Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

General Assembly of the Association of General Engineers in the Bridges, Water and Forestry Sectors (AIGPEF)

Paris, 8 January 2016

The land sectors (agriculture, forests and soils) in the face of the twin challenges of food security and climate change

Guillaume Benoit,
High Council for Food, Agriculture and Rural Areas (CGAAER)

I. The land sector in a global context

II. The land sector in France

III. Examples of solutions in different contexts

agriculture
.gouv.fr
alimentation
.gouv.fr

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

I. The land sector in a global context

A key area finally recognized by the IPCC (2014)

« AFOLU » : Agriculture, Forestry and Other Land Use

A sector of « unique » importance

- **Photosynthesis / mitigation** : the role of « **carbon pumps** » of woods and fields. Ability to act on several fronts to contribute to mitigation
- A **vital sector for its other mutiples roles** : food ; employment and rural/urban balance, management of water and soils, biodiversity, and landscapes...
- An **area threatened** by deregulation, yet **+ 60% increase in agricultural production needed by 2050** (FAO)

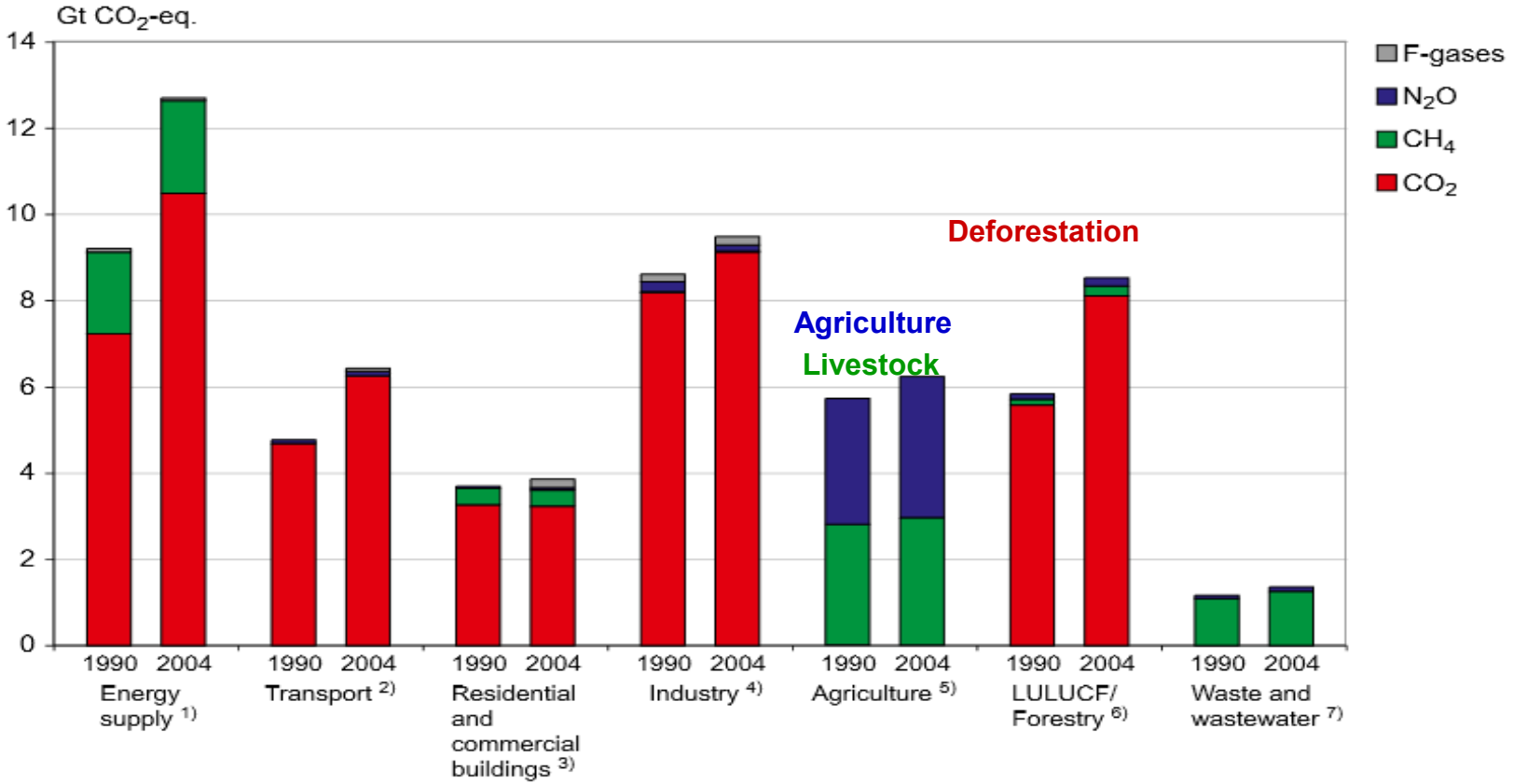
Global challenge = combining food security (access, stability, availability, quality), adaptation and mitigation

alimentation
.gouv.fr

1.1 Emissions and Mitigation
A human responsability « clearly established »

AFOLU in 2012 = 24 % of global GHG emissions (failing) :

