

# *Climate crisis in the agri-food sector: policy and tools to manage the transition*



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# Outline of presentation

- Public Policy pattern
- Climate, economics and markets change;
- Public support in risk management policies in agricultural&fishery sectors;
- Climate change: pattern, assessment and focus on fishery
- Tools to cope revenue crisis: an overview

# 1. Public Policy Pattern

## Rationale of the CAP

- Ensure **food security** at all times
- while responding to **societal requirements and expectations**
- at a **reasonable price** for consumers

This is only possible if:

- The **singularity of the agricultural sector** is recognised
- farmers can realise a **fair income**

## EUROPEAN AGRICULTURAL SECTOR AFTER WORLD WAR II

- Demand for food
- Rationing was the norm but it was undercut by black markets



- So that, food policies had been directed at maximising agricultural production

# Ensuring food security

- Vulnerable due to **external political, economic and strategic decisions beyond our control**
- Absolute food security can only be ensured by building up or maintaining a high degree of **self-sufficiency**
- This is difficult in a free world market environment when the region does not have a **comparative advantage**
- Government must therefore intervene to compensate for this **comparative disadvantage**

## responding to societal expectations

- The agricultural sector not only produces food, but also a wide range of **extra goods and services**
- With the production of these goods and services, both from a private and public nature, the sector responds to **societal requirements and expectations**

# TREATY OF ROME: THE STARTING POINT

The Common Fisheries Policy was already created by the Treaty of Rome in 1957 and is provided for in Article 38 of the Treaty establishing the European Communities.

«The common market includes agriculture and trade in agricultural products. Agricultural products are understood to be the products of the soil, of **agriculture and fisheries**, as well as products of primary processing directly related to these products.»

**Fisheries was initially included in the Common Agricultural Policy.**

When we talk about "agricultural" or "farming" in Articles 39-46, we also mean fishery products.

# Art. 39

The aims of the common agricultural policy are:

- (a) **to increase agricultural productivity** by developing technical progress, ensuring the rational development of agricultural production and the better use of the factors of production, in particular labour,
- (b) thus to **ensure a fair standard of living for the agricultural community**, in particular by increasing the individual earnings of persons engaged in agriculture,
- (c) **to stabilise markets**
- (d) **to ensure security of supply,**
- (e) **to ensure reasonable prices in deliveries to consumers.**

# HOW TO IMPLEMENT THE CAP?

However, the formulation of the objectives in **Article 39** did not clarify the instruments and lines of action through which they could be achieved;

**The lines of action of the CAP were identified in 1960 and referred to two main concepts:**

- **Regulating agricultural prices and markets, bearing in mind the price differentials between member countries and the resulting income disparities**
- **Improving agricultural production structures in order to facilitate the modernisation of enterprises, especially family enterprises, which are considered to be "backward" and unfit to participate in achieving the objectives set out in the Treaty of Rome.**

## BENEFITS FROM THE CAP

- Self-sufficiency of food supplies in the Community  
- agricultural output increased greatly
- Food security was assured
- Agricultural markets were stabilised
- Farmers enjoyed a fair standard of living -  
although large farmers and farmers in the North  
of Europe benefited most from this situation

## SUMMARIZING.....

- Government aid to the farming population. The policies varied slightly among countries;
- Encouragement to productive improvements, through low rate credits, subsidies etc.;
- These had the effect of foster mechanisation (higher yields).

# GOVERNMENT POLICIES OF INCOM SUPPORT

## Effects?

- productivity in agriculture grew!
- “Second agrarian revolution” - food supplies were adequate and the level of consumption was satisfactory

# GOVERNMENT POLICIES OF INCOM SUPPORT

**But...**

- incomes of people working in the agricultural sector lagged behind those of people employed in the other sectors ⇒
- migration from the countryside

# GOVERNMENT POLICIES OF INCOM SUPPORT

**Why?**

- **Downward trend of agricultural prices!**

One of the reasons for the lag in incomes in the countryside was the downward trend of agricultural prices, and this was due to the fact that demand for food was relatively income inelastic.

**This means that although incomes grew very rapidly, because of economic growth in the industrialised world, people did not use their higher income to buy more food, but to buy other, higher-value commodities.**

Few products were in much greater demand, such as meat. Meat prices in fact moved up, but prices of all the other major foodstuffs/commodity, such as wheat, sugar and dairy products moved downwards.

## GOVERNMENT POLICIES OF INCOM SUPPORT

- Farm incomes, therefore, were increasingly dependent on government aid.
- Protection was important especially for those commodities that were most cheaply produced outside Europe (e.g. wheat, corn)

E.g. wheat - the European prices were higher by a considerable extent than prices in North America, Australia and Argentina.

For meat, and dairy products, many European products were competitive, so that the effect of protection was much slight. There was a paradox here for wheat and cereals were the crops for which demand was more stagnant; **by protecting them the governments were in effect encouraging surpluses and discouraging shifts to other crops and products.**

This kind of distortion was greater in the countries which produced large quantities of cereals such as France, Germany, and much less prominent in countries where agriculture was heavily geared to specialised dairy products such as the Netherlands



first attempt to solve agricultural problems through **integration**

# WHAT WENT WRONG?

- Guaranteed prices - overproduction
- Problem of surpluses began to emerge
- Big farmers produced more and thereby earned more money; small farmers needed assistance earned less;
- In order to increase output - soil with excessive amount of fertilisers, herbicides: environmental problems

# WHAT WENT WRONG?

- Quotas, levies, tariffs in agricultural trade - problem for exporters to the EC and to promote open trade and further liberalisation
- Dumping on world markets distorted prices and antagonised non-EU producers.
- Consumers however lost out - high food prices

# Summarizing the Historical development of the CAP



The Early Years	The Crisis Years	The 1992 Reform	Agenda 2000	CAP reform 2003	CAP Health Check 2008
<p><b>Food security</b></p> <p><b>Improving productivity</b></p> <p><b>Market-stabilisation</b></p> <p><b>Product support</b></p>	<p><b>Over production</b></p> <p><b>Exploding expenditure</b></p> <p><b>International friction</b></p> <p><b>Structural measures</b></p>	<p><b>Reduced surpluses</b></p> <p><b>Environment</b></p> <p><b>Income stabilisation</b></p> <p><b>Budget stabilisation</b></p>	<p><b>Deepening the reform process</b></p> <p><b>Competitiveness</b></p> <p><b>Rural development</b></p>	<p><b>Market orientation</b></p> <p><b>Consumer concerns</b></p> <p><b>Rural Development</b></p> <p><b>Environment</b></p> <p><b>Simplification</b></p> <p><b>WTO compatibility</b></p>	<p><b>Reinforcing 2003 Reform</b></p> <p><b>New challenges</b></p> <p><b>Risk management</b></p>

## FOCUS

# Political context of 2003 reforms

- Berlin Agreement set budget to 2006
- France resisted a Mid-Term Review but Germany keen on further reforms
- States supporting reform:
  - Germany, UK, Denmark, Netherlands, Sweden
- States against:
  - France, Greece, Ireland, Luxembourg, Italy

# FOCUS

## Fischler Reform 2003

- **Decoupling direct support by granting:** more flexibility, more responsibility to the farmers to meet markets challenges in the future. Decided- it is too early to make this important move and support for the cereals and meat sectors were left still partly coupled.
- **The other important element of the CAP reform was Cross-compliance (CC).** It is a combination of bigger responsibility and greater quality, according to which, farmers applying for the direct payments directly responsible for complying with the EU standards (environmental, animal and plant protection, food safety). By implementing CC requirements farmers gain public recognitions of better food quality and environmental protection.

# FOCUS

- Market issues: **some of them were revised (mostly milk and cereals sectors)**, for the others EU Council committed to do it in the Mid-term review of the reform (which was later renamed as Health check);
- In 2009 we have **“Health check”**, where all above mentioned issues are listed. **Climate change** is slightly new thing, but related with environmental issues.
- In addition, food prices and self sufficiency becoming an issue (once again!!!).

# FOCUS

**The importance of EU agriculture and rural development after a year 2013 is related to essential and arising functions:**

- The most **essential** function of the CAP is the further guarantee of **food security and food safety** in EU member states as a one of substantial elements of common security of member states, together with Energetic security and safety;
- **Arising** functions are related to challenges of our days:
  - EU agriculture plays an important role as a guarantee of a common EU-wide standard of food safety and quality, cross-compliance etc. and surveillance of its implementation;
  - another challenge is the implementation of the EU Energy Strategy in sustainable way with an **important role of renewable energy resources**, including usage of energy crops and forest plants for production of biofuel;
  - agriculture of the EU must play **a role on mitigation of climate change**.
- Agriculture of the EU retains its relevance with a growing **importance of rural development**, ensuring the development of rural areas and rural employment.

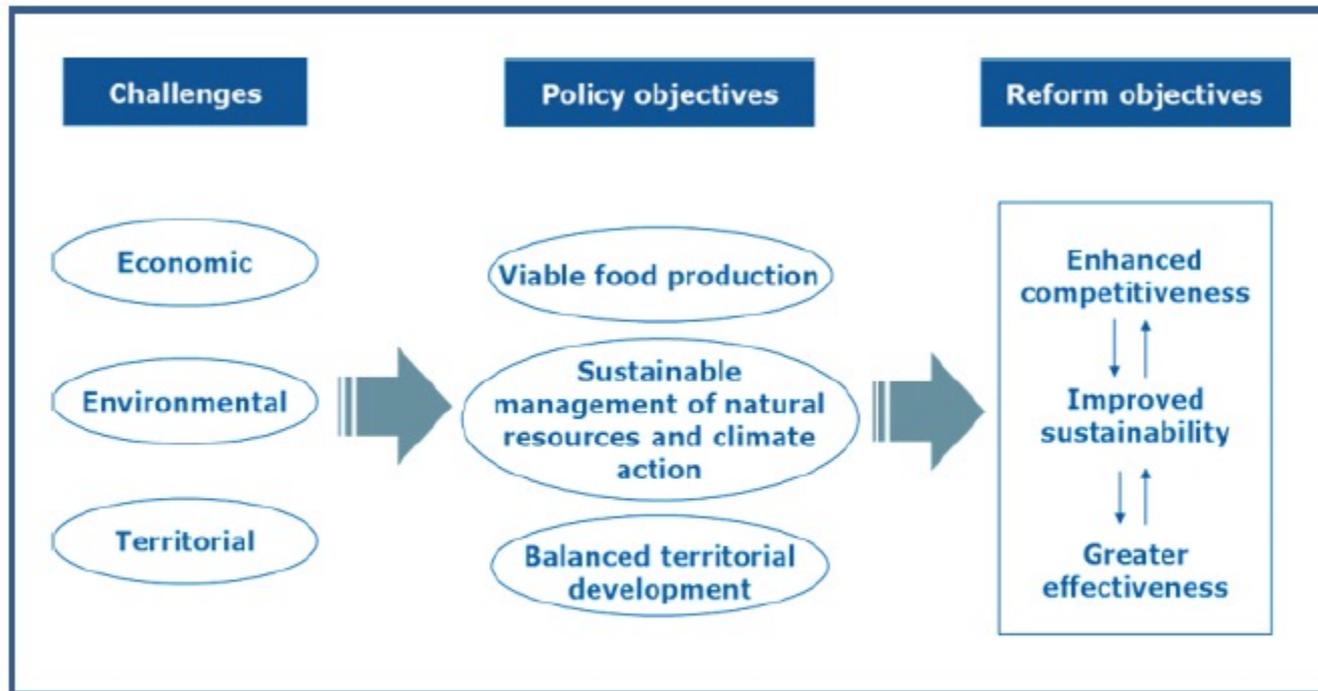
# The CAP 2014 - 2020

The CAP reform started more than 3 years ago in 2010 with a public debate, followed by the publication of the Commission's Communication on its vision of agriculture and the challenges and priorities for the future CAP and finally by legislative proposals for the first ever overhaul of the entire policy. **The decision-making process differed from previous reforms, with the European Parliament for the first time acting as co-legislator with the Council.**

The new policy continues along the historical reform path, moving from product to producer support and now to a more land-based approach. This is in response to the challenges facing the sector, many of which are driven by factors that are external to agriculture.

**These have been identified as economic** (including food security and globalization, a declining rate of productivity growth, price volatility, pressures on production costs due to high input prices and the deteriorating position of farmers in the food supply chain), **environmental** (relating to resource efficiency, soil and water quality and threats to habitats and biodiversity) and **territorial** (where rural areas are faced with demographic, economic and social developments including depopulation and relocation of businesses).

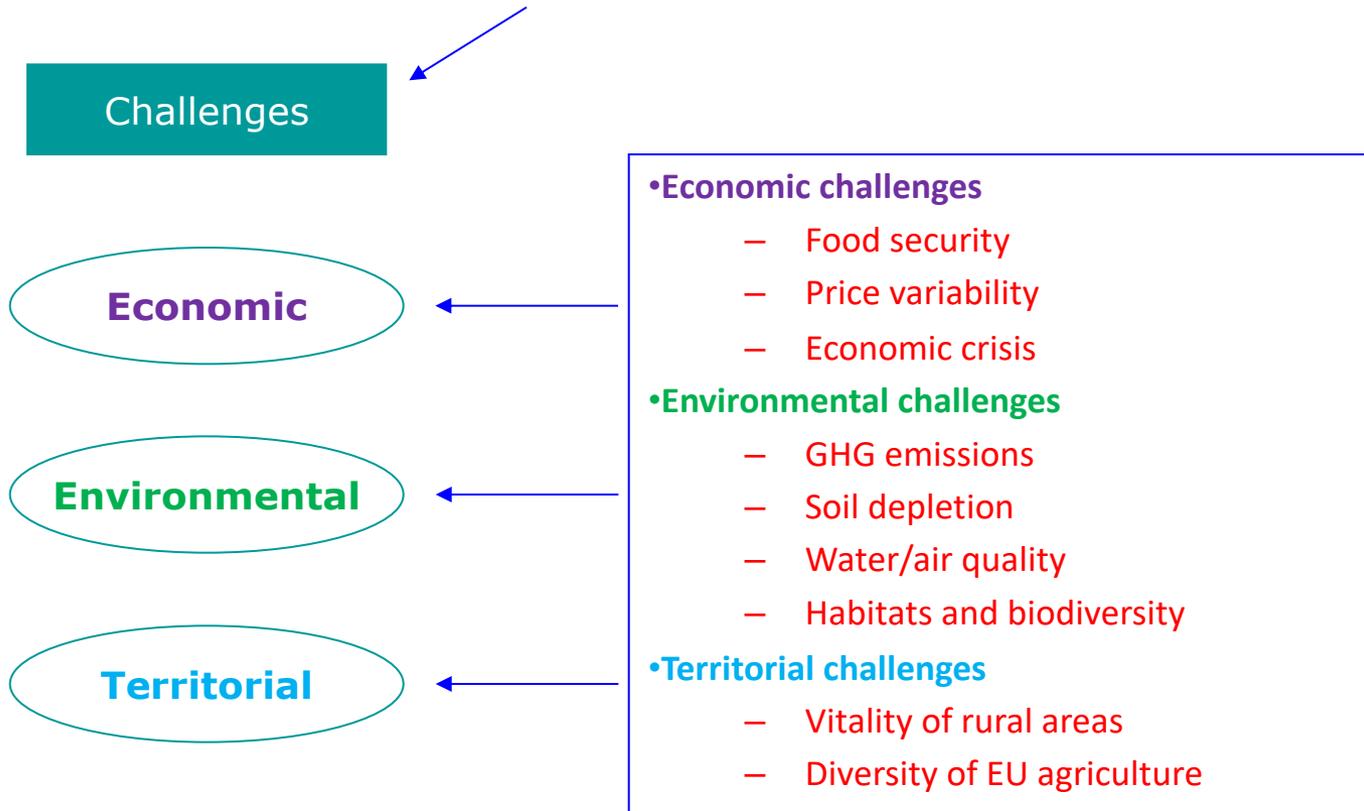
# The CAP 2014-2020: From challenges to reform objectives



Source: DG Agriculture and Rural Development.

# What are the challenges for agriculture...

Commission Communication 'The CAP towards 2020'



Pac post 2023

# GREEN DEAL = Green Growth



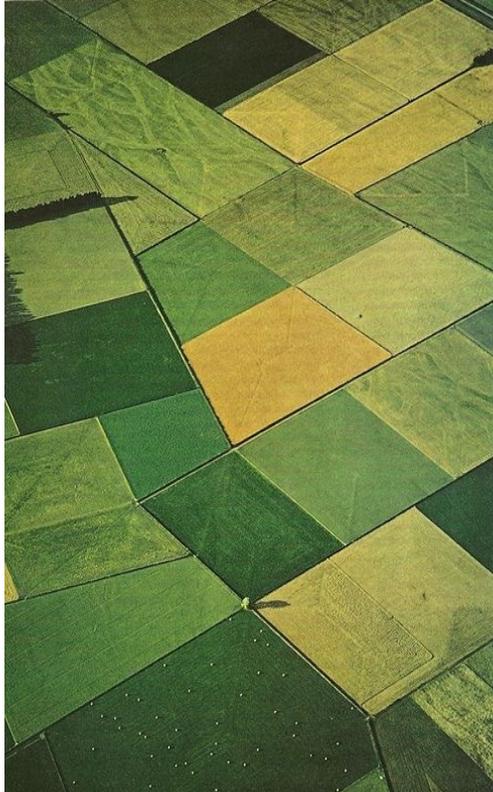
It derives from the European citizens demand for concrete political action on climate change.



