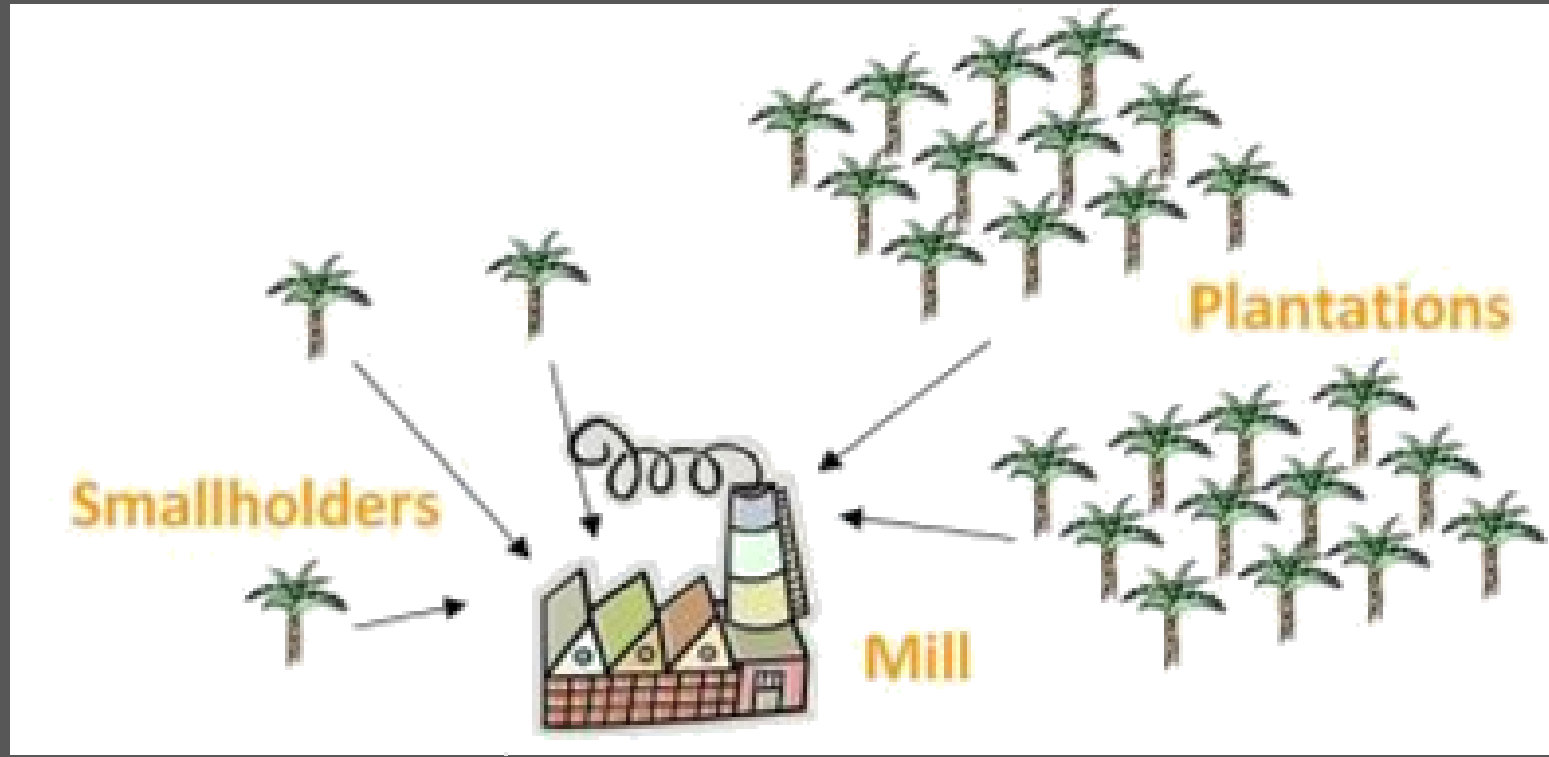


- ✓ Choosing the right planting material is the first decision for sustainable plantation management
- ✓ Only certified planting material - seeds, plants, rootstock, scions - is able to secure the planter's investment
- ✓ Selected planting material provides desirable traits
  - Resistance to abiotic stress: draught, salinity, cold ...
  - Tolerance to biotic stress: pest and diseases
  - Quality of product (oil , rubber, cocoa or coffee beans)
- ✓ Breeding contributes to continuous yield improvement : 1% per year for oil palm

- Agroecology
- Breeding
- ➔ **Waste management**
- Precision Agriculture
- Best agricultural practices
- Greenhouse Gas mitigation
- Integrated Pest Management
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# Sustainable Waste Management