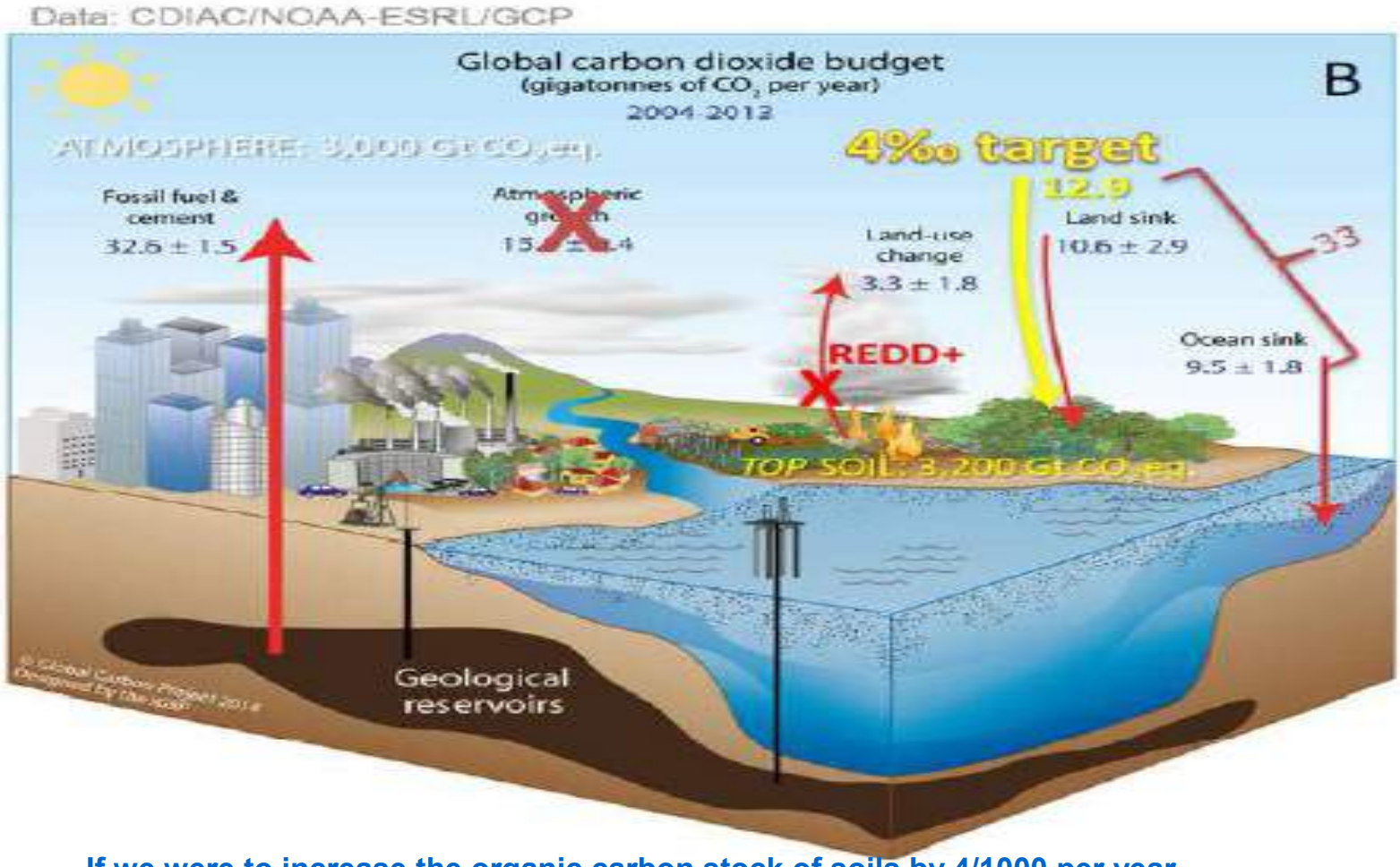
agriculture : 10 %, deforestation : 11%, fire : 3 %



Source : IPCC, 3rd Working Group, 2007

Emissions but also sequestrations
The challenge of the « 4 per 1000 » initiative

Disturbance of the carbon cycle due to human activities, 2003-2012 (billion tonnes of C per year)



If we were to increase the organic carbon stock of soils by 4/1000 per year, all anthropogenic CO2 emissions are offset

The theoretical calculation of 4/1000

- Stock of organic carbon in the soil (0-40 cm) = 820 GtC
- Anthropogenic emissions : 8,9 GtC/an
- Sequestration by the terrestrial biosphere and the oceans : 5,4 GtC/an

4 / 1000 = 0,4 % = 3,5 (8,9-5,4) / 820

The real potential of stocking carbon in the terrestrial biosphere

Activity		Technical Potential (Pg C/yr)	
I.	**Forest**		
	1. Afforestation, Forest Successions Peatland Restoration	1.2-1.4	
	2. Forest Plantations	0.2-0.5	
II.	**Soils**		
	1. Croplands	0.4-1.2	Reducing emissions Sequestering carbon
	2. Pasturelands	0.3-0.5	
III.	**Degraded Lands**		
	1. Salt-affected soils	0.3-0.7	
	Total Technical Potential	2.6-5.0 (3.8 Pg C/yr)	

Lal (2010)

Stocking is only valid for a certain time (20-100 years) and destocking is possible = a « bridge » for the survival of humanity

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

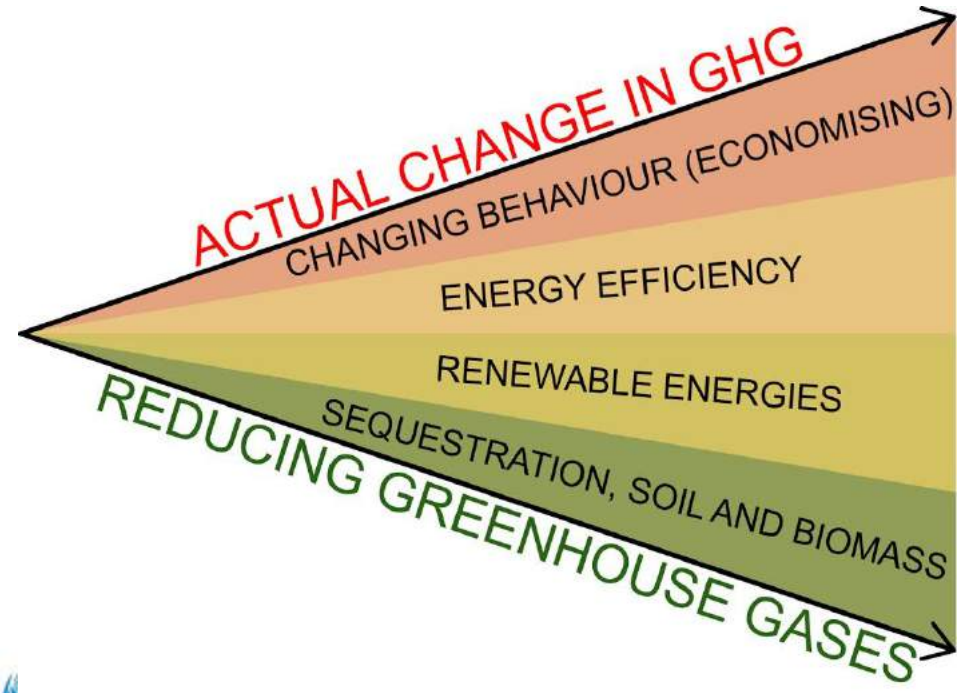
MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

Successful mitigation = emission reductions of 40-70% by 2050 compared with 2010

= "Large scale changes
in our energy systems **and** land sector" (IPCC)

Today Tomorrow



Urban :
De-carbonise the economy

+

Rural :
Re-carbonise the biosphère
(photosynthesis)

The land sector: 40% of the global mitigation potential in 2030 (IPCC)

ACTIONS ON THE SUPPLY SIDE : produce more and better and enhance

Livestock — Crops — Integrated systems — Forest

Bioenergy….

- emissions
+ storage
+ substitution (bio-products)

ACTIONS ON THE DEMAND SIDE

Reduce food and land losses

Promote the timber sector (building..)

2 global priorities : Restore degraded lands

Preserve and dynamically manage the forests and the timber industry

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

1.2 Risks and adaptation : A sharp rise in risks

IPCC 2014 :

Foods

Droughts, rainfall variability / breakdown in food systems

Decline in agricultural productivity / insufficient access to irrigation water

Loss of means for ecosystem services / fishing

Extreme weather events

… migrations, failed states, instability

Thus, issues related first to :

Water / Food security /
Urban development

Hundreds of millions more people to suffer from hunger by 2050 and pushed to migrate?