## Basic principles:

- climate neutrality of the European Union by 2050;
- reduce CO<sub>2</sub> emissions and eliminate the present one from the atmosphere;
- develop a circular economy based on the use of renewable sources;
- green and fair transition, leaving no one behind.

# The EU Green Deal europeo: the policy



- Clean energy: Energy production and use account for more than 75% of EU greenhouse gas emissions;
- Sustainable industry: promotion of the use of recycled materials with a view to a clean economy;
- Building and renovating with a view to greater environmental sustainability;
- Sustainable mobility, both public and private;
- Greater protection for biodiversity, forests, oceans;
- “Farm to fork” strategy;
- Elimination of pollution.

# Strategy Objectives



- **Reduce the use of chemical pesticides by 50% by 2030**
- **Reduce the use of the most dangerous pesticides by 50% by 2030**



- **Reduce nutrient losses by at least 50%.**
- **Reduce the use of fertilizers by at least 20% by 2030**



- **Reduce the antimicrobial elements by 50%.**



- **25% of total agricultural land will have to be devoted to organic farming by 2030**

# The new EU-wide Biodiversity Strategy will:

> Establish protected areas for at least:



**30%**  
of land in  
Europe



**30%**  
of sea in  
Europe

With stricter protection of remaining EU primary and old-growth forests legally binding nature restoration targets in 2021.

> Restore degraded ecosystems at land and sea across the whole of Europe by:



Increasing organic farming and biodiversity-rich landscape features on agricultural land



Halting and reversing the decline of pollinators



Restoring at least 25 000 km of EU rivers to a free-flowing state



Reducing the use and risk of pesticides by 50% by 2030



Planting 3 billion trees by 2030

# CAP common specific objectives



# Common Agricultural Policy

## First Pillar

### DIRECT PAYMENTS - Key elements - **structure**

- **Basic payment** - national/single area
- **Redistributive** income support mechanism - **compulsory** - covering at least 10% of the direct payment envelope
- **Young farmers** payment (YFP) - **voluntary** - but ... at least 3% of direct payments envelope must be used to support young farmers... as **income support**, investment support or start-up aid for young farmers
- **Coupled support** granting max 13% of direct payment envelope to support some sectors
- **Eco-schemes - voluntary for farmers mandatory for MS** - 25% of the direct payments focused on a common list of action areas (organic farming, agro-ecological practices, precision farming, agro-forestry or carbon farming, animal welfare)

# RURAL DEVELOPMENT - II Pillar

Key elements - **structure**

## — *National Plan*

**Up to 35% of the overall budget should be devoted for environmental action (e.g. organic and animal welfare)**

## — *Measures:*

- Advisory services, farm management and farm relief services;
- Quality schemes for agricultural products, and foodstuffs;
- Investments in physical assets;
- Farm and business development: young farmers and investments in creation and development of non-agricultural activities;
- Organic farming;
- Animal welfare;
- **Risk management.**

# 1970: THE FIRST BUILDING STONE FOR A REVISED FISHERIES POLICY

## *Start*

It was only in 1970 that the Council adopted the acts to establish a **common market organisation for fishery products** and put in place a Community structural policy for fisheries.

## *Early developments*

**Fisheries played an important role in the negotiations that led to the accession of the United Kingdom, Ireland and Denmark to the EEC in 1972.** This led to a departure from the fundamental principle of freedom of access to the sea, with the extension of national exclusive coastal fishing rights in territorial waters, defined as those within 12 nautical miles of the coast, to include EEZs up to 200 nautical miles from the coast. Member States accepted that the management of fisheries resources fell within the competence of the European Community.

# THE COMMON FISHERIES POLICY: THE EVOLUTION

## The 1983 Regulation

After several years of negotiations, the Council adopted Regulation (EEC) No 170/83 **in 1983, establishing the new generation CFP**, which enshrined:

- the commitment to respect the EEZ and
- formulated the concept of relative stability, providing for conservation management measures based on **total allowable catches (TACs) and quotas**.

# WHILE SIGNING THE MAASTRICHT TREATY...

## The 1992 Regulation

In 1992, Regulation (EEC) No 3760/92, the provisions that governed fisheries policy until 2002, sought to redress the serious imbalance between fleet capacity and catch potential. The remedy advocated was the reduction of the Community fleet, accompanied by structural measures to mitigate the social consequences.

The regulation introduced the notion of 'fishing effort'<sup>1</sup> to restore and maintain the balance between available resources and fishing activities.

Access to resources was provided for through an effective licensing system.

<sup>1</sup> Fishing effort is defined as the product of fishing capacity and fishing activity, the latter calculated on the basis of time spent in a given area.

## THE 2002 REFORM

The measures introduced by Regulation (EEC) No 3760/92 did not prove sufficiently effective in halting overfishing, and the deterioration of many fish stocks even accelerated. This critical situation led to a reform that included three regulations adopted by the Council in December 2002 and entered into force on 1 January 2003:

- framework **Regulation (EC) No 2371/2002** on the conservation and sustainable exploitation of fisheries resources [repealing Regulations (EEC) No 3760/92 and (EEC) No 101/76];
- Regulation **(EC) No 2369/2002** laying down the detailed rules and arrangements regarding Community **structural assistance in the fisheries sector** [amending Regulation (EC) No 2792/1999];
- Regulation **(EC) No 2370/2002** establishing an emergency **Community measure for scrapping fishing vessels.**

# THE 2013 CFP REFORM

**The 2002 reform did not meet expectations in the short term**, as the deterioration of some stocks continued to increase. At the same time, it highlighted some problems that had gone unnoticed until then, such as discards.

**In 2009, the Commission launched a public consultation on the reform of the CFP**, with the aim of integrating new principles to govern EU fisheries in the 21st century. **After a long discussion in the Council and, for the first time, in the Parliament, an agreement was reached on 1 May 2013 on a new fisheries regime based on three main pillars:**

- 1) the new CFP (Regulation (EU) No 1380/2013);**
- 2) the common organisation of the markets in fishery and aquaculture products (Regulation (EU) No 1379/2013);**
- 3) the new European Maritime and Fisheries Fund (EMFF) (Regulation (EU) No 508/2014).**

## THE NEW REFORM

The new CFP aims to ensure that the activities of the fisheries and aquaculture sectors are environmentally sustainable in the long term and are managed in a manner consistent with the objectives relating to the economic, social and employment benefits to be achieved. The most significant points are:

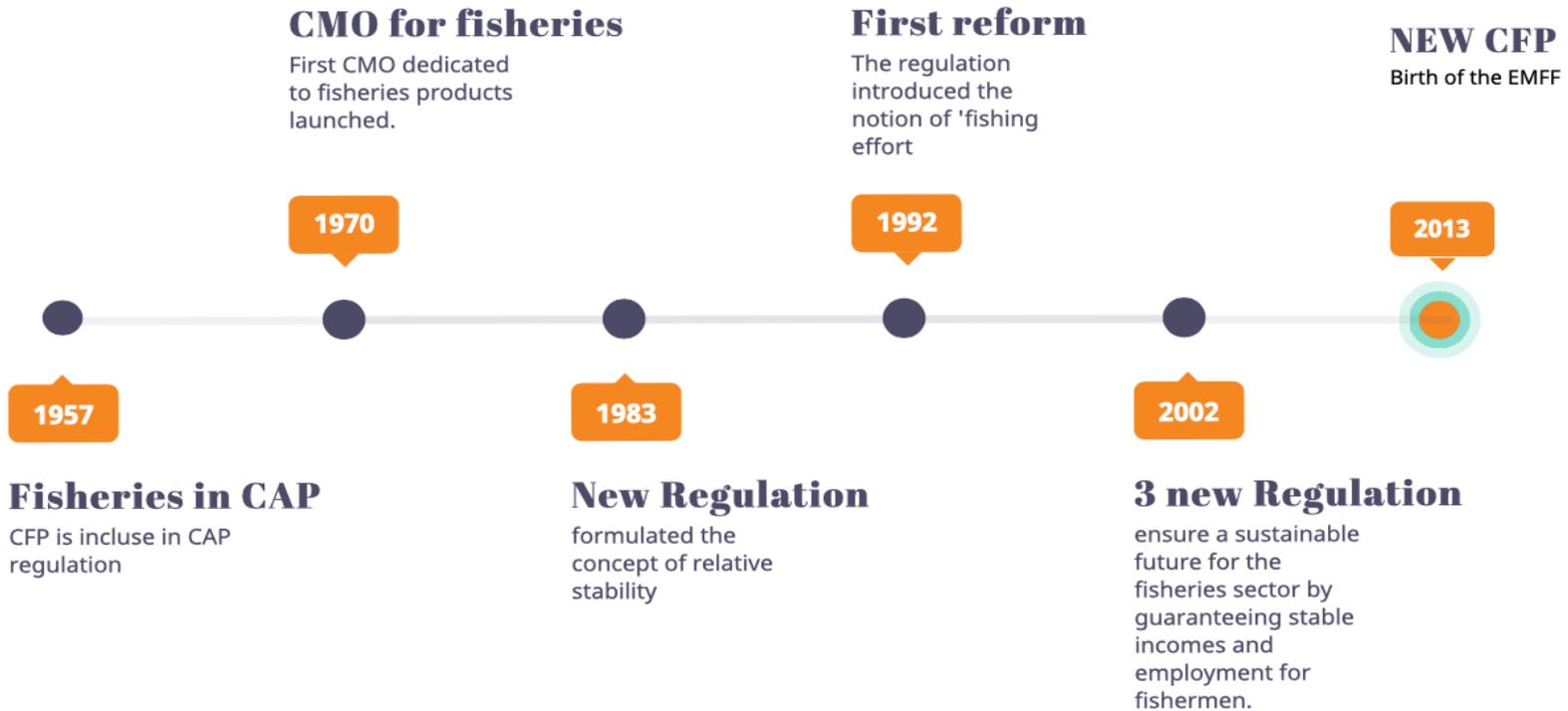
- **Multi-annual ecosystem-based management**
- **Maximum Sustainable Yield (MSY)**
- **Ban on discards**

## THE NEW REFORM (2)

- **With regard to fleet capacity**, under the new CFP Member States are required to adapt their fishing capacities through national plans so that they are balanced with their fishing opportunities. Small-scale fisheries have a special role to play in the new CFP. The 12-nautical mile exclusive zone for traditional fleets is to be extended until 2022.
- **The rules governing the activities of the EU fishing fleet in international and third country**
- **Sustainable aquaculture increases yields to supply the EU seafood market and promotes growth in coastal and rural areas through national plans.**
- **New obligations on Member States;**
- **Decentralised governance.**

The current set of technical measures defined in Council Regulation (EC) No 850/98 constitutes a complex and heterogeneous system of provisions that is currently being revised to provide the new CFP with a new set of technical measures.

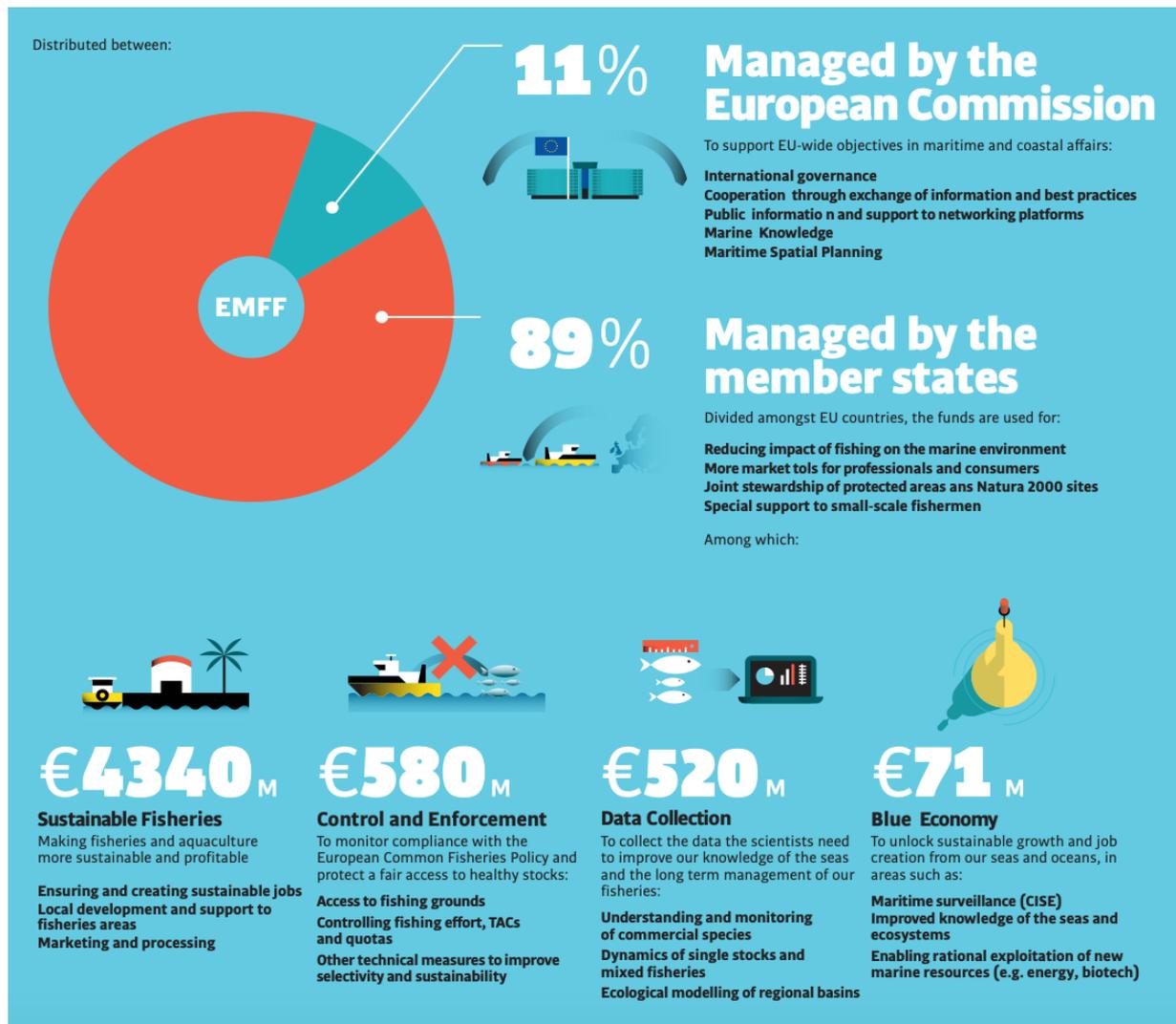
# TO SUMMARIZE: THE EVOLUTION OF CFP



## THE EMFF: THE FINANCIAL ALLOCATION

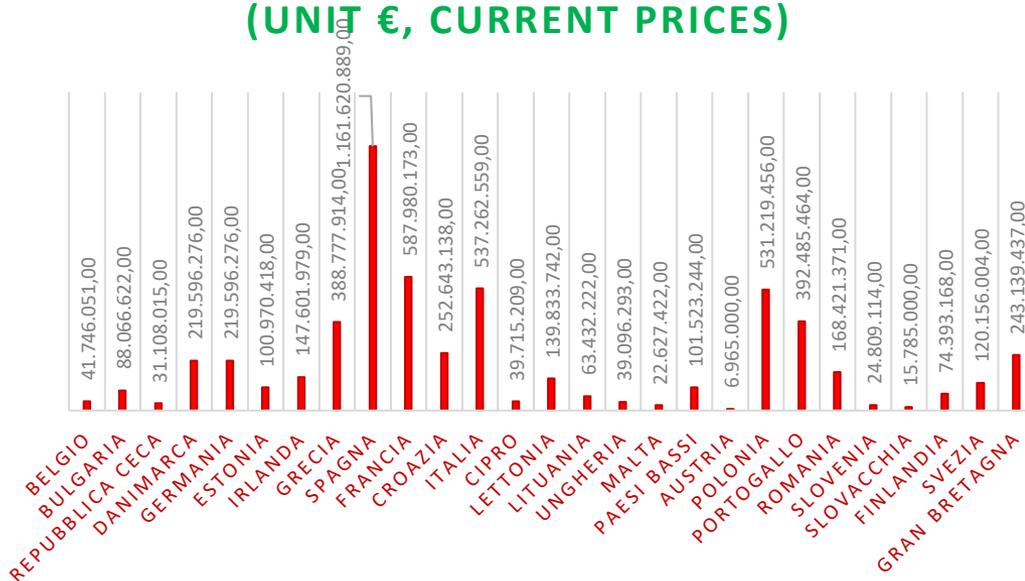
The total amount allocated to the EMFF

for the period 2014-2020 it amounts to approximately Euro 6.4 billion.