**EMPTY FRUIT  
BUNCHES  
EFB  
(solid)**



**PALM OIL  
MILL EFFLUENTS  
POME  
(liquid)**

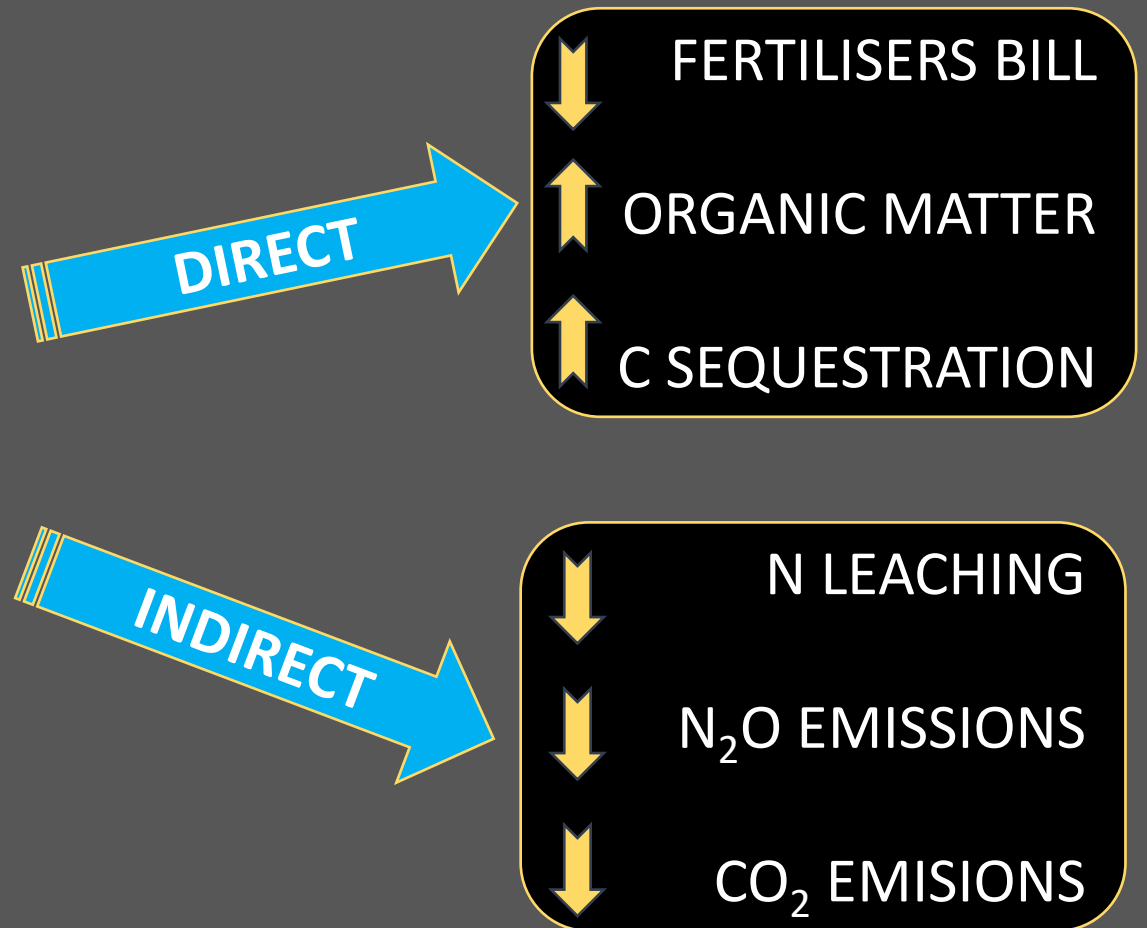




# Sustainable Waste Management

An environmentally and economically efficient composting

Composting reduces needs for mineral fertilizers of 15%  
It improves both soil fertility and texture.





## Biodigestion of Palm Oil Mill Effluents - POME



12 m<sup>3</sup> methane per ton FFB  
 15 m<sup>3</sup> methane per m<sup>3</sup> POME