Africa and South Asia in danger

-20 to - 50% drop in rainfall in the Mediterranean at the end of the century?

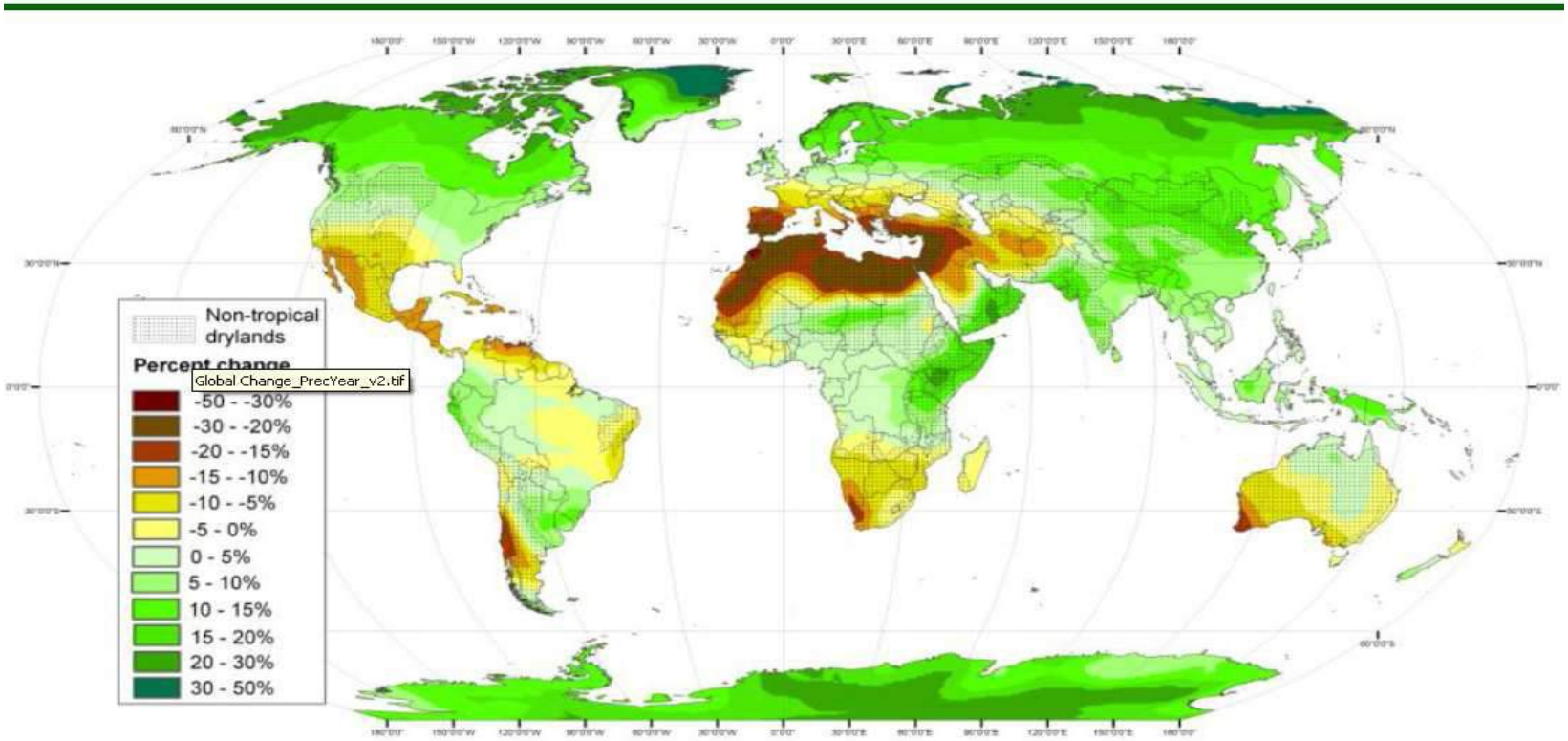
Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

Climate Change: Relative change in mean annual precipitation

1980/1999 to 2080/2099



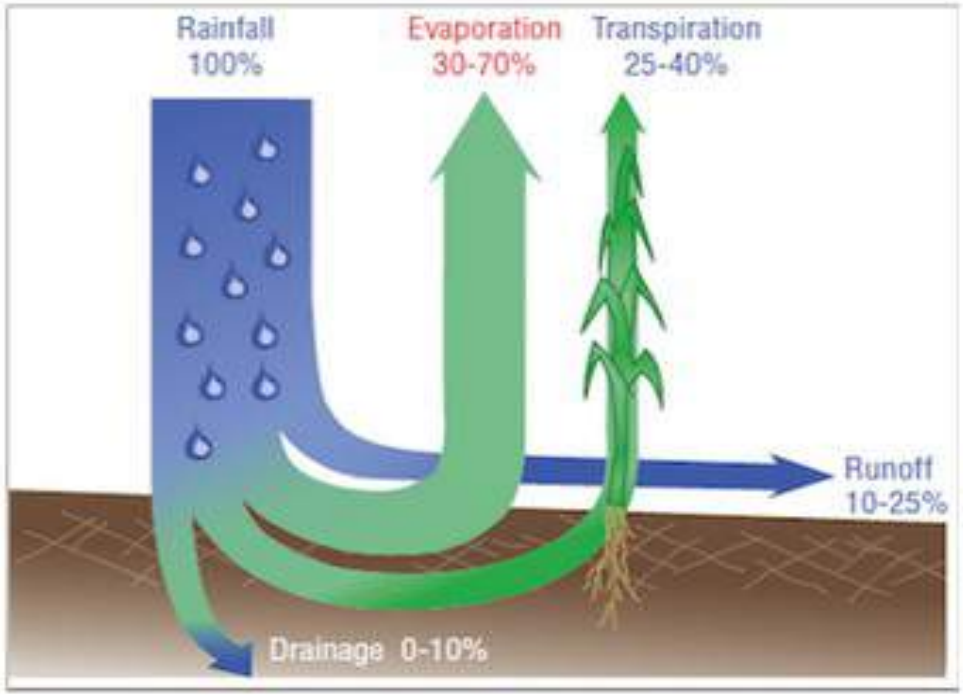
Relative change of mean annual precipitation 1980/1999 to 2080/2099, scenario A1b, average of 21 GCMs (compiled by GIS Unit ICARDA, based on partial maps in Christensen et al., 2007)