# THE ALLOCATION AROUND THE EUROPE

## TOTAL EU ALLOCATIONS OF EUROPEAN MARITIME AND FISHERIES FUND 2014-2020 (UNIT €, CURRENT PRICES)



Spain is the most resourceful nation.

Italy is third

The top 4 countries (Spain, Italy, France and Poland) intercept 45% of the resources.

Fact: Luxembourg is excluded from the EMFF.

## TO SUMMARIZE

1. The EMFF is the fund to finance the fishery sector
2. It's value is about 6 billion euro
3. The 4 area of EMFF are: Sustainable fisheries, Control and Enforcement, Data Collection, Blue Economy
4. The EMFF is divided in 5 chapter

## POLICY CHOICES IN THE LIGHT OF THE ENVIRONMENTAL/CLIMATIC/ECONOMIC SCENARIO

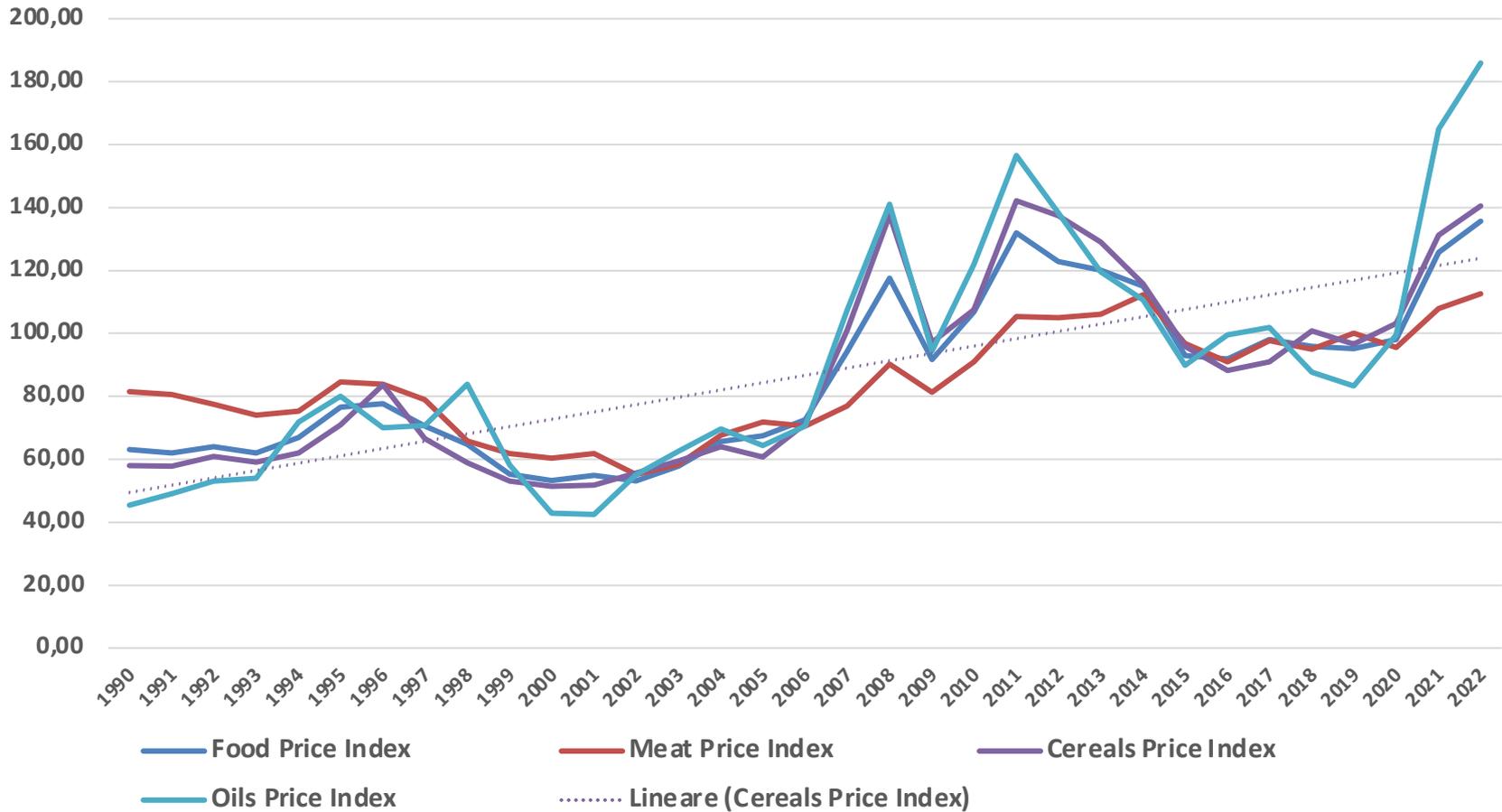


## 2. Climate, economics and market change

### Introduction

- **Agricultural/Fishery sector vs risk «old relationship»**
- In market-oriented agricultural sectors, farmers choose which crops to grow and how best to grow them by considering potential profits and potential risks.
- In general, there is a tradeoff between potential profit and risk.
- Successful farmers will be those that choose high-profit activities who successfully manage associated risk.

# Price pattern of agricultural commodity 1980-2022



# Food prices variability and food security in new global scenario

From the “Green Revolution” to the return of “Scarcity”

- What has changed in the latest 15 years?
- What has compromised the reaching of internationally-agreed goals regarding the war against malnutrition?

Three concepts of food security: social, political and economics

- (social) even though there was enough calories in the daily food intake to fulfill nutrition health allowance of daily per capita requirements, there was a high proportion that could not reach such level from the daily food intake, particularly in rural regions;
- (political) in MPC's market much rely on the world market to satisfy domestic consumption of agricultural products;
- (economic) the performance of the agricultural foreign trade had shown a much wider gap between exports and imports than the total merchandize balance.

# Food prices variability and food security

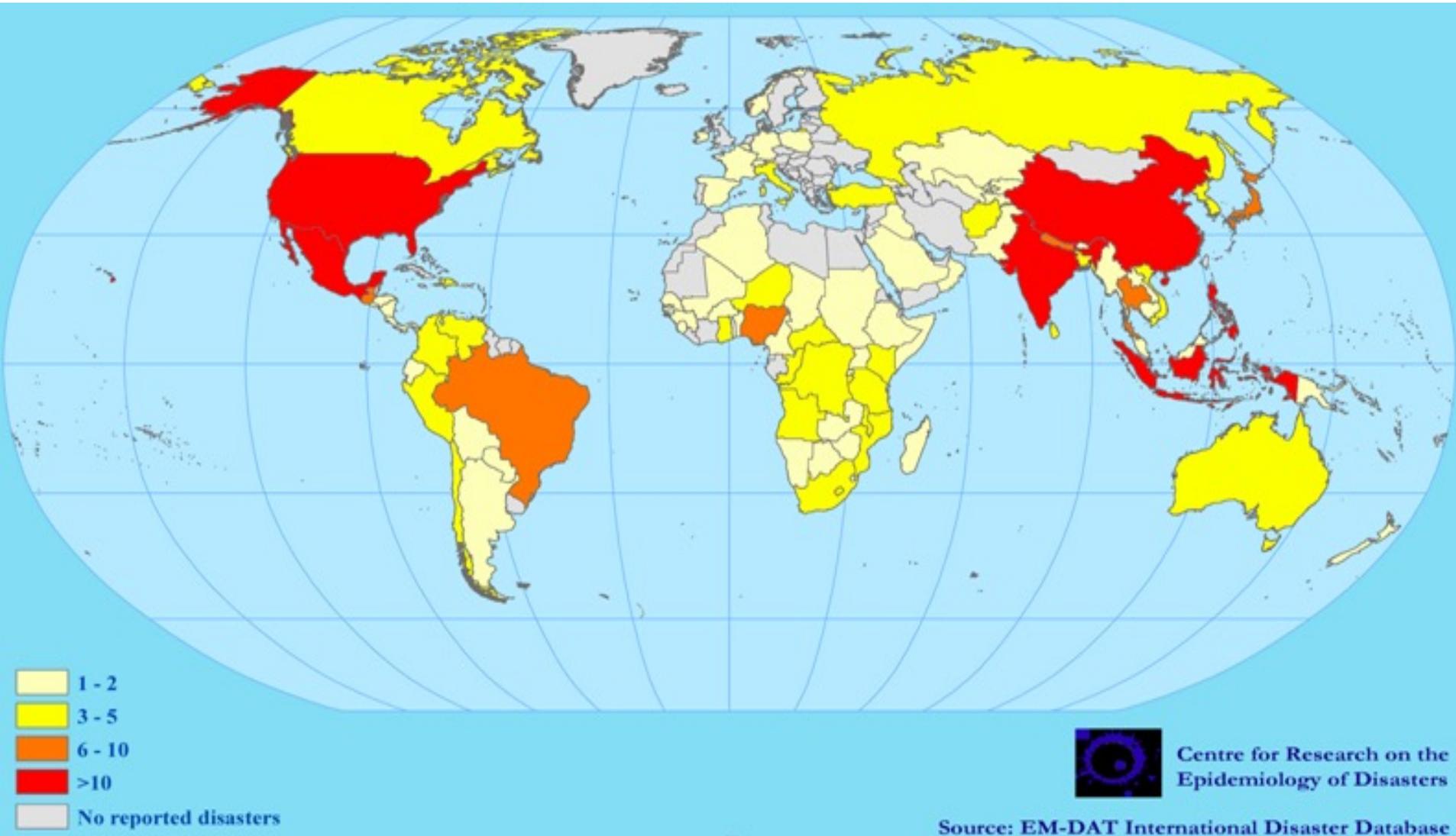
High and volatile agricultural commodity prices challenge the ability of consumers, producers and governments to cope with the consequences

**Factors** have contributed to increases price and volatility:

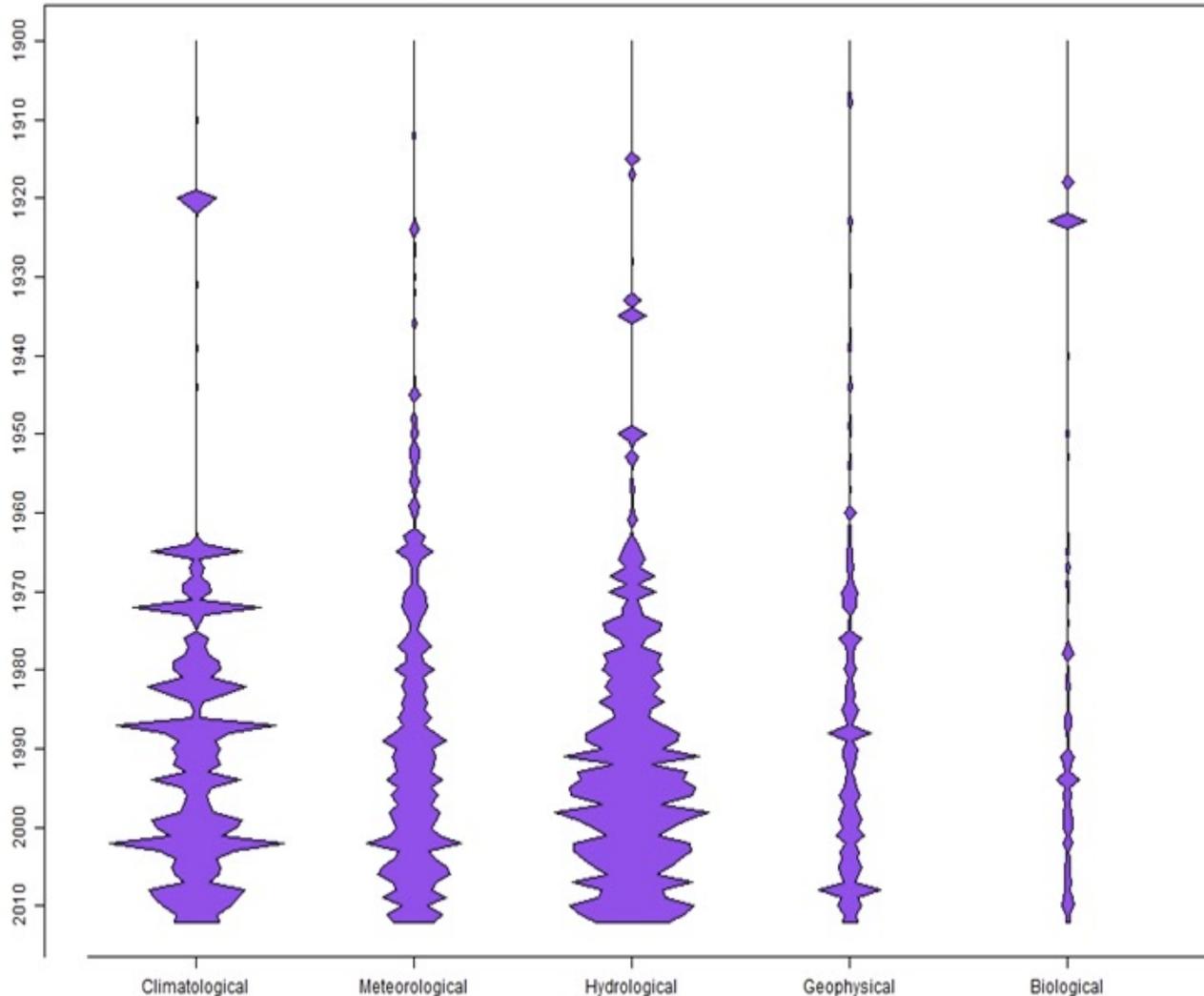
- Income growth of some countries e.g. China, India
- Demand increasing at higher rate than supply
- Reduction in stocks to uncomfortably low levels
- Biofuel production linking agricultural prices and markets more closely to energy markets and volatile oil prices
- Speculation on food commodity futures markets (which follows the above driving factors)