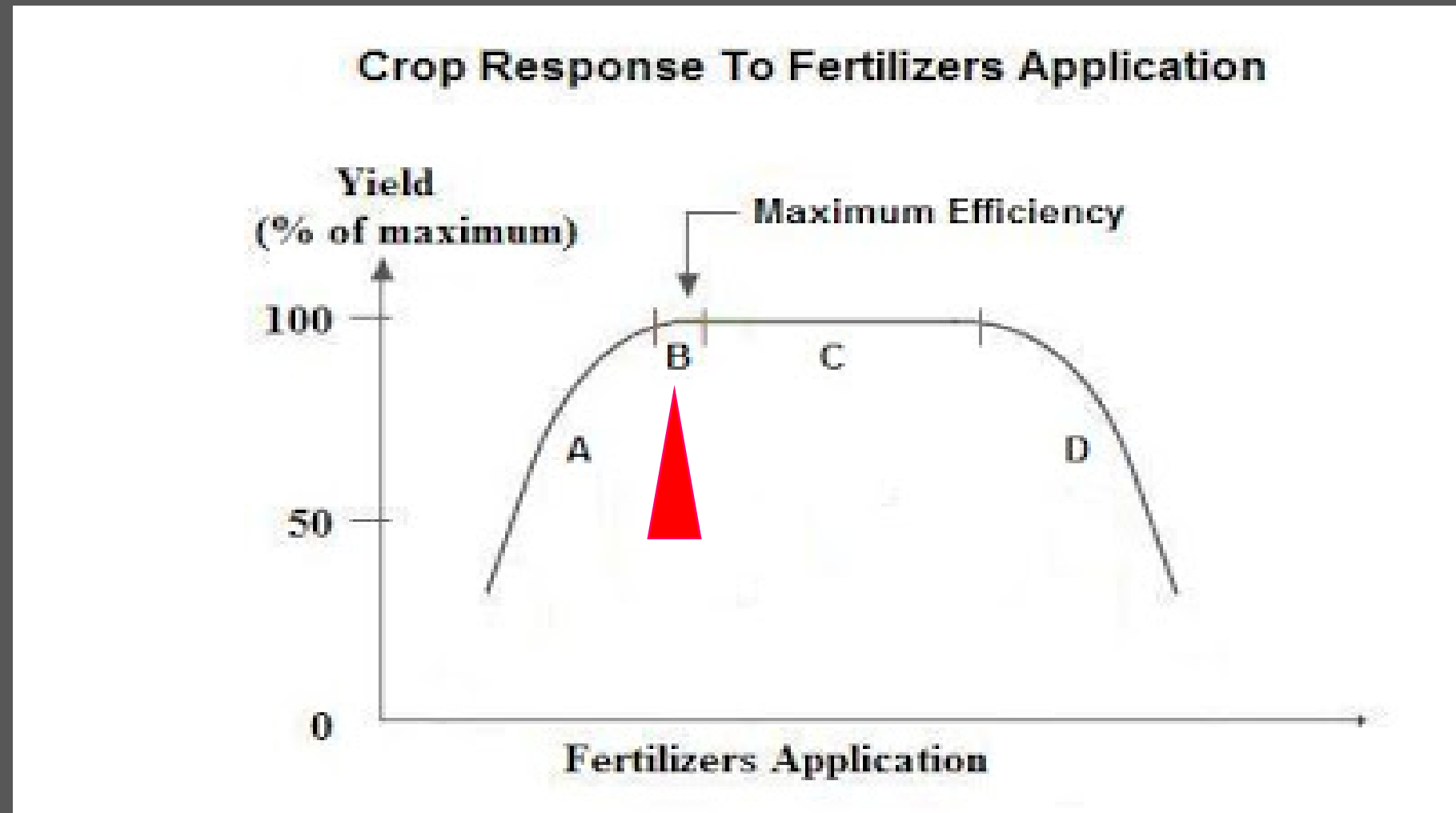
Global project - 3 palm plants		2012	2020
<b>Palm plants</b>			
Milling (T FFB/year)		295,000	438,000
POME flow (m <sup>3</sup> /year)		231,500	344,700
COD load (T/year)		15,400	22,900
<b>Methanization systems</b>			
Biodigester capacity	(m <sup>3</sup> )	37,500	37,500
Methan captured and used	(m <sup>3</sup> /year)	3,645,900	5,382,600
Diesel/Kerosene savings	(l/year)	2,946,600	4,059,800
<b>GHG reduction</b>			
CH <sub>4</sub> and N <sub>2</sub> O avoided	(T CO <sub>2</sub> eq./year)	40,500	59,800
Diesel/Kerosene savings	(T CO <sub>2</sub> eq./year)	9,400	13,900
<b>Economics</b>			
Investment costs(5%, 9years)	k€	5,453	8,460
Savings	k€		17,564
O&M costs	k€		5,258
Net profit	k€		3,847

Methane captation by biodigestion: A pilot project in Africa

- Agroecology
- Breeding
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- ➔ **Precision Agriculture**
- Best agricultural practices
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Adapting fertilizer dose and frequency to the actual needs of the plant



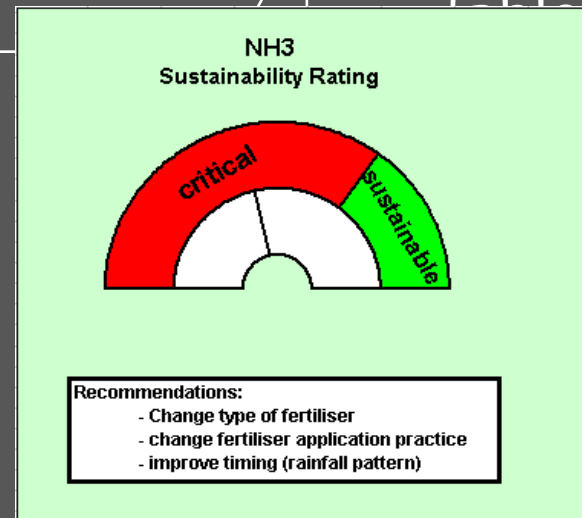
Adapting fertilizer dose and frequency to the actual needs of the plant

## Too Low

- No impact on growth and oil yield
- Useless purchase of fertilisers
- Useless manpower costs

## Too High

- No impact on growth and oil yield
- Evaporation of urea : N<sub>2</sub>O (GHG)
- Leaching to surface water: rivers
- Leaching to groundwater: water



Useless manpower costs





**Any questions?**

<https://www.talent-programme.org/>

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