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

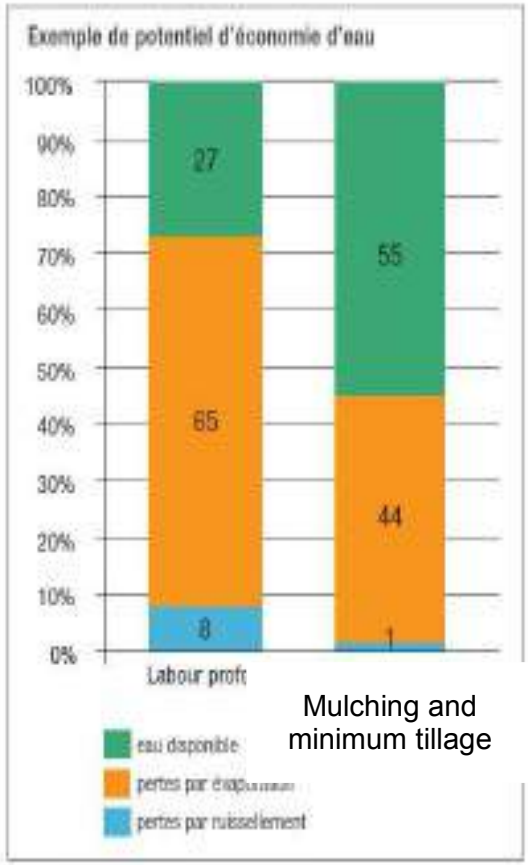
MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

Successful adaptation

Invest in water storage / irrigation: $ 225 billion by 2030 (IPCC)
Make better use of green water / agroecology + genetics...
= Water and Land productivity



Productive water (transpiration) and water losses (evaporation and runoff) without water conserving measures in dry lands.



Mulching and minimum tillage

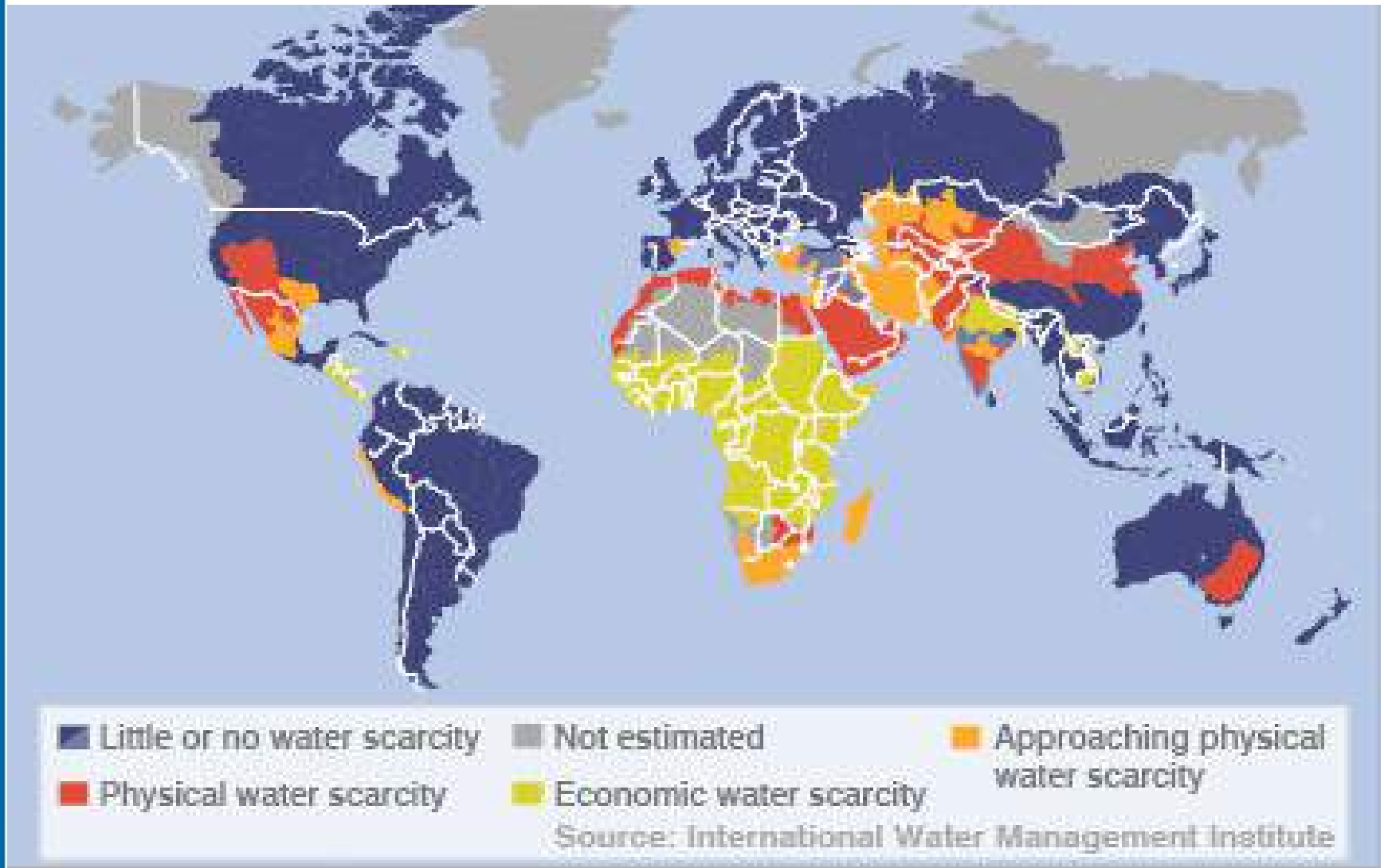
Source : La pratique de la gestion durable des terres ; TerrAfrica, FAO, WOCAT, 2011

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

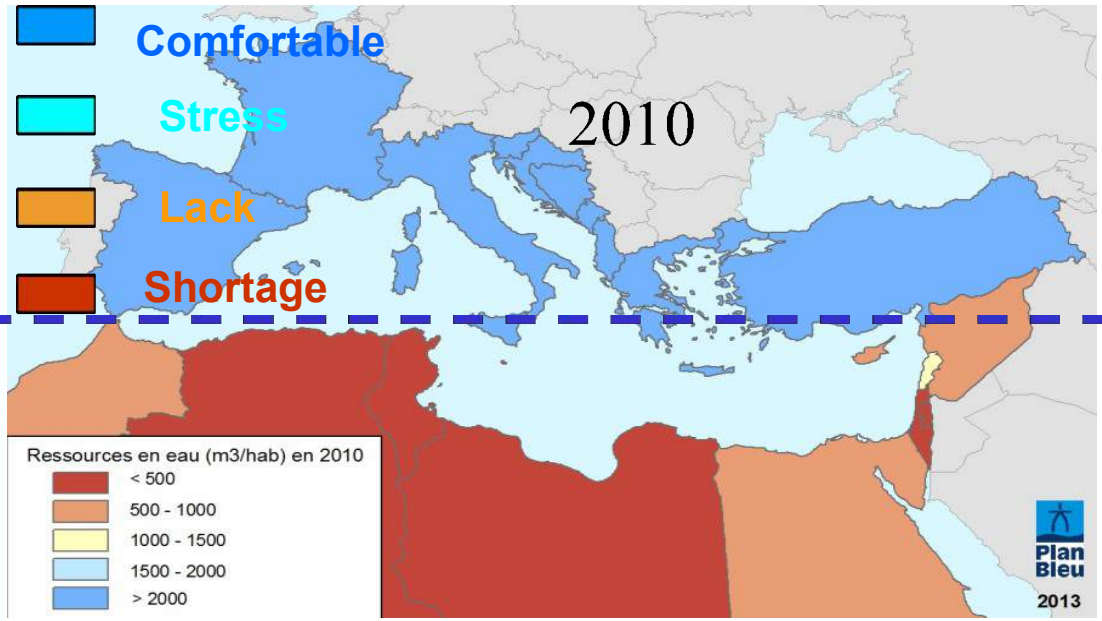
CGAAER
CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

Water resources are unevenly distributed



Abundance in the North / Physical scarcity in the Southern Mediterranean :

290 million people suffering shortages in the Mediterranean in 2050 (64 million in 2010) ?