**Market equilibrium is changing**

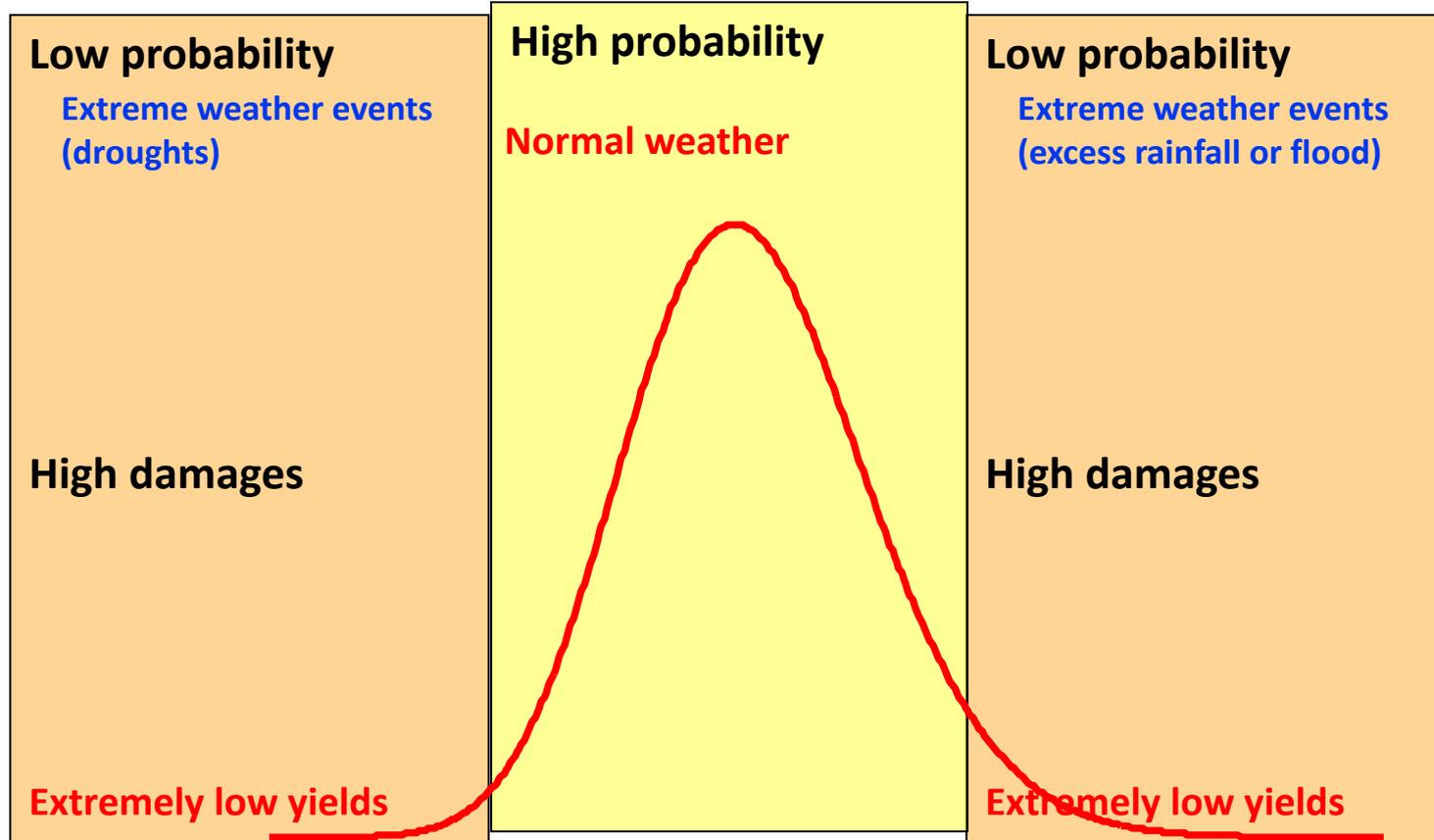
# Climate



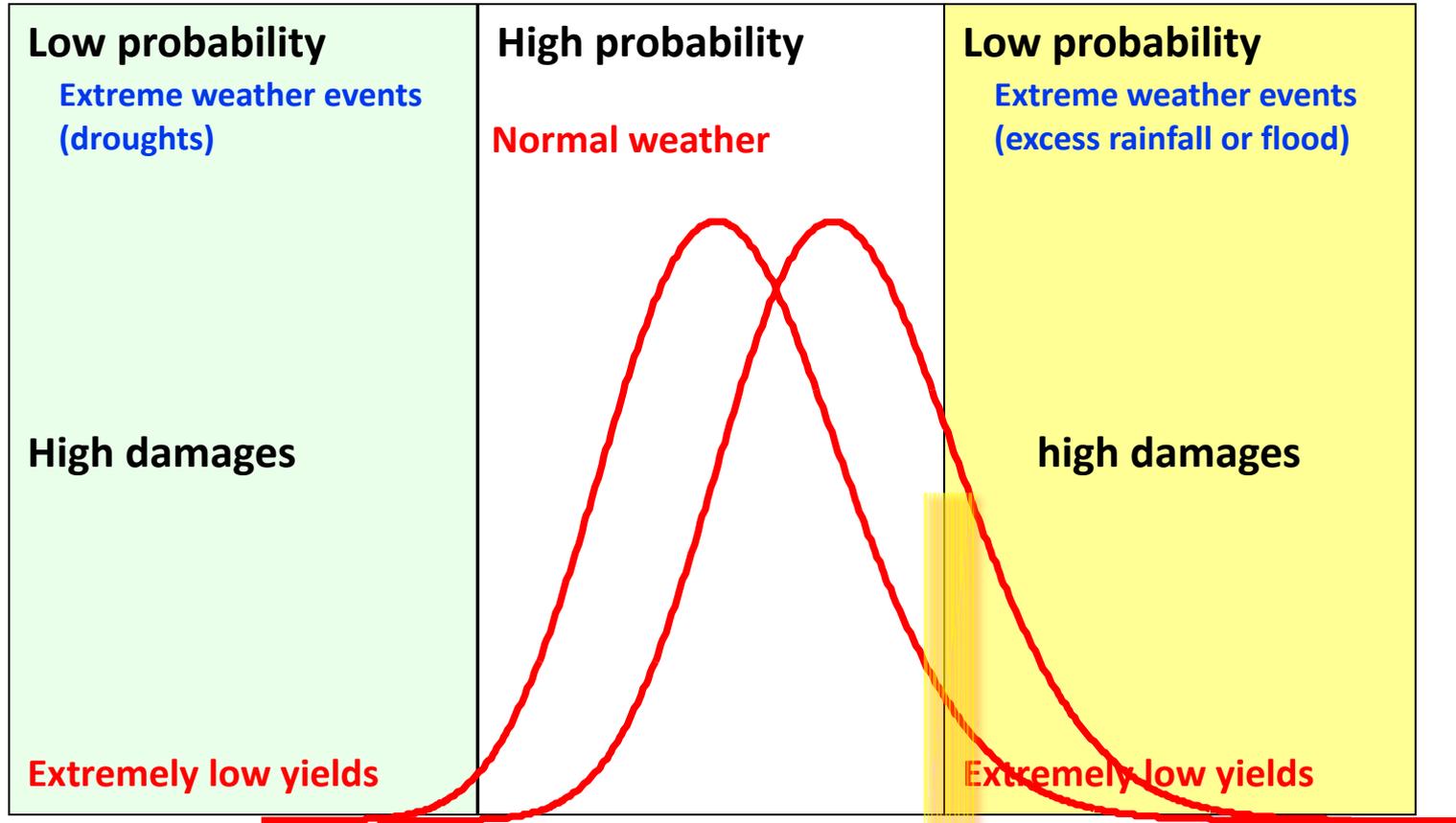
# Switch in pattern of frequency and severity of catastrophic events



# By the way, climate change affect probability distribution of weather events increasing uncertainty

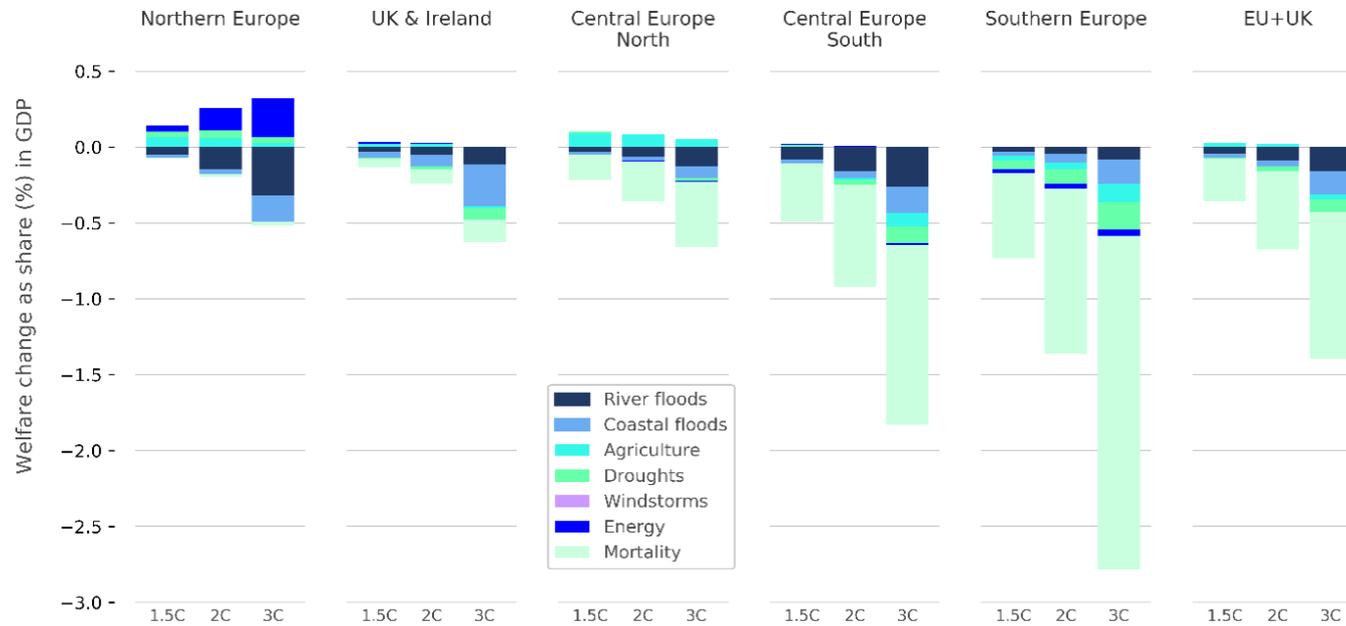


# So that...what were rare and catastrophic becoming «nomal»



# Climate change impact assessment

## Rationale



*How climate change is going to affect natural and human systems?*

# Climate Models

*How will the climate be  
in the next 30 years?*

*How will the climate be  
at the end of the  
century?*

*How does the climate  
system respond to  
changes in its forcing?*

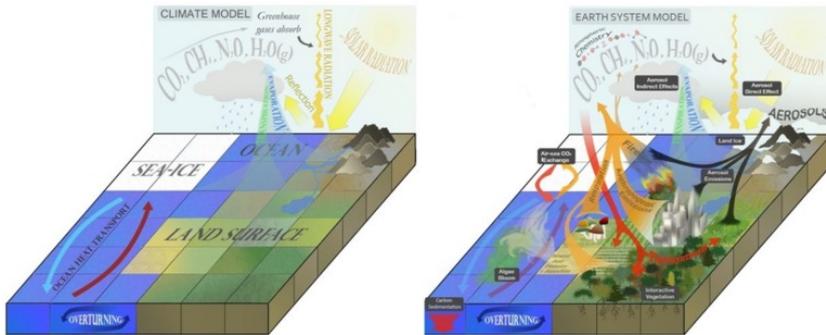
*How will the climate  
conditions be in the next  
season?*

...

*Understanding, predicting and projecting the climate system for the coming season and decades require modelling..i.e. simulating the key processes and interactions of the climate system components*

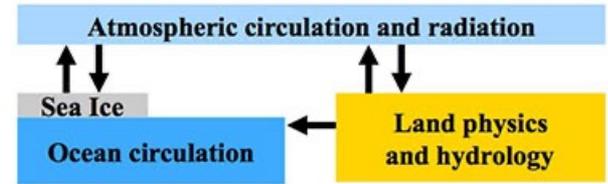
# Climate Models

## Earth System Models

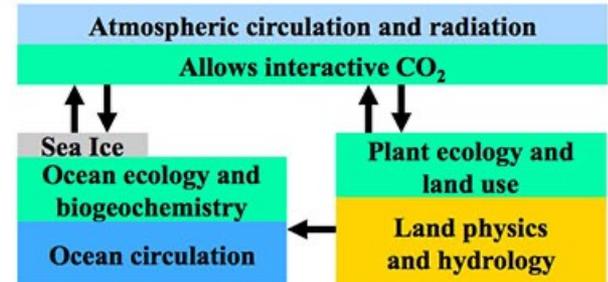


Source: Nature Education

## Climate Model



## Earth System Model

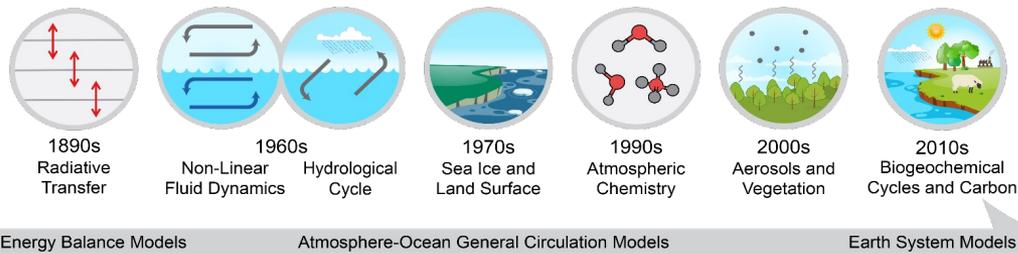


Source: soccom.princeton.edu

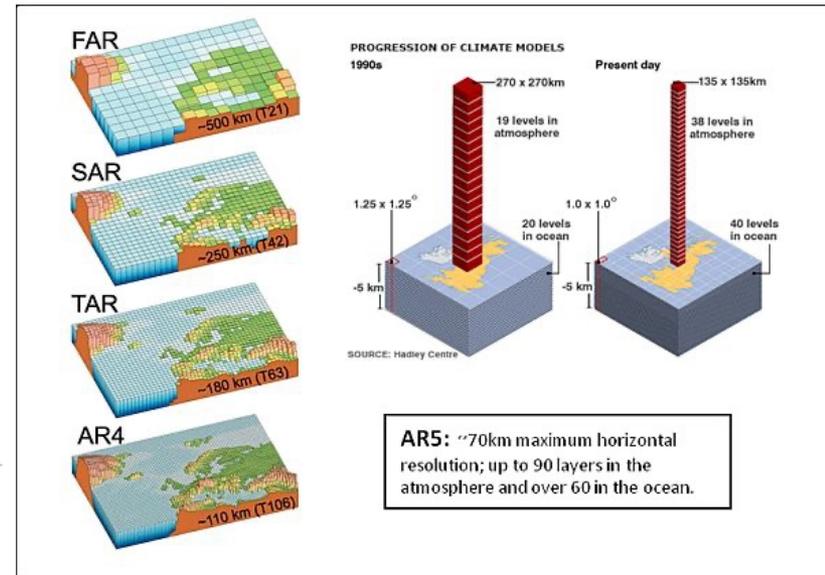
# Climate Models

## Evolution of climate models

A Climate Modeling Timeline  
(When Various Components Became Commonly Used)

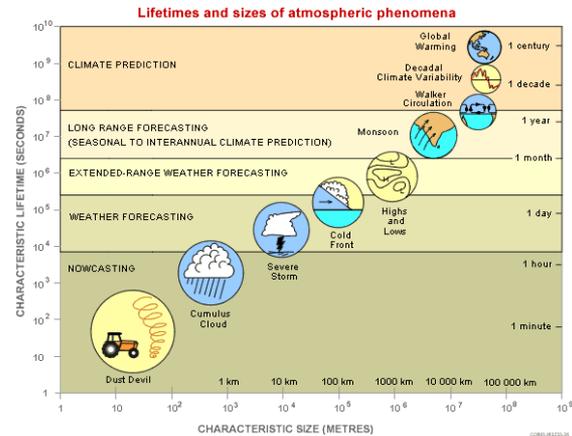
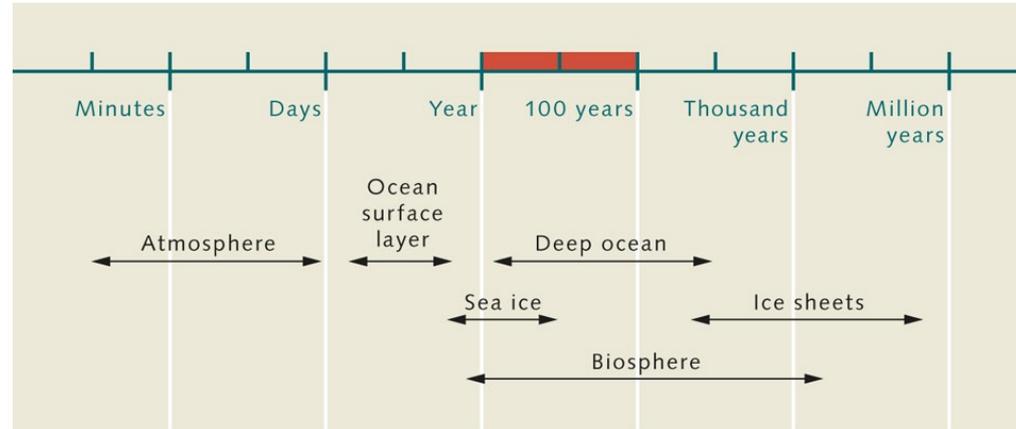
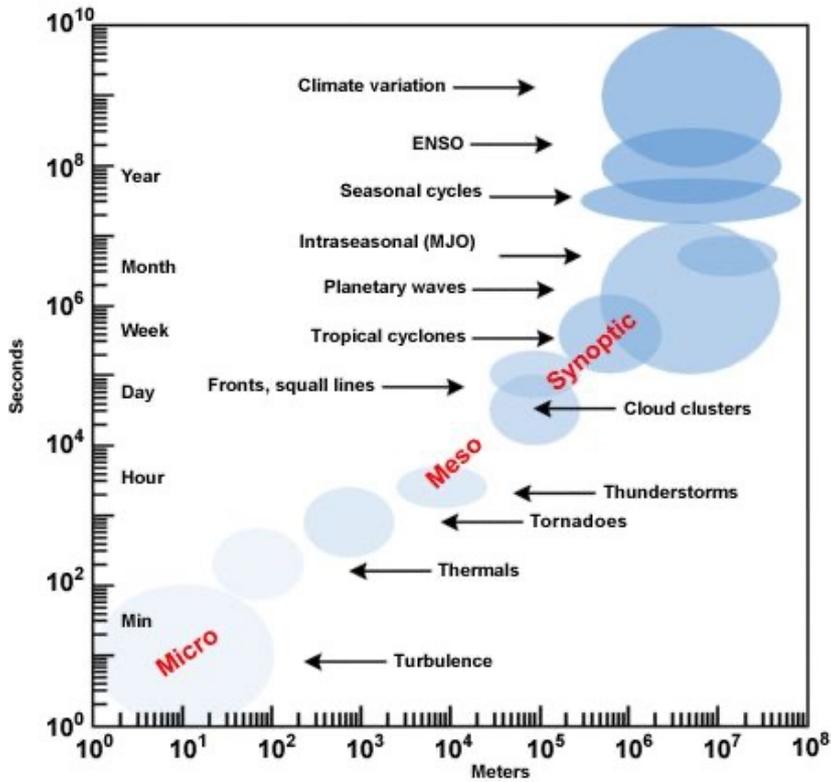


Source: [Globalchange.gov](http://Globalchange.gov)



Source: IPCC

# Climate Models



5  
8 Source: UCAR, WMO

*Time scales of the climate system*

# Assessment: The objective

## Agriculture in a changing climate

Climate change may trigger yield losses and shocks in European agriculture markets, especially in the south, with trade acting as an important adaptation mechanism for dealing with variability in yields.