Water resources (m3/capita) in 2010

North (incl. Portugal) :
90% of water resource
Water demand = 138 km3
= 13% of conventional potential water resource

South (incl. Jordan) :
10% of water resources
Water demand = 116 km3
= 105% of conventional potential water resource

Economic scarcity in West Africa

- Renewable water resources : 387 cubic km/year (surface : 287, underground : 100)
- Total take out : 13 cubic km/year
- **Level of exploitation : 3 %**

Source : Observatoire du Sahara et du Sahel

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE DE L'AGRICULTURE DE L'AGROALIMENTAIRE ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL DE L'ALIMENTATION DE L'AGRICULTURE ET DES ESPACES RURAUX

1.3 The land sector in the bargaining / action

Analyse our interrelationships in terms of solutions

Go beyond North-South divisions and position agriculture / food positively in COP21

- **Link climate and food security / development**
- **Show that agriculture is a solution!**

Think in terms of the "land sector"; quantify what progress is possible

- **Intensification of agriculture / Restoration of degraded lands / Zero deforestation**
- **Agriculture and food / forest / livestock / bio sectors**
- **No possible large-scale development of bioenergy without progress in global agriculture to ensure food security**

No Malthusian vision in Europe

Reducing production would be an absurdity from a climatic perspective (almost certain indirect increase in deforestation and GHG emissions), social perspective (jobs) and food perspective

No local action without taking into account global public goods: climate and food security

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE DE L'AGRICULTURE DE L'AGROALIMENTAIRE ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL DE L'ALIMENTATION DE L'AGRICULTURE ET DES ESPACES RURAUX

COP 21 : what results ?

1. Success (relative) thanks to the "bottom up" approach

2. Clear inclusion of the food challenge in the Agreement :

Preamble: "Recognizing **the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change »**

Article 2 :

a. Limiting global warming to 2 ° C / 1.5 ° maximum above pre-industrial levels
b. Increasing the ability to adapt to the adverse impacts of climate change and to promote low greenhouse gas emissions development, **in a manner that does not threaten food production**
c. Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate resilient development.

3. 82% of countries INDCs include adaptation with priorities for agriculture (91%) and water (88%) (analysis of 119 countries by UNEP in October 2015).

4. The solutions Agenda (Lima-Paris Action Plan) : initiatives on natural resources: soils (4/1000), water, landscapes ("landscape management")

Advance further at COP 22 in Morocco / what policies ?

agriculture.gouv.fr
alimentation.gouv.fr

II. The land sector in France : What potential for mitigation ?

A report commissioned to CGAAER by Agriculture Minister S. Le Foll, for COP 21

Les contributions possibles
de l'agriculture et de la forêt
à la lutte contre le changement climatique

Etabli sous la coordination de
Marie Laurence Madignier, Guillaume Benoit et Claude Roy

Avec la participation de
Barbara Bour Desprez, Jean-Pierre Chomienne, Michel de Galbert, Jean Gault, Max Magrum, Yves Marchal, Yves Riou, Jean-Marie Seillan et Jacques Teyssier d'Orfeuil

Membres du CGAAER

février 2015

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER

CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

A report that includes in the analysis the 3 dimensions: emissions, stocking / destocking, substitutions

Reduce emissions of the land sector (direct & indirect)	**Stock more carbon** in the terrestrial biosphere (soils, biomass) **= emissions compensated**	**Substitute** renewable products for conventional products **= emissions avoided** (in other sectors)
Economise energy, both direct (tractors, glasshouses) & indirect (food waste) Reduce emissions of CH4 & N2O (agriculture & livestock)	Stock more carbon in soils (organic carbon) and in biomass (wood...) Reduce destocking of carbon (land degradation, deforestation, urbanisation)  *Illustration : Börner et al.* Carbon stocking in forests	Innovate and increase production of bio-products (plant-based chemicals, wood, bioenergy...) to replace products with high GHG emissions (cement, oil, gas...)  Energy substitution

agriculture
.gouv.fr
alimentation
.gouv.fr

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE DE L'AGRICULTURE DE L'AGROALIMENTAIRE ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL DE L'ALIMENTATION DE L'AGRICULTURE ET DES ESPACES RURAUX

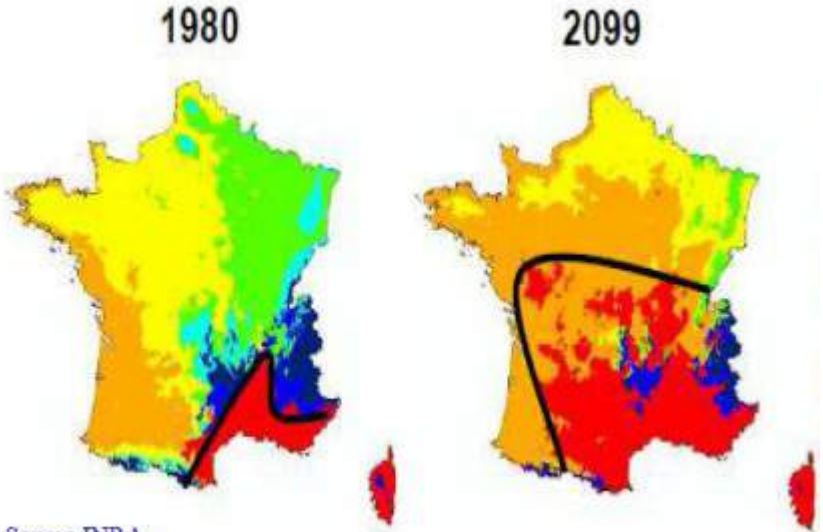
Balance sheet in France 2012 and 2030 mitigation scenario (CGAAER)

Mt CO2 equiv. /year	Emissions balance 2012	Mitigation 2030 (Scenario CGAAER)	Hypotheses / actions
Agriculture & livestock	+101 • N20 : 52 • CH4 : 38 • C02 : 11	12 - 15	Transition to agro-ecology • Fertilizer Management (nitrogen): 5.1 (optimize applications, substitute organic N, legumes) • Energy savings (tractors, glasshouses): 1.6 • Carbon sequestration in soils: 3.3 (zero tillage, agroforestry & hedges, intercropping, optimal grassland management) • Livestock rearing: 4.0 - 6.5 - improved rations, genetics - manure management - energy autonomy
Forest, wood sector, bioeconomy	- 129 Carbon stocks in forests –69,5 Carbon stocks in wood – 4,7 Subst. wood energy - 30 Subst. wood materials -25 Subst. chemicals from plants and biofuels - 8	28 - 35	• Forest/wood : stocking +5, substitution +26 • Substitution for chemicals from plants +4 • Promotion of wood in construction • Reforestation (50,000 ha/yr) and forest management • Climate energy package, and low carbon strategy
Land use	+ 28 Loss of grassland +14 Loss of cropland +14	8 - 10	• Reduction of carbon losses by 30%
Food waste		8 - 10	• Reduction of food waste by 20%
TOTAL		**50 -76 = 1/3 to ½ of national mitigation target**	

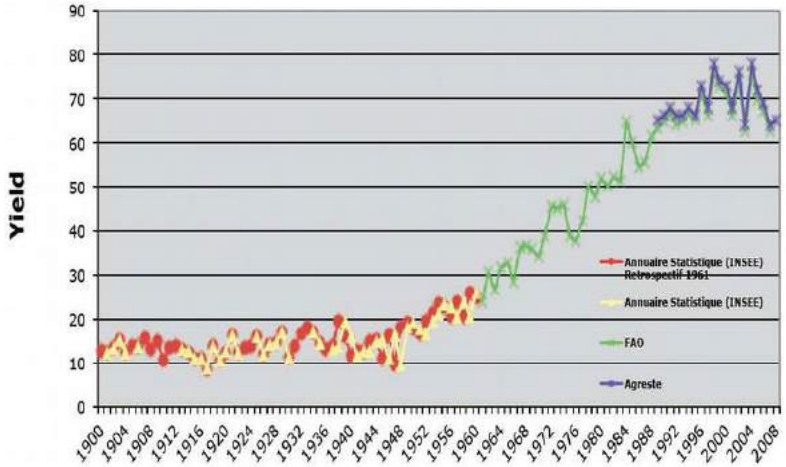
agriculture.gouv.fr
alimentation.gouv.fr

One condition: successful adaptation. What risks ?

Mediterraneisation (e.g. forests)



Source INRA



Changes in wheat yields in France

Stagnating wheat yields

Risks and adaptation

IPCC : 3 risks for Europe

Water and agriculture :

- Increasing water needs
- Low point in water levels: + severe, + long

Uncontrolled urbanization / floods

Heat waves / health and productivity

Adaptation of the land sectors =

- **Water: hydraulic infrastructures, extension and irrigation efficiency**
- **Agroecology**
- **Other: access to appropriate seeds, shortening of cycles (forests)...**

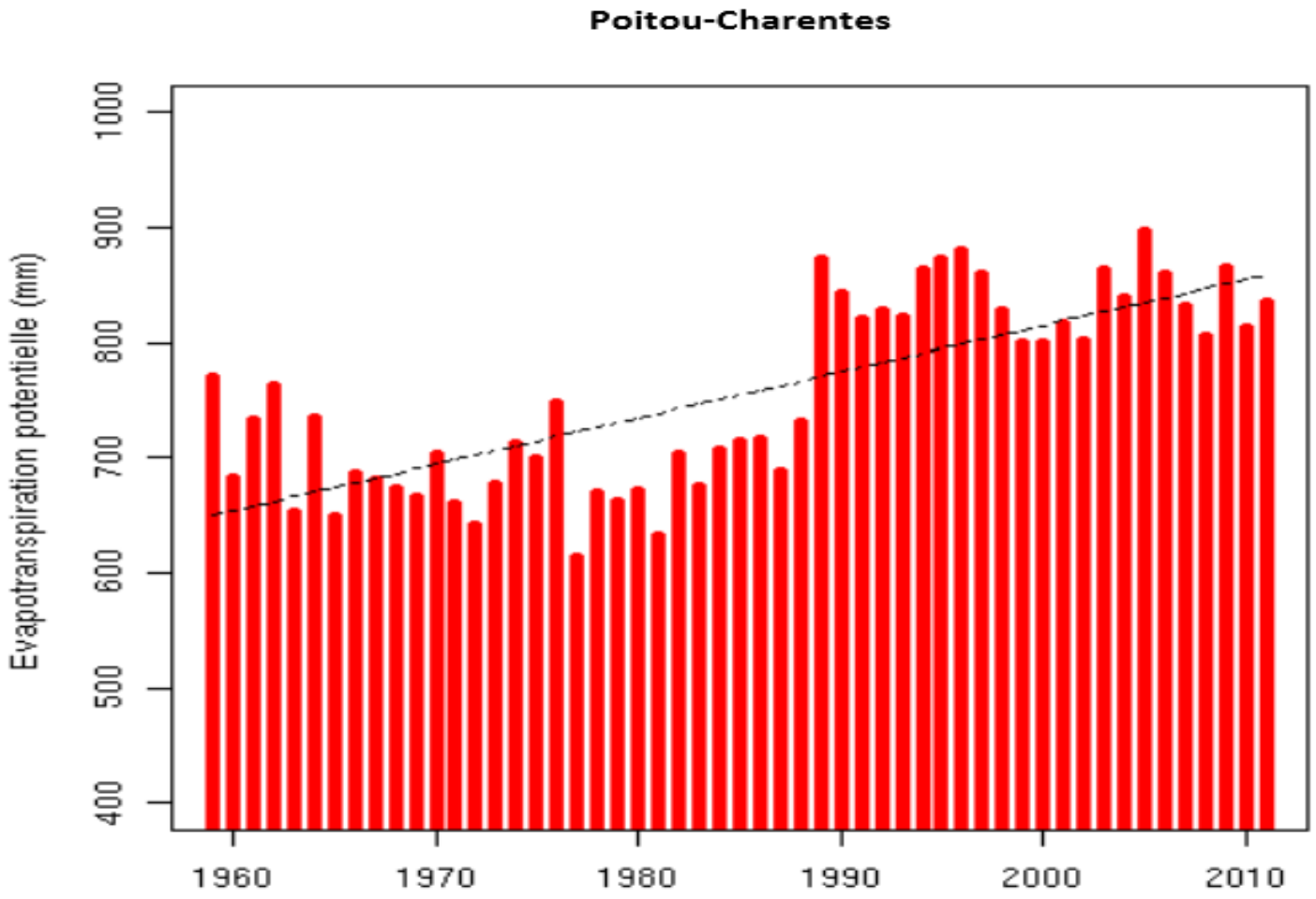
Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER

CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

Already a strong increase in ETP detected

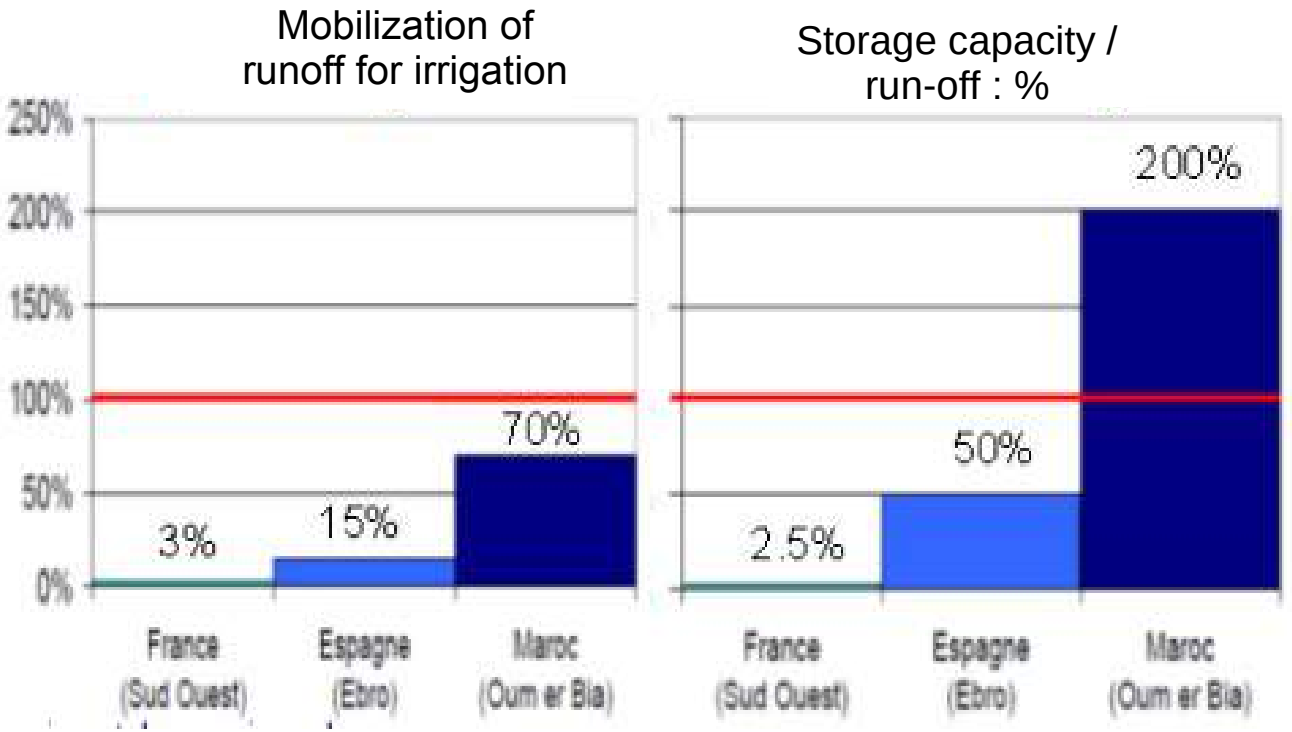


METEO FRANCE
Toujours un temps d'avance

agriculture
.gouv.fr
alimentation
.gouv.fr

Water resources still underutilized / under stocked in France (compared with Spain, Morocco)

Annuel run-off
(average)



The resource-poor countries are those that store the most

CONCLUSION: towards "climate-smart territories"

Each region / area needs to develop its own solution, successfully achieving the triple goal of: production-access / adaptation / mitigation

1. What risks, what adaptation options?

2. What mitigation potential? What production potential?

3. How to better manage / develop rural resources / achieve a "triple win", act "local" taking into account the "global" (climate and food)?

- **Agroecology:** water retention / soil enrichment (4 per 1000), diversification, legumes, autonomy, grassland management, livestock…+ grassland conservation + **plant breeding, genetics**
- **Water = storage, transfer, extension / irrigation efficiency** (in compliance with the European Water Framework Directive**)**
- **Forestry / wood sector**: reforestation, forest management, manufacturing, use of wood in construction
- **New agricultural biosectors** (plant chemistry ...), **innovation,..**
- **Reduce food waste and waste of land resources** (urban sprawl)

III. Examples of solutions '4 per 1000' in different contexts

1. Agroforestry

Example: Southern Niger

- 5 million hectares regenerated by 1 million farmers since 1985
- + 500,000 tonnes of grain (enough to feed 2.5 million more people)

In Zambia, Mali (Seno Plain), Malawi.

Yields that can double
+ production of trees:
- 20m3 to 60m3 wood / ha / year
- 2-6 tons of forage / ha / year

Agroforestry system in Niger with high density of *Faiderbia albida* trees

Source : C Reij, WRI

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

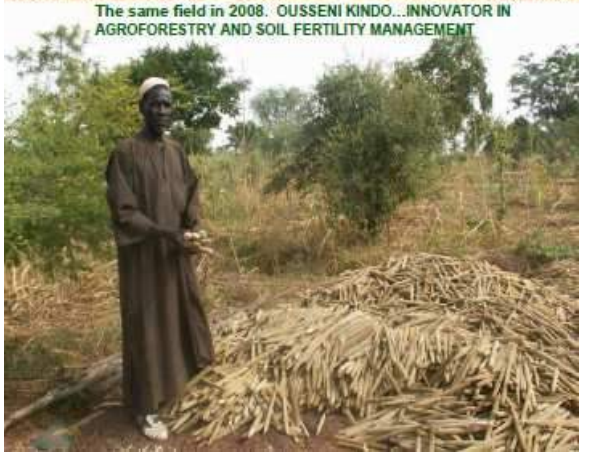
MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER

CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

2. Rainwater harvesting / zaï technique (improved by Ousseni Kindo)

500,000 farmers in Burkina and Mali involved since 1985



With micro-dosing (targeted fertilizer applications in very low doses): millet and sorghum yields doubled, revenues increased by 50% to 130%

agriculture
.gouv.fr
alimentation
.gouv.fr

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

3. Landscape ("terroirs") management

Example of the Tigray region in Ethiopia

- the driest region of the country
- terrible famines in the 1980s
- become the most water secure region of the country!