Pure biophysical effects of climate change



1. Maize yields are potential, i.e. assume that sufficient water is available for irrigation.

## Impacts

**Markets** Potential price spikes & volatility; global markets may offer opportunities for European agriculture if physical and socio-economic factors are well-managed

**CO<sub>2</sub>** Some positive effects on wheat productivity but negative on nutritional aspects

## Mitigation

Keeping global warming **below 2 °C** reduces the risk and facilitates adaptation

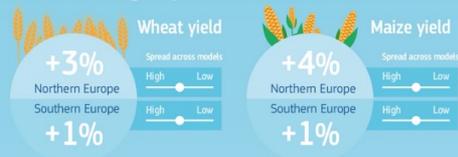


## Adaptation mechanisms

Market adjusted effects of climate change<sup>2</sup>

For some crops improvement of agro-management practices, and introduction of new varieties may protect against climate change. A novelty of this study is that global market demand may steer adaptation in Europe with advantages for the European farming sector.

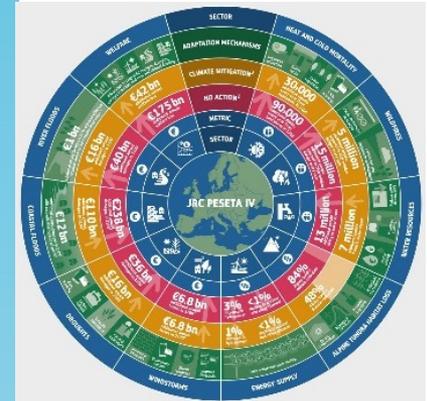
2 °C warming in year 2050



2. The market adjusted projections used the biophysical projections as input in the modelling framework.

## Farm management

- Copernicus** - Digital transformation of agriculture holdings using earth observations
- Climate services** - Climate-informed agro-management planning and anticipation of unfavourable conditions
- CAP** - Support climate action, increase resilience and sustainability

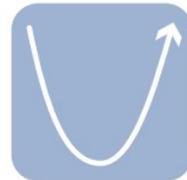


Without mitigation and adaptation, wheat and maize yields will decrease in southern Europe and the crops produced will have reduced nutritional value.

## Past and current changes



It is warming almost everywhere



The warming reversed a long-term cooling

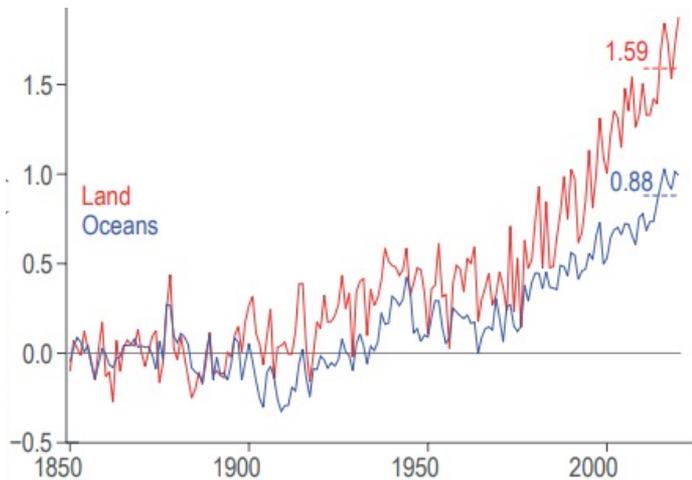


It is warming rapidly

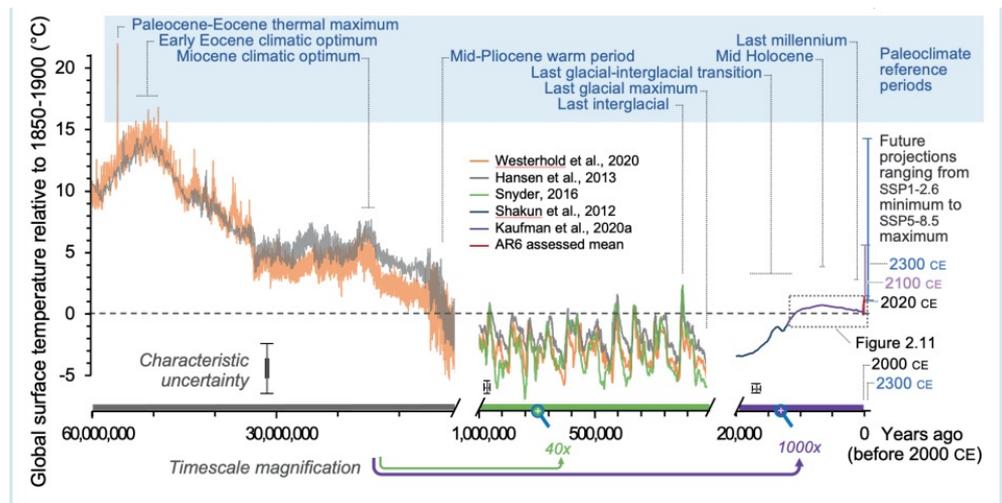


It has been a long time since it has been this warm

# Past and current changes



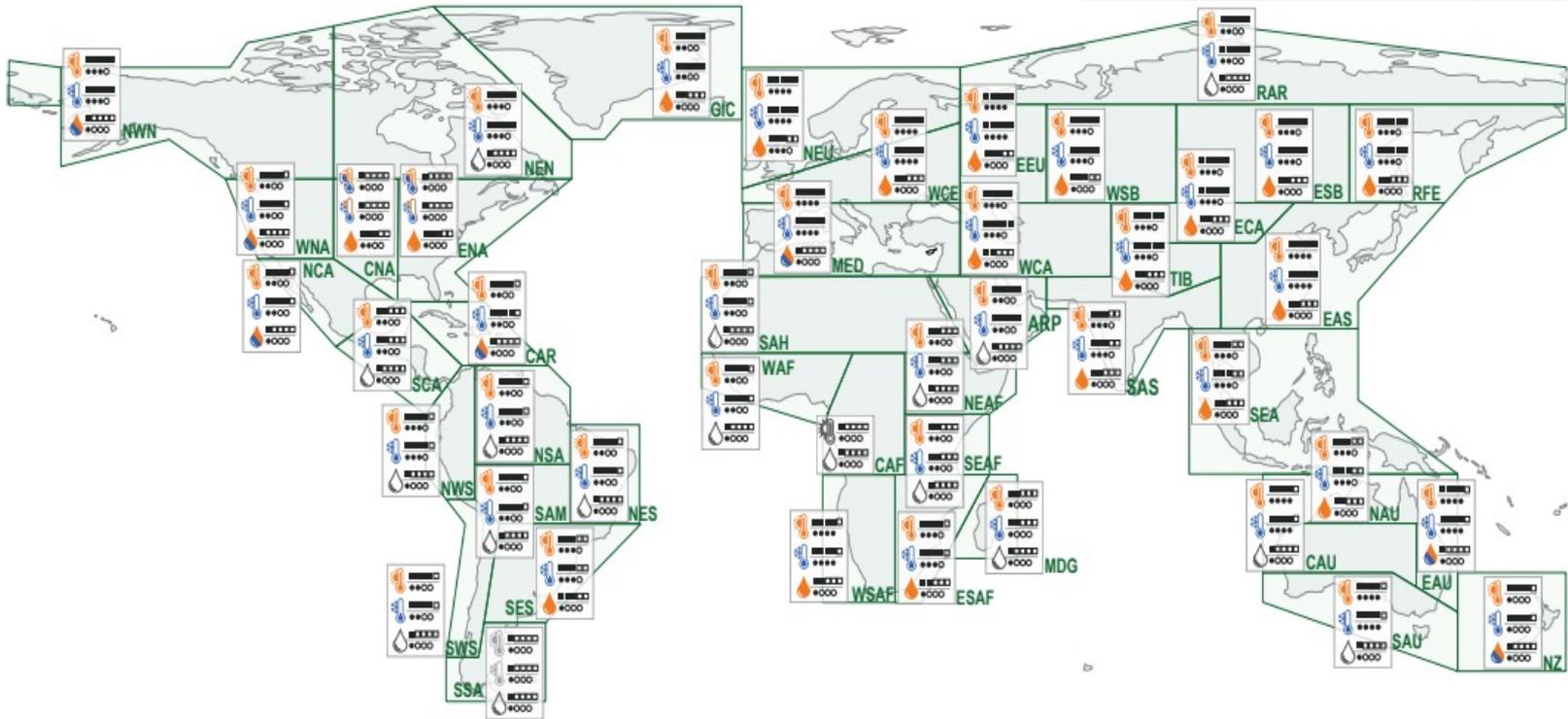
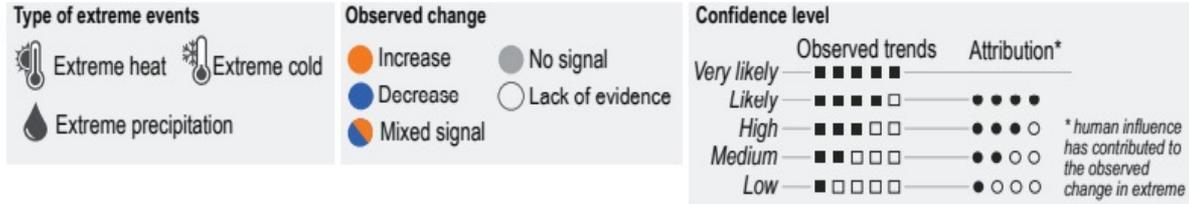
Global temperature anomalies w.r.t. 1850-1900.  
Source: IPCC AR6.



Global mean surface temperature over the past 60 million years w.r.t. 1850-1900. Source: IPCC AR6

# Past and current changes

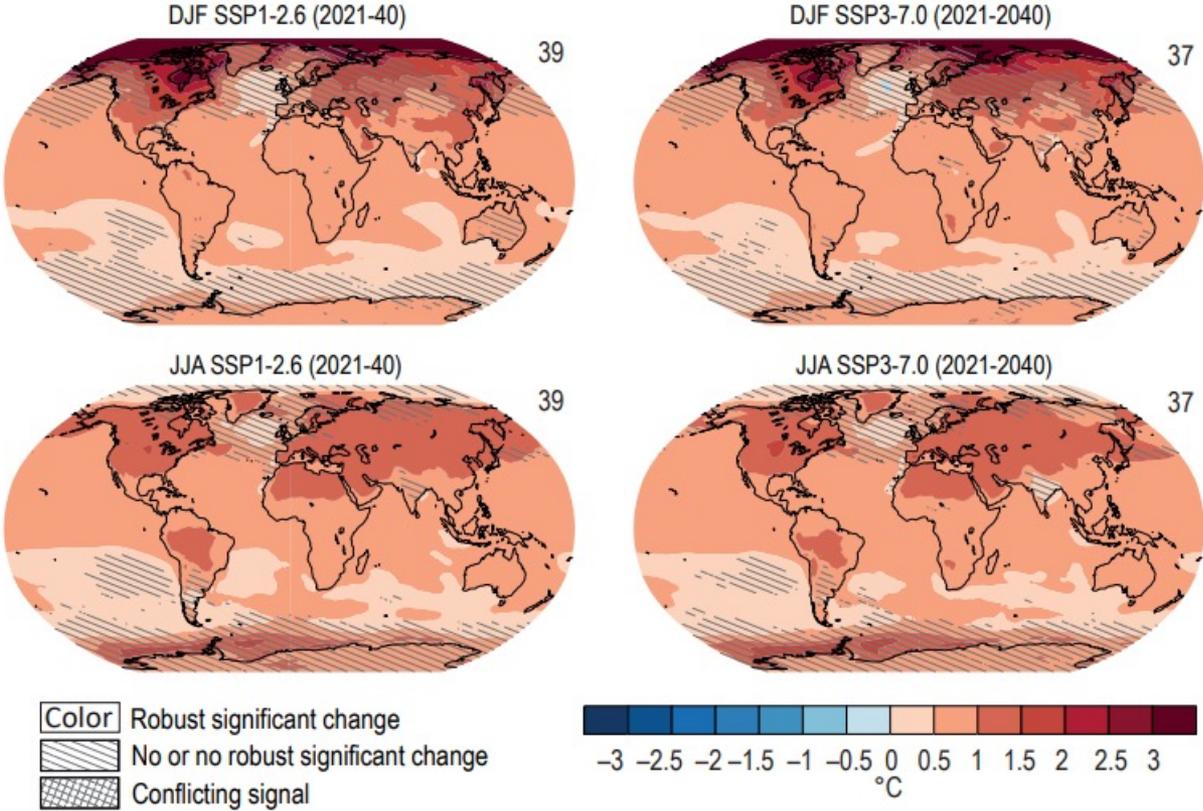
## Overview of assessed events



Source: IPCC AR6.

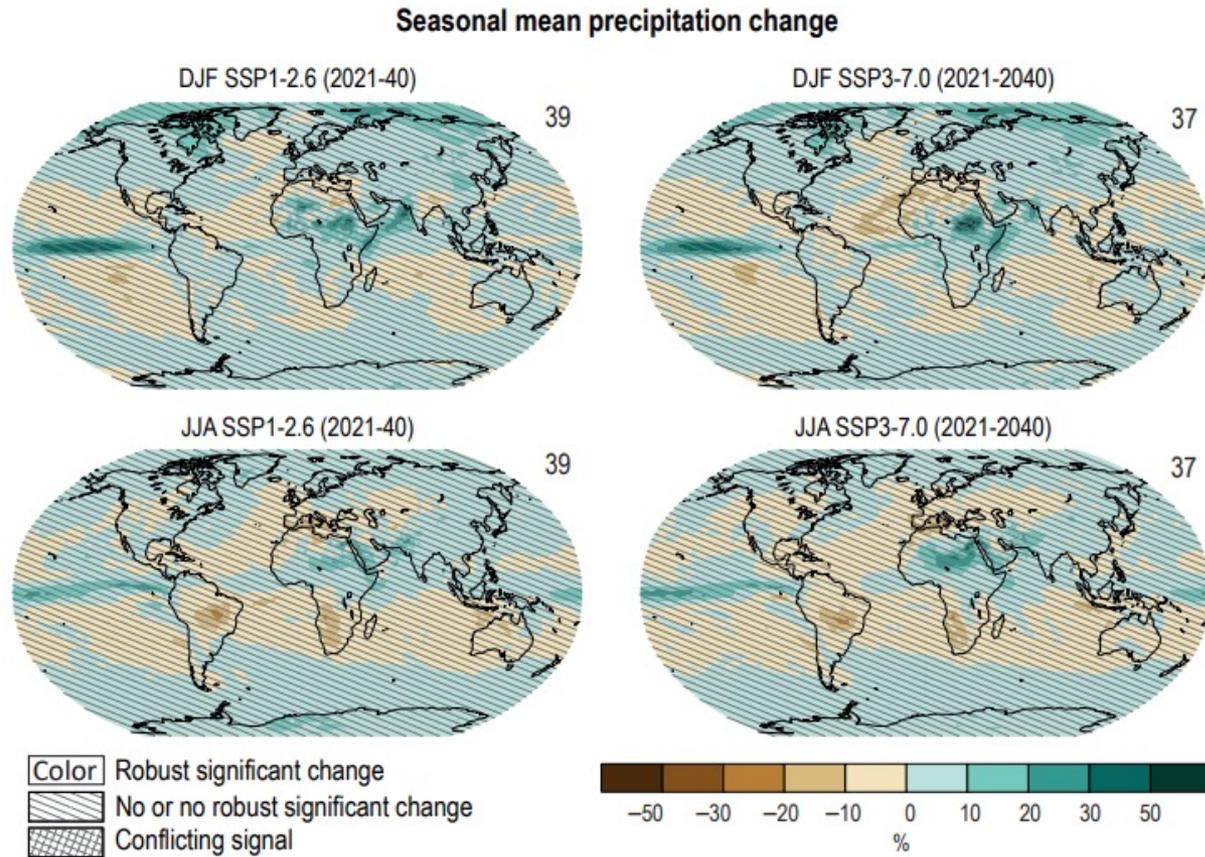
# Near-future projections

Seasonal mean temperature change



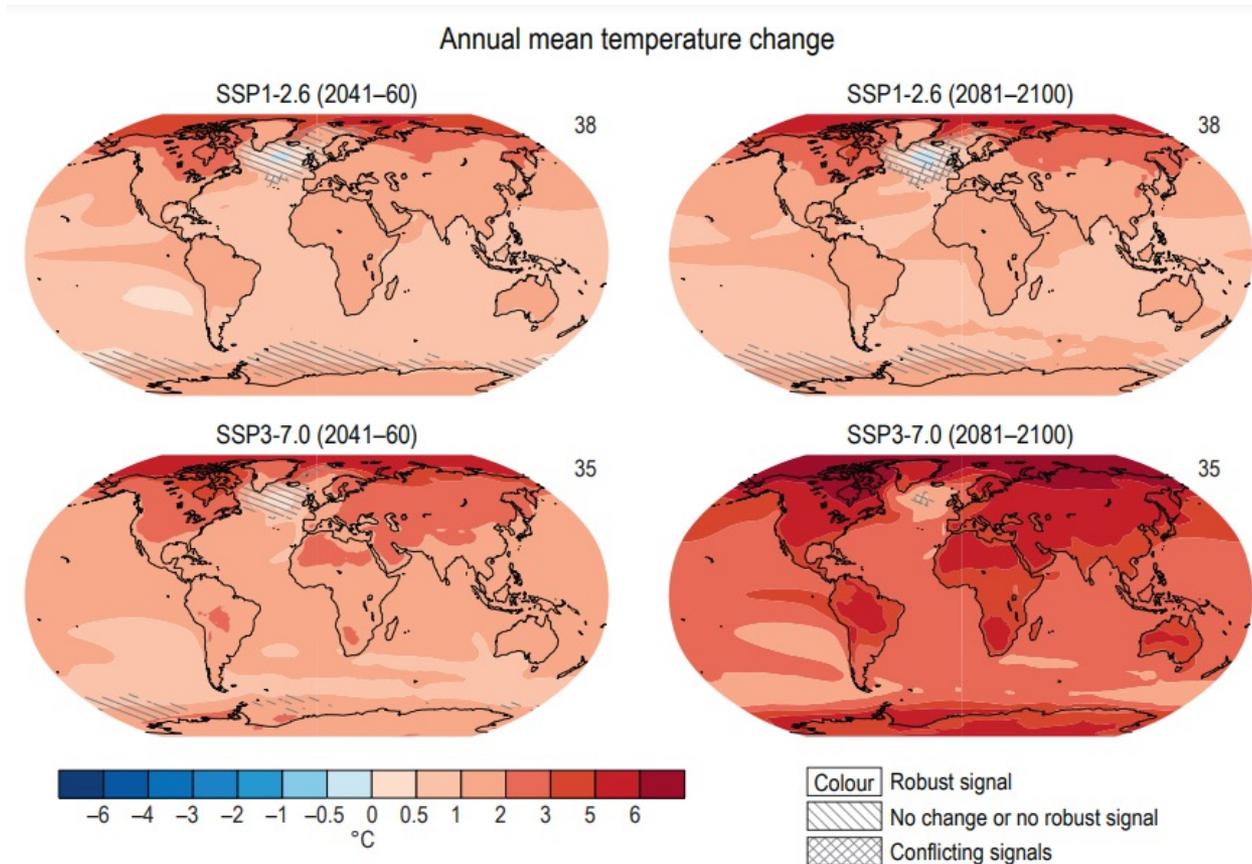
Source: IPCC AR6. Reference 1995-2014

# Near-future projections



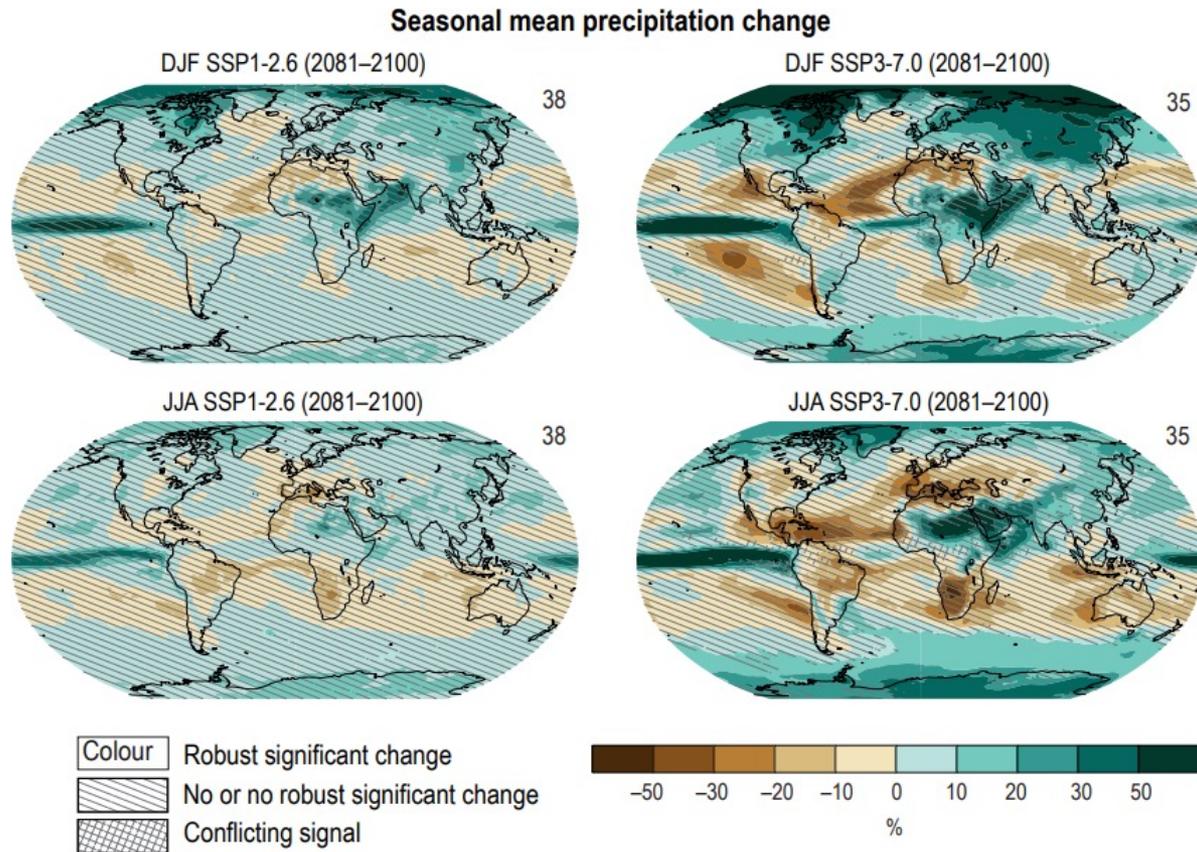
Source: IPCC AR6. Reference 1995-2014

# Mid- end-of-the century projections



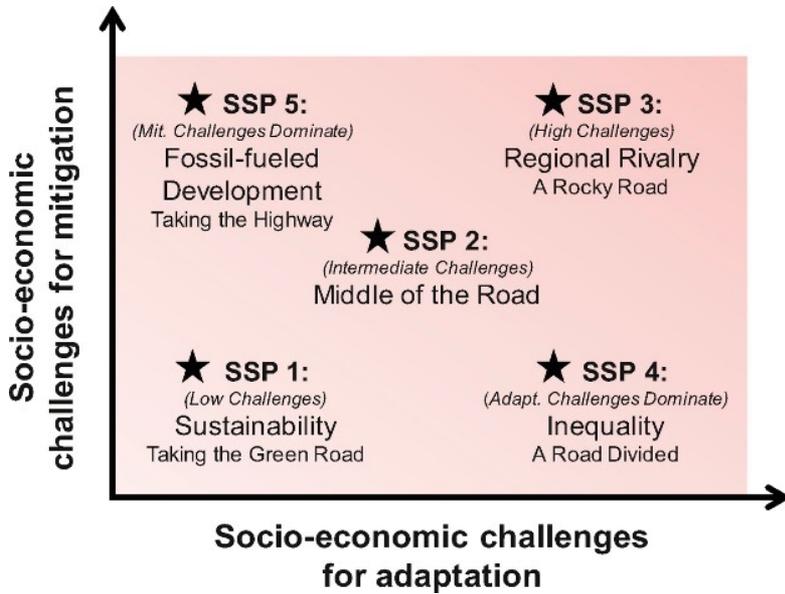
Source: IPCC AR6. Reference 1995-2014

# Mid- end-of-the century projections

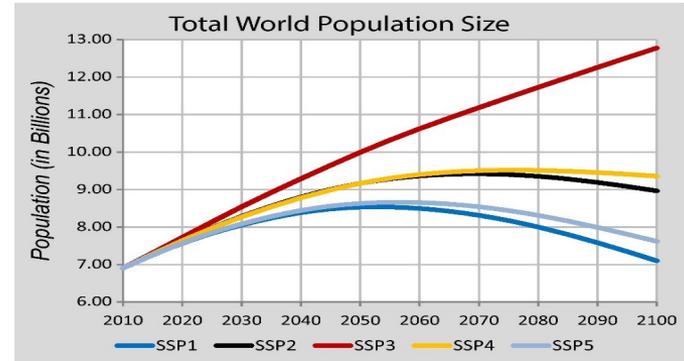


Source: IPCC AR6. Reference 1995-2014

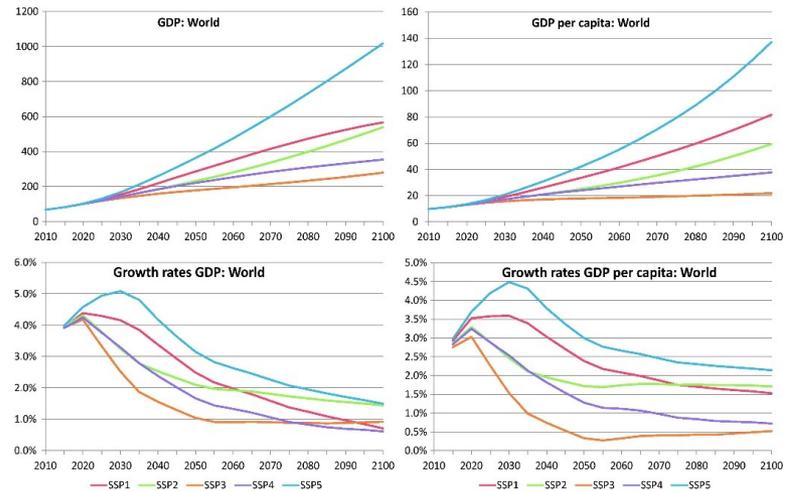
# Scenarios



Source: O'Neill et al. 2017

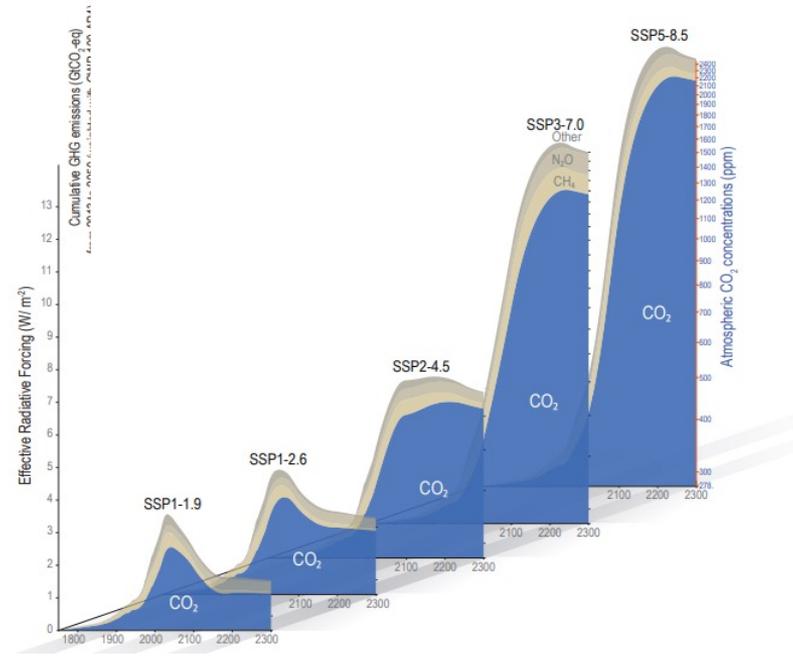
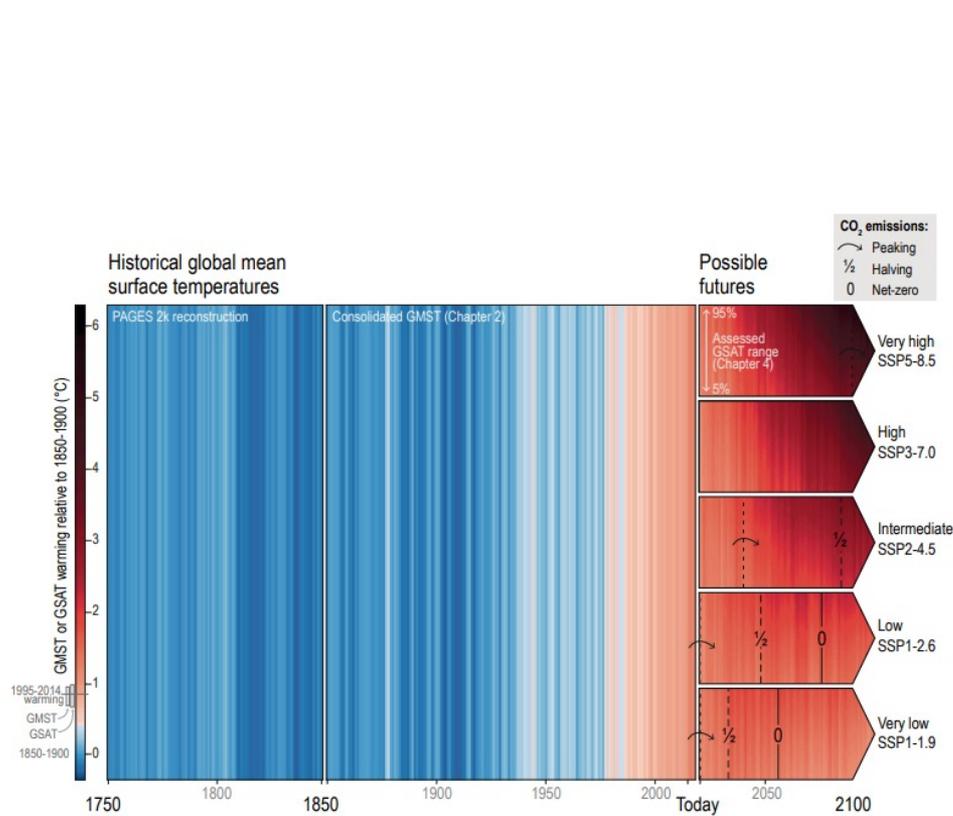


Source: KC and Lutz, 2017



Source: Dellink et al., 2017

# Scenarios



Source: IPCC AR6.

# The Threat of Global Climate Change for fishery

## Potential impacts on physical features of oceans:

- Sea surface temperatures
- Sea levels
- Ocean circulation patterns
- Salinity
- pH

## Potential impacts on marine fish:

- Migration patterns
- Changes in reproductive patterns
- Food web effects

# Climate change impacts on the Great Barrier Reef

## Which future will we choose?

Climate change is changing our Reef. If carbon dioxide continues to rise, the Great Barrier Reef could look very different. It is up to us to determine what the Reef's future will be.



**Low  
CO<sub>2</sub> levels**

**+ 1 °C**



**Moderate  
CO<sub>2</sub> levels**

**+ 2 °C**



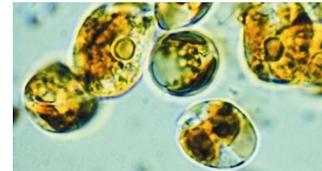
**High  
CO<sub>2</sub> levels**

**≥ +3 °C**

# Coral bleaching

## Our warming seas

Sea temperature increases of just a couple degrees can cause corals to bleach and die. Without corals, the future of reefs and the marine life they harbour is at risk.



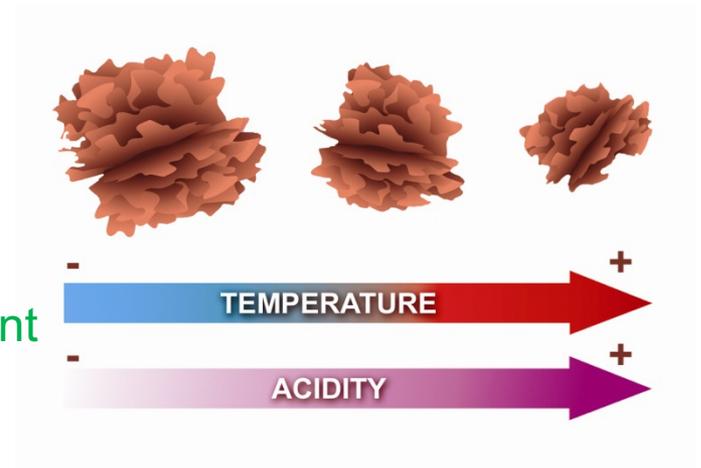
# Ocean acidification

One-third of the carbon dioxide we produce ends up in the ocean. When carbon dioxide is mixed with water it creates carbonic acid. Human activities are making the oceans more acidic than they have been in hundreds of thousands of years.