1 million ha restored since the 1990s

Reforestation + terraces and half moons
+ creation of hundreds of small dams and wells

90 million tonnes of soil and stones removed by hand

Irrigation increased from 40 ha to 40,000 ha since 1990

Food self-sufficiency restored since 2007

Source C Reij, WRI

agriculture
.gouv.fr
alimentation
.gouv.fr

4. Restoration of degraded lands and rangelands by planting biodiverse legumes

Source : D Crespo, Fertiprado

Very large areas degraded in the Mediterranean
(Maghreb, Eastern Mediterranean), Turkey, Spain, Portugal, Italy ...)

with high productivity loss / land abandonment and fires

Exemplary restoration in **Portugal** through the use of **local biodiversity (planting legumes)** + phosphorus inputs

- 500,000 hectares restored in 20 years
- Productivity and carbon sequestration doubled
- Major co-benefits: water, biodiversity, landscapes

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

5. Conservation agriculture / arable crops

Born the 1930's in the US in response to droughts, sandstorms

105 million ha worldwide, including 25m in Brazil
Yields: + 20%-120%
Water use: - 20% to – 50%

Example of the operation of M. Brant in Ohio (USA):

- 1150 acres
- Zero tillage since 1971
- Under-sowing since 1978
- Catch crops. Heavy use of legumes...
- Elimination of cover crops by rolling
- Continuous innovation

Source : Brant, OECD/MAAF workshop, 2015

Organic matter content increased from 0.5% to 8% from 1971-2015
Herbicide consumption down by as much as 90%
Yields: +15% (maize) to + 45% (soybeans) / local average
Production costs: $ 210 / acre (local average $ 480)

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER

CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

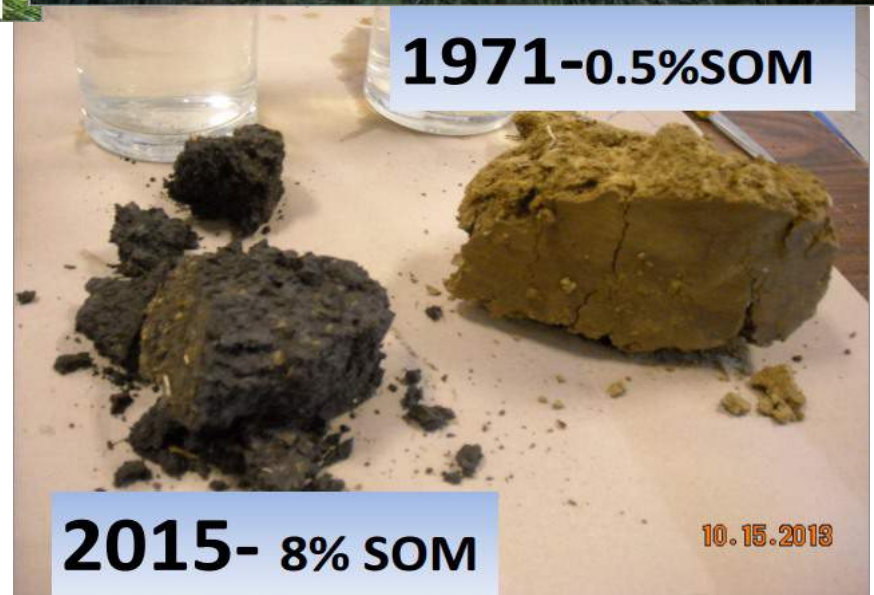
agriculture
.gouv.fr
alimentation
.gouv.fr

Rolling Rye after planting, effective plant termination without herbicide

Can be done on small scale for vegetable growers

05.24.2015

Innovative Seeding Methods for Corn and Bean Farmers



1971-0.5%SOM

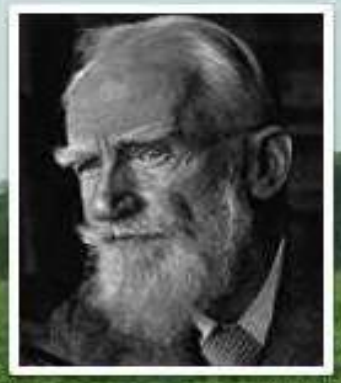
2015- 8% SOM

10.15.2013

6. Integrated systems: agriculture / forest / livestock in Brazil

Brazil's objective for 2030 (INDC COP21):

- Restoration of degraded land: + 15 million h4
- Zero deforestation (already -85% since 2005); reforestation
- 18% biomass (sustainable biofuels) in the energy mix compared with 5.6% in 2012
- Zero tillage, nitrogen and manure management, use of legumes
- Integrated livestock / forest / crops



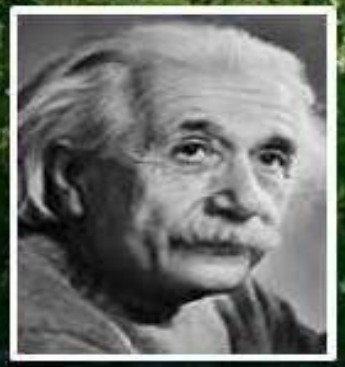
George Bernard Shaw
1856-1950

You see things and you ask “why”?
I see things that do not yet exist; and I ask “why not”?

Sénèque, died in 64

It is not because things are difficult that we don’t dare to do them, but because we don’t dare to do them that they are difficult

Insanity is to always behave the same way and expect a different result...
Imagination is more important than knowledge



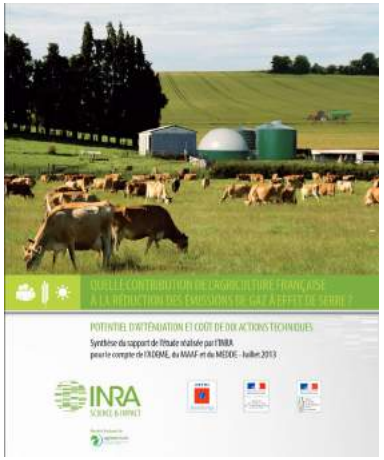
Albert Einstein
1879-1955

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE
DE L'AGRICULTURE
DE L'AGROALIMENTAIRE
ET DE LA FORÊT

CGAAER
CONSEIL GÉNÉRAL
DE L'ALIMENTATION
DE L'AGRICULTURE
ET DES ESPACES RURAUX

For more information :



CGAAER Report n°14056

http://agriculture.gouv.fr/sites/minagri/files/rapport_ag_fev_2015_version_finale_cle45a8c5.pdf

INRA Study

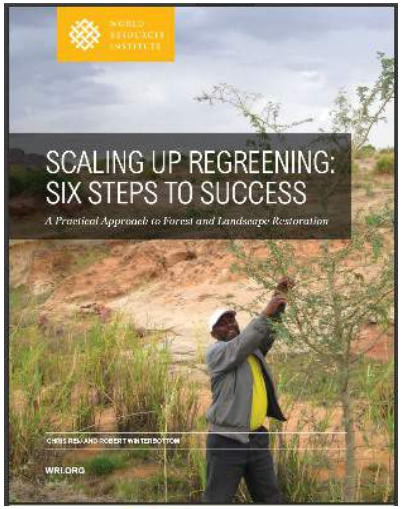
http://inra-dam-front-resources-cdn.brainsonic.com/ressources/afile/237958-637ec-resource-etude-reduction-des-ges-en-agriculture-synhese-90-p-.html

4 per 1000 Initiative

http://agriculture.gouv.fr/sites/minagri/files/1509-climat-4pour1000-fr-bd.pdf

Scalling up regreening : 6 steps to success

http://www.wri.org/sites/default/files/scaling-regreening-six-steps-success.pdf



agriculture
.gouv.fr
alimentation
.gouv.fr