## More acidic oceans will mean:

Corals and animals with calcium shells and skeletons may grow slower (coral growth on the Great Barrier Reef has already declined 14 per cent since 1990)

Shells and corals may become more brittle and breakable



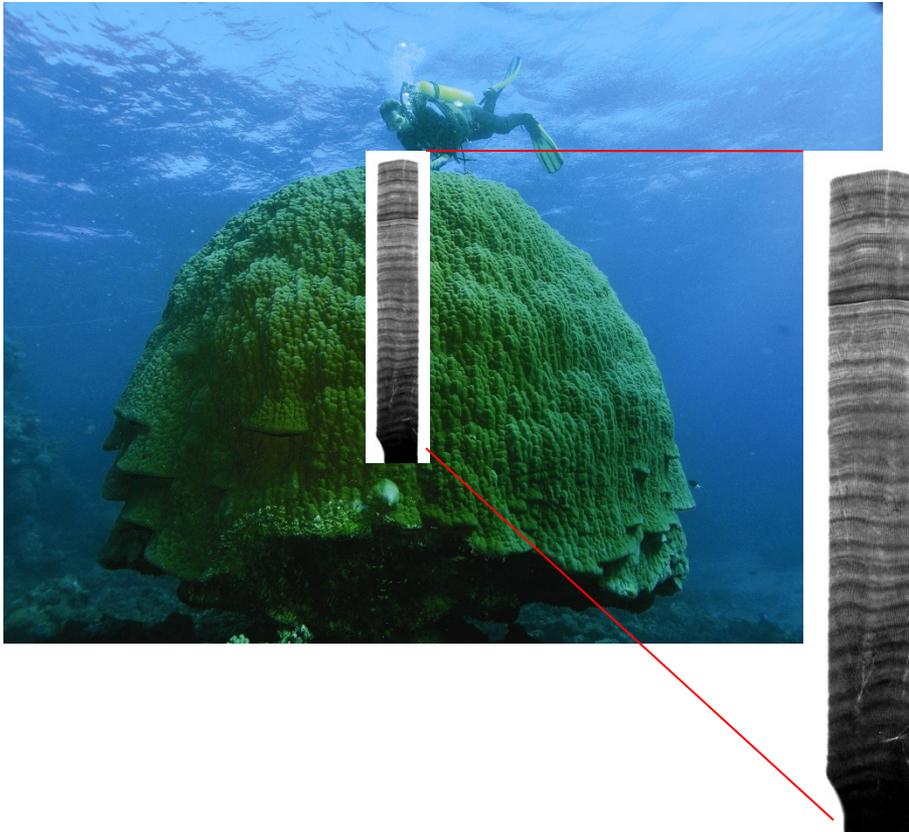
# Corals: living history books of the seas

## Unlocking climate secrets from corals

Long-lived corals growing on the Great Barrier Reef are used to help construct global climate records.

Core samples from corals up to 400 years old show that:

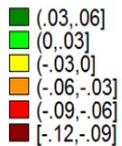
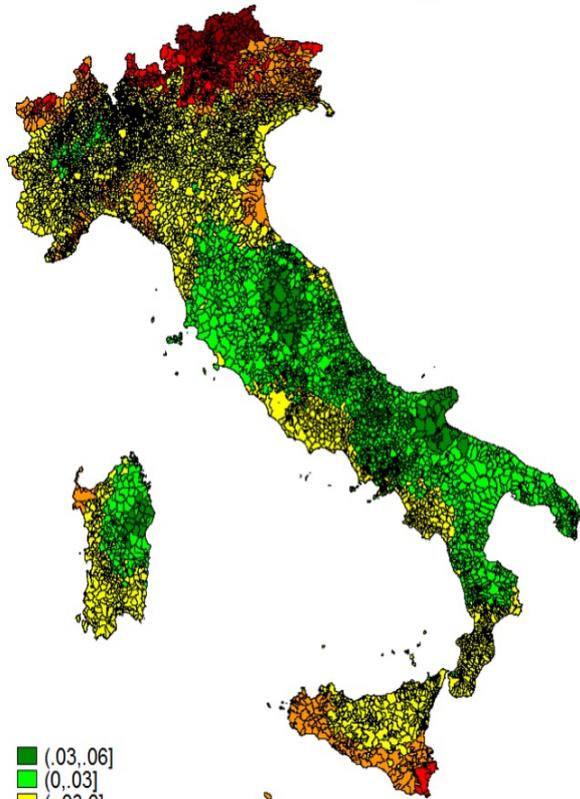
1. **temperatures have warmed**
2. **rainfall has become more variable and coral growth has declined**
3. **human land use has increased the sediment carried out to the Reef.**



# Marginal effects on land value due to climate change

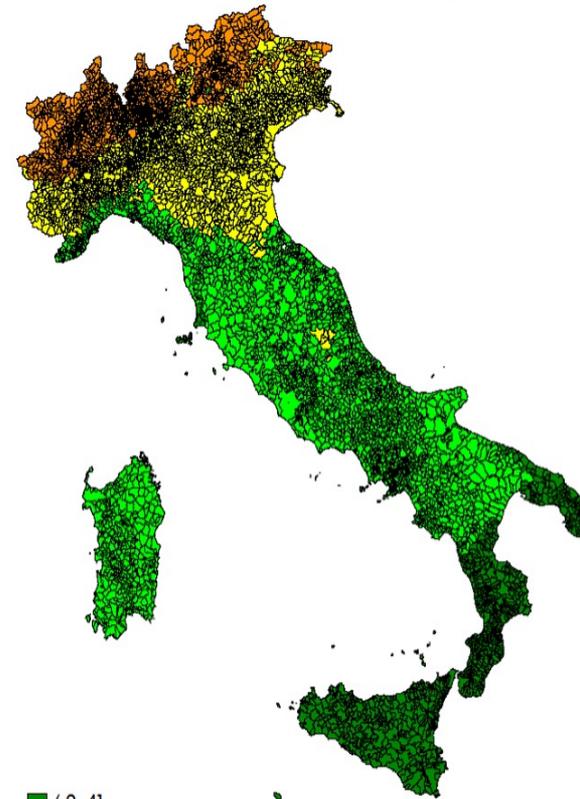
## TEMPERATURE

impact in EUR/ha of 1°C:region FE

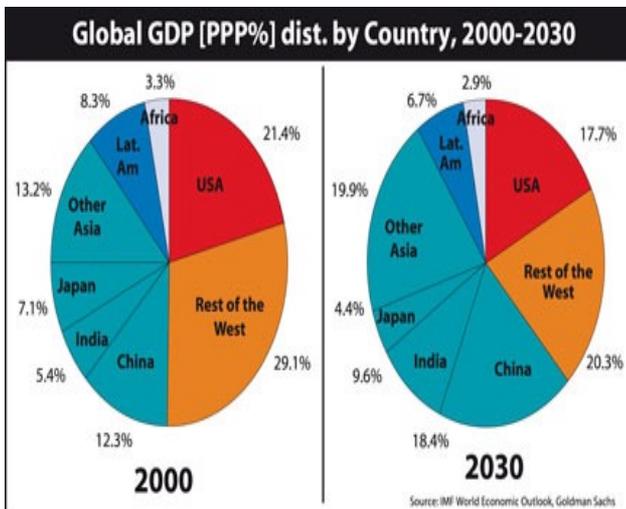


## PRECIPITATION

impact in EUR/ha of 10mm:region FE



# World already changed...if someone still remain at XX Century debates



# «BRIC food BREAK»

3 Billion of people change diet

## RUSSIA

Increase in sugar consumer

## CINA

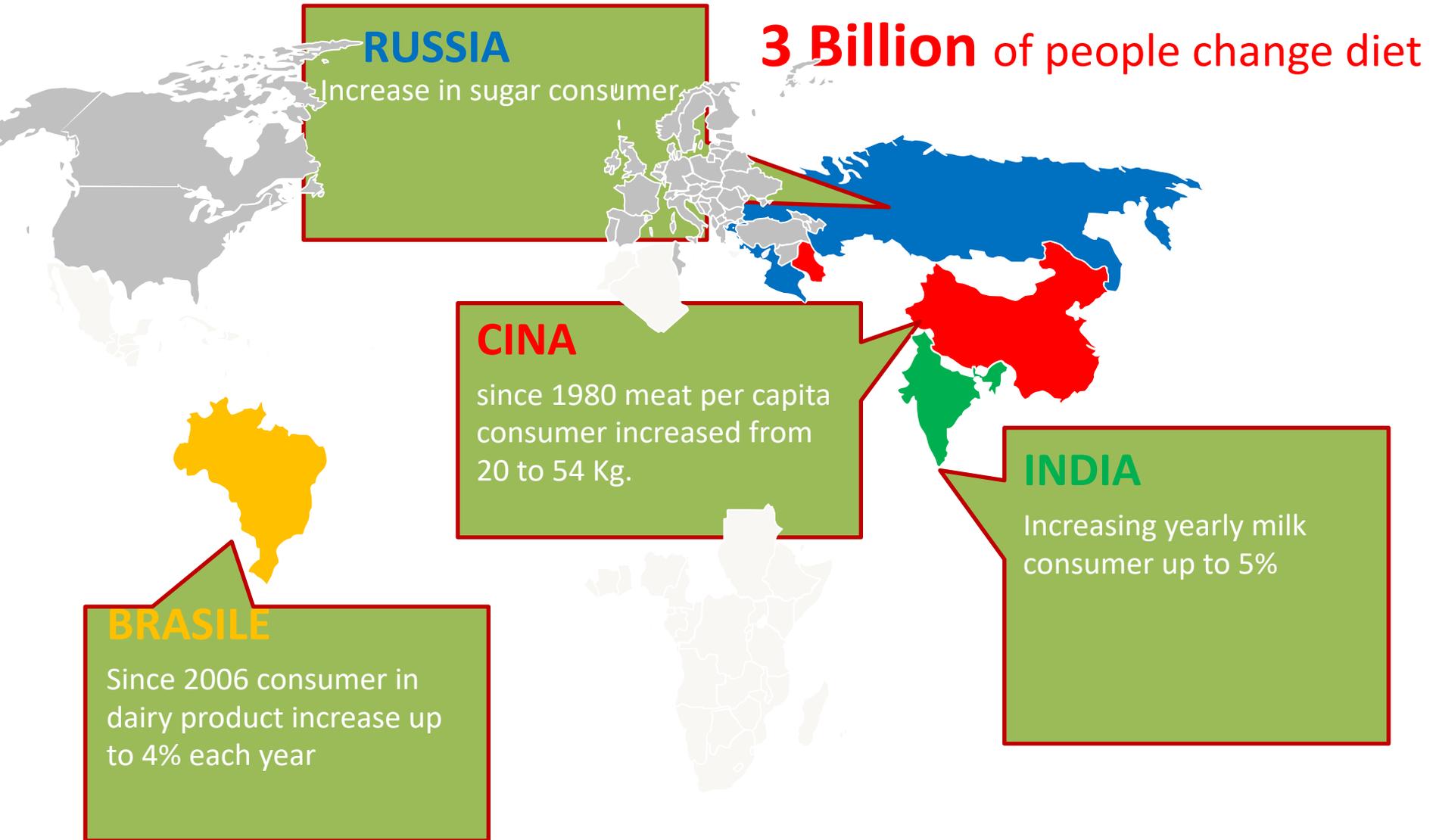
since 1980 meat per capita consumer increased from 20 to 54 Kg.

## INDIA

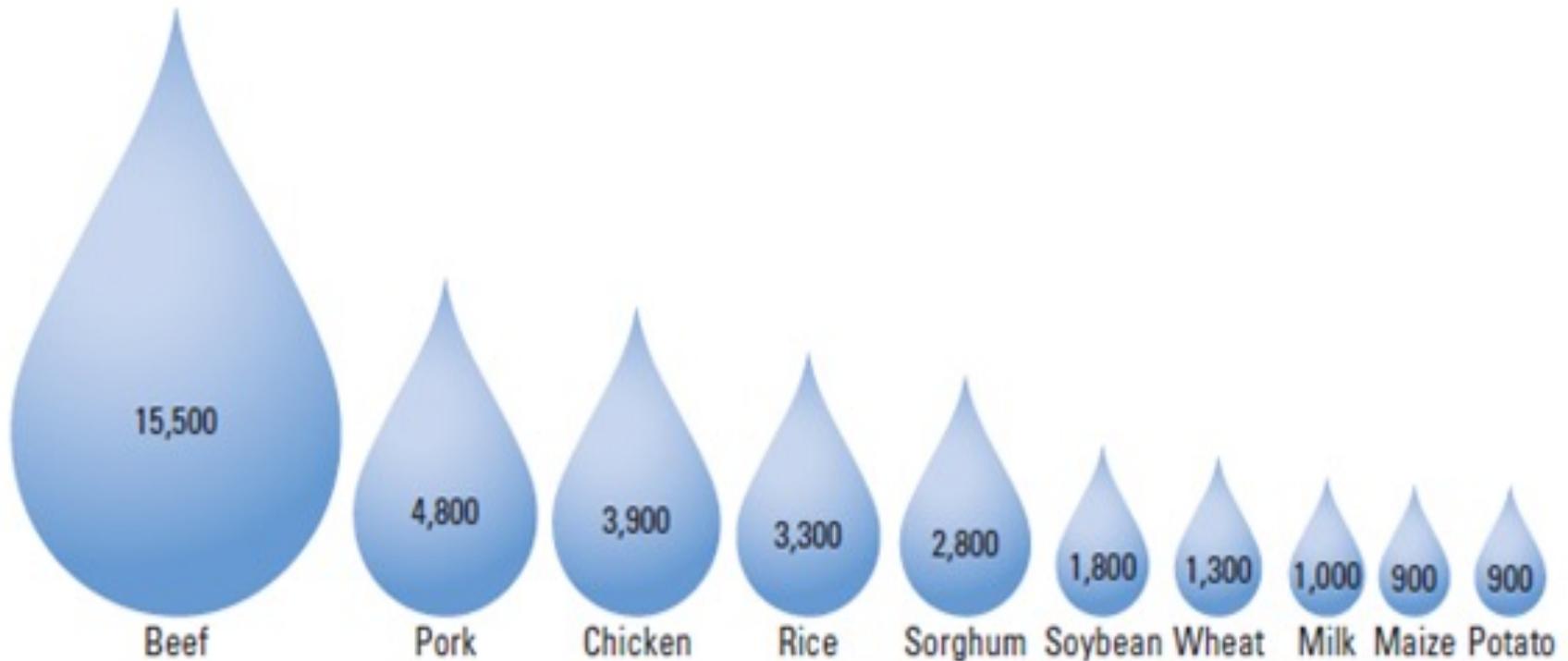
Increasing yearly milk consumer up to 5%

## BRASILE

Since 2006 consumer in dairy product increase up to 4% each year



# Environmental risk: water scarcity



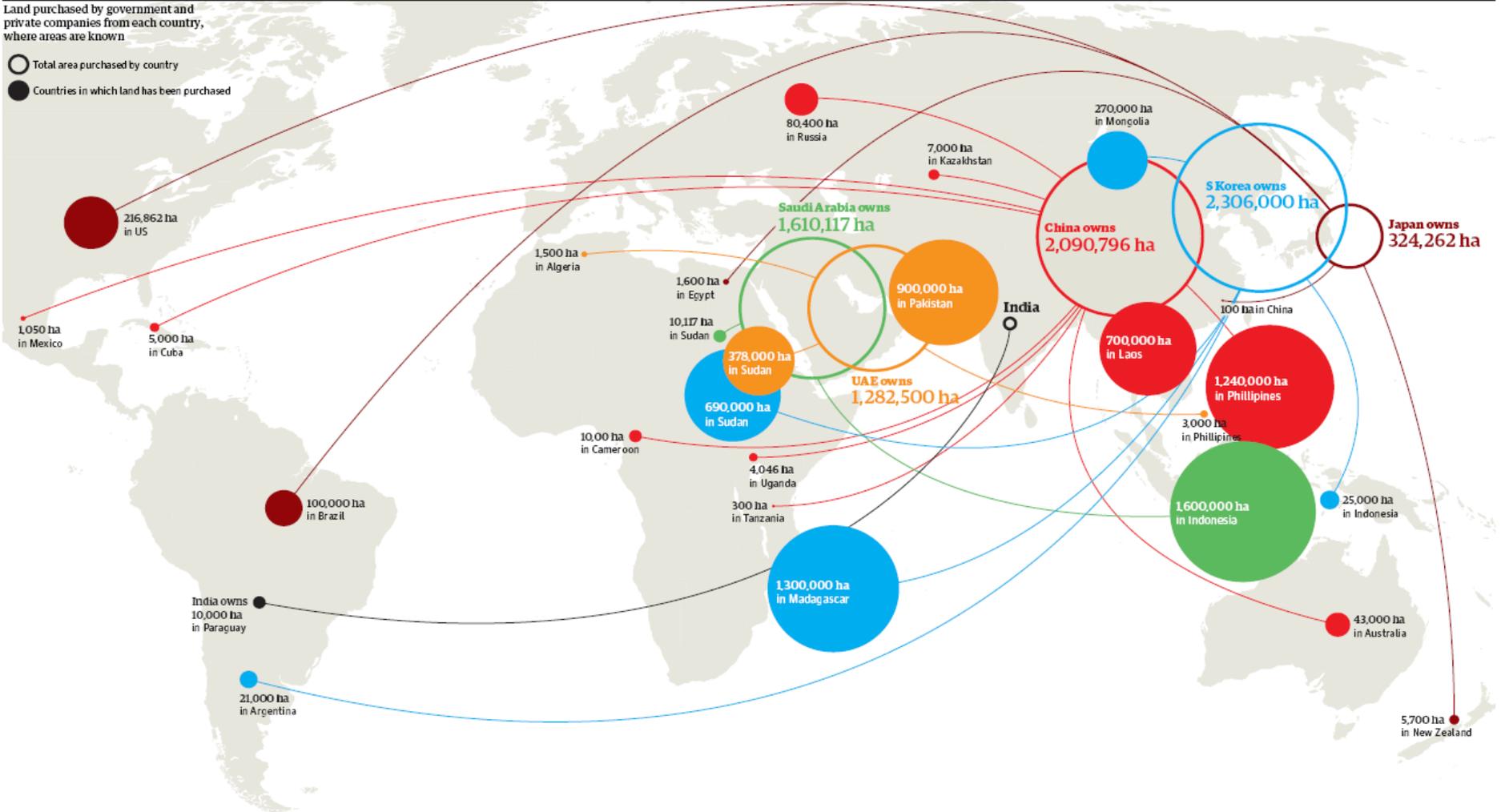
Litri di acqua per Kg  
prodotto

# Land grabbing

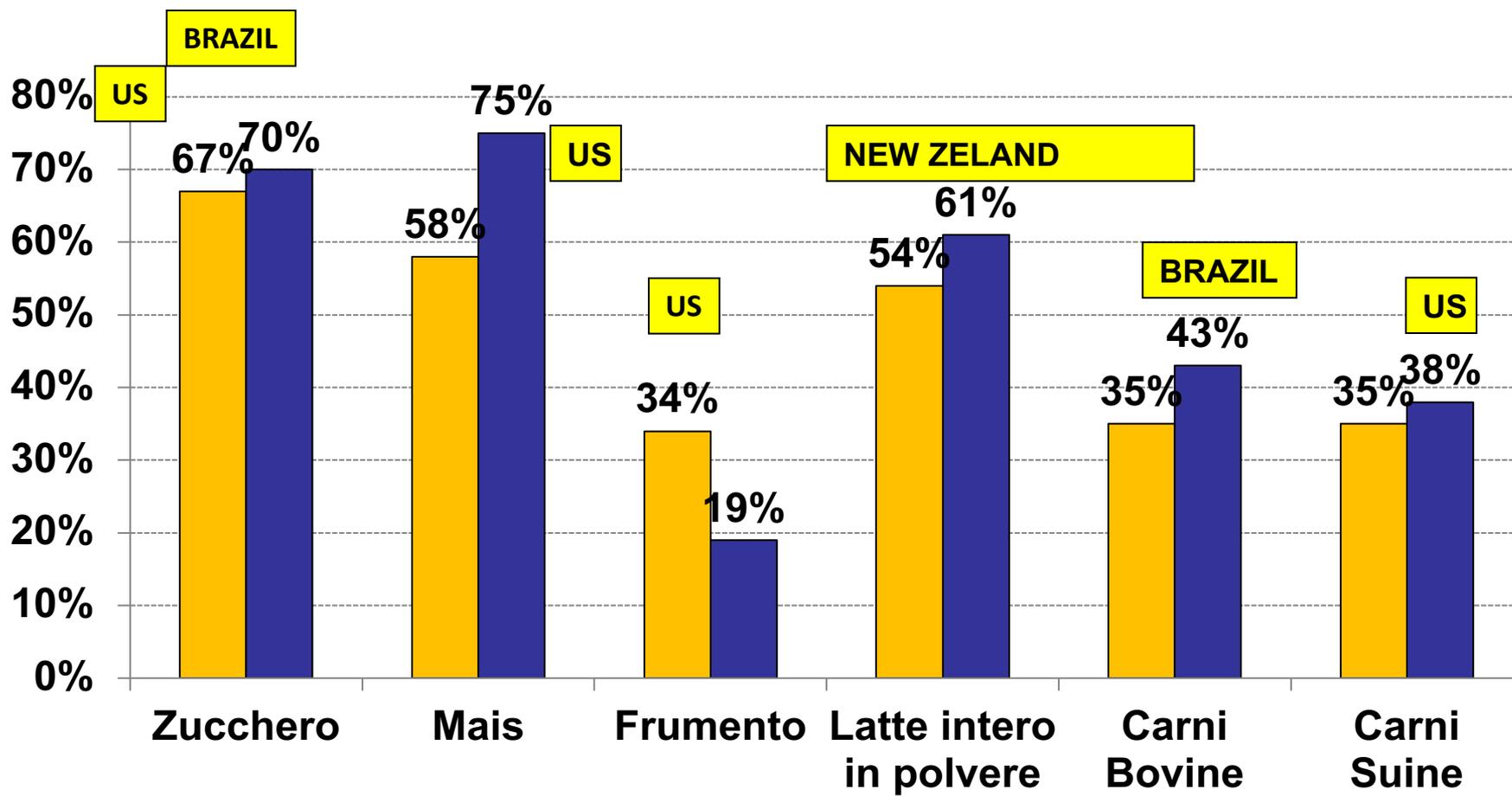
## World land grab

Land purchased by government and private companies from each country, where areas are known

- Total area purchased by country
- Countries in which land has been purchased



# Monopoly market for agricultural commodity



Quota di mercato del maggior paese esportatore ■ 2010 ■ 2020

# Sources of Risk in Agriculture

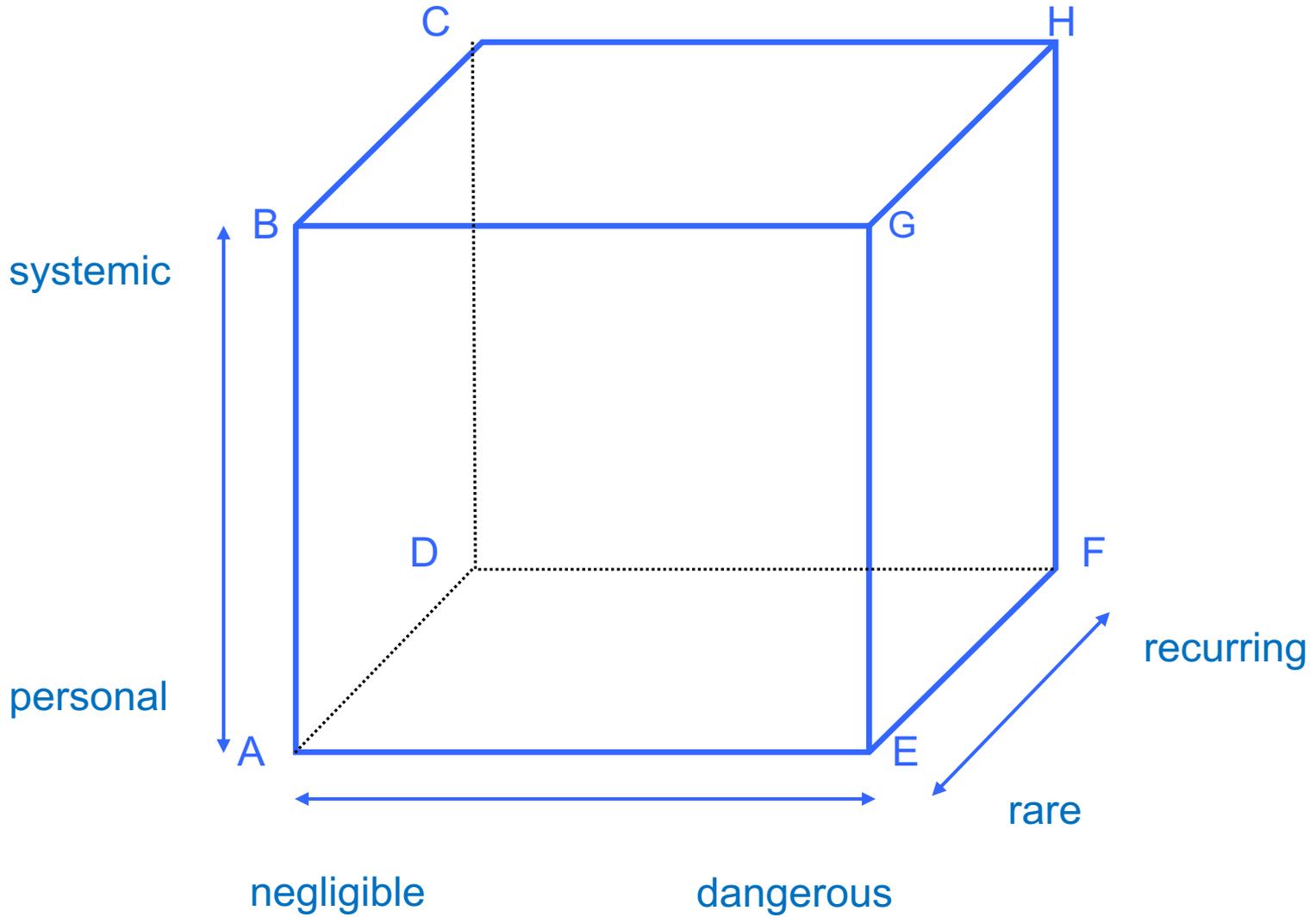
Common risks of farmers and non-farmers

- Property: Damage to buildings and equipment
- Casualty and health: Loss of life or injury
- Farmers face unique risks
- Damage to crops from adverse weather or unexpected disease or insect infestations
- Unexpected declines in price
- Farmers also face new risks
- BSE, foot and mouth disease, avian flu have led to widespread loss of markets, especially export markets. Result is large price decline.

## Risk management: type of risk

- Frequency: from rare to recurring
- Damages: from negligible to dangerous
- Correlation among insured pool: from single farmer to area
- «Fourth» dimension: predictability

# Risk box



# Risk management in agriculture

- Ex-ante: risk management
  1. – Don't put all your crops into one area (if possible)
  2. – Don't plant only one crop
  3. – Raise both crops and livestock
  4. Share risk (insurance, mutual fund, financial market)
- Ex-post: “risk coping”
  1. Damages management

# Management of Property and Casualty Risk

- Use Insurance
  - Self-insurance and diversification: farm assets and management mitigate the loss
  - Market insurance: insurance company covers the loss in exchange for an annual pre-paid premium
    - First Principle of Insurance:
      - Premiums of the many pay the losses of the few.

# Crop insurance as one of possible tool in ex ante management (!!!)

- Condition for insurability: damages quantification; randomness; mutuality; economics sustainability
- Limits: asymmetric information (ex ante and ex post moral hazard and adverse selection);
- In agriculture: systemic risk

# Types of Crop Insurance

- Insure each crop separately,
  - Most complete and expensive insurance
- Or pool production from multiple crops
  - Reflects actual financial risk
- Insure individual yield,
  - Most complete and expensive insurance
- Or, insure area yield
  - Easier to implement and more cost effective

# What behind public intervention in risk management in agriculture?

1. Uncertainty of economic result
  - Farmer is unable to manage production factors;
2. Impossibility to adequate production choice versus economic trend
  - temporal lag among farmer sowing decision and biological cycle of crops
3. Systemic risk
  - share with insurance market losses in case of catastrophic events

# Bearing and Eliminating Risk

- Why do people buy insurance?
- Why do people buy extended warranties?

These questions are answered by:

- 1) Actuarially Fair Insurance
- 2) Risk Premium

# Actuarially Fair Insurance

## Actuarially Fair Insurance

-insurance where the premium is equal to the expected value of the payout

$$AFI = E(\text{payout})$$

$$AFI = (\text{payout}) f(\text{payout})$$

## Actuarially Fair Insurance Example

Assume that you could buy hail insurance. You have a \$100,000 expected revenue, and an 80% chance to lose \$75,000 (crop fails). Your utility is  $U=\sqrt{I}$ .

**Risky Income:  $p(\$100,000) = 0.2$ ,  $p(\$25,000) = 0.8$**

**1) Calculate Actuarially Fair Insurance Premium**

$$AFI = E(\text{payout})$$

$$AFI = (\$75,000)(0.8)$$

$$AFI = \$60,000$$

# Actuarially Fair Insurance Example

If you didn't get insurance, your utility would be:

$$U = \sqrt{I}$$

Risky Income:  $p(\$100,000) = 0.2$ ,  $p(\$25,000) = 0.8$

## 2) Utility without Insurance

$$E(U) = \sum U f(U)$$

$$E(U) = 100,000^{1/2} (0.2) + 25,000^{1/2} (0.8)$$

$$E(U) = 189.7$$

# Actuarially Fair Insurance Example

With fair insurance, your utility would be:

$U = \sqrt{I}$       Risky Income:  $p(\$100,000) = 0.2$ ,  $p(\$25,000) = 0.8$

Insurance: \$60,000

## 2) Utility with Insurance

$$E(U) = \sum U f(U)$$

$$E(U) = (100,000 - 60,000)^{1/2} (0.2) \\ + (25,000 - 60,000 + 75,000)^{1/2} (0.8)$$

$$E(U) = (40,000)^{1/2} (1)$$

$$E(U) = 200$$

# Actuarially Fair Insurance

Utility

*AFI gives you the expected income of a risky situation*

U

$U_{\text{insure}}$

$U_{\text{no insure}}$

D

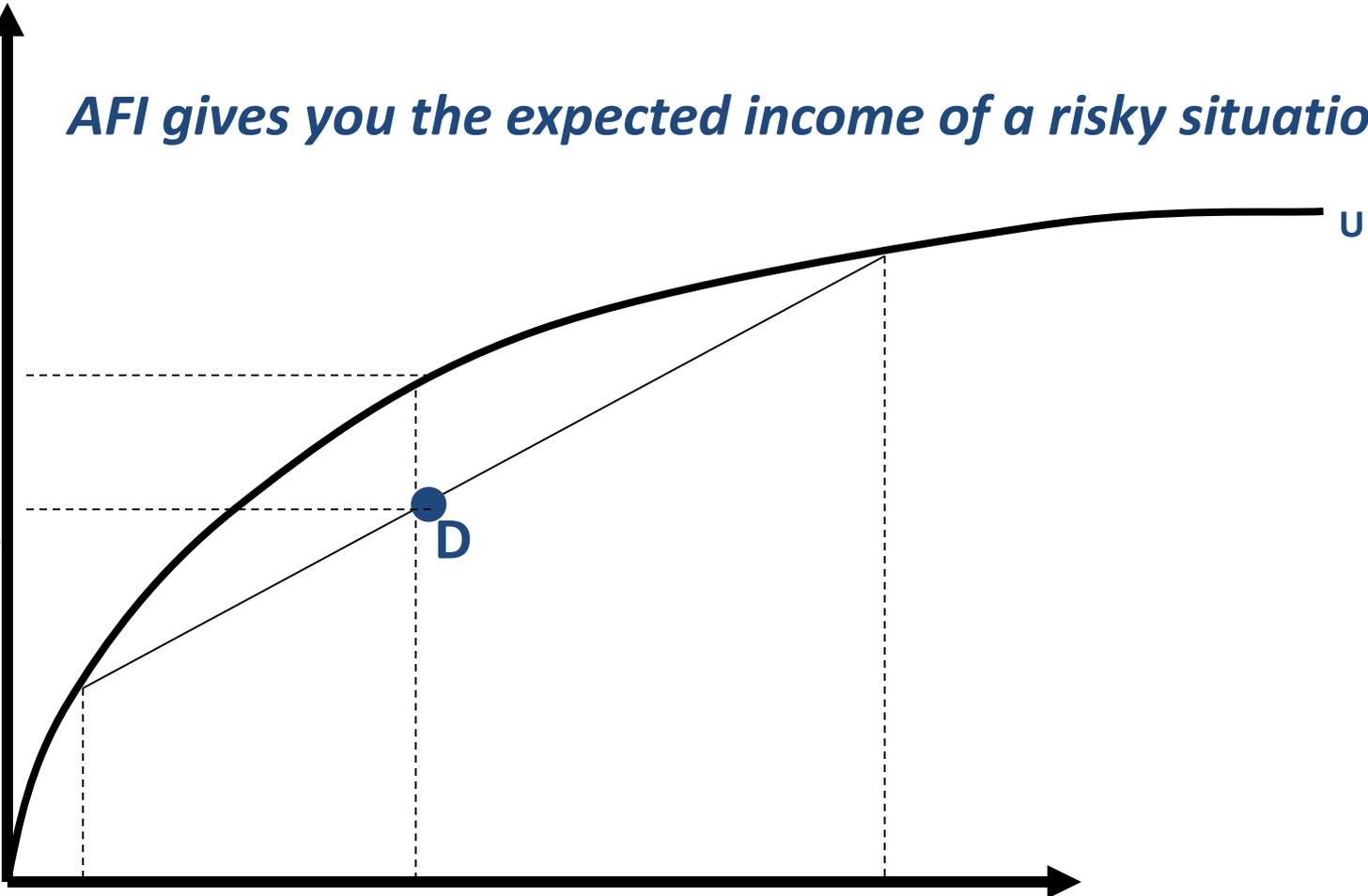
0

25K

$\$40K = E(I)$

100K

Income



## Is Insurance ever Fair?

Actual insurance premiums are rarely actuarially fair, partially due to a firm making profit, but also due to other factors:

- administration
- moral hazard
- adverse selection
- Systemic risk in agriculture

What is the maximum amount someone will pay above actuarially fair premiums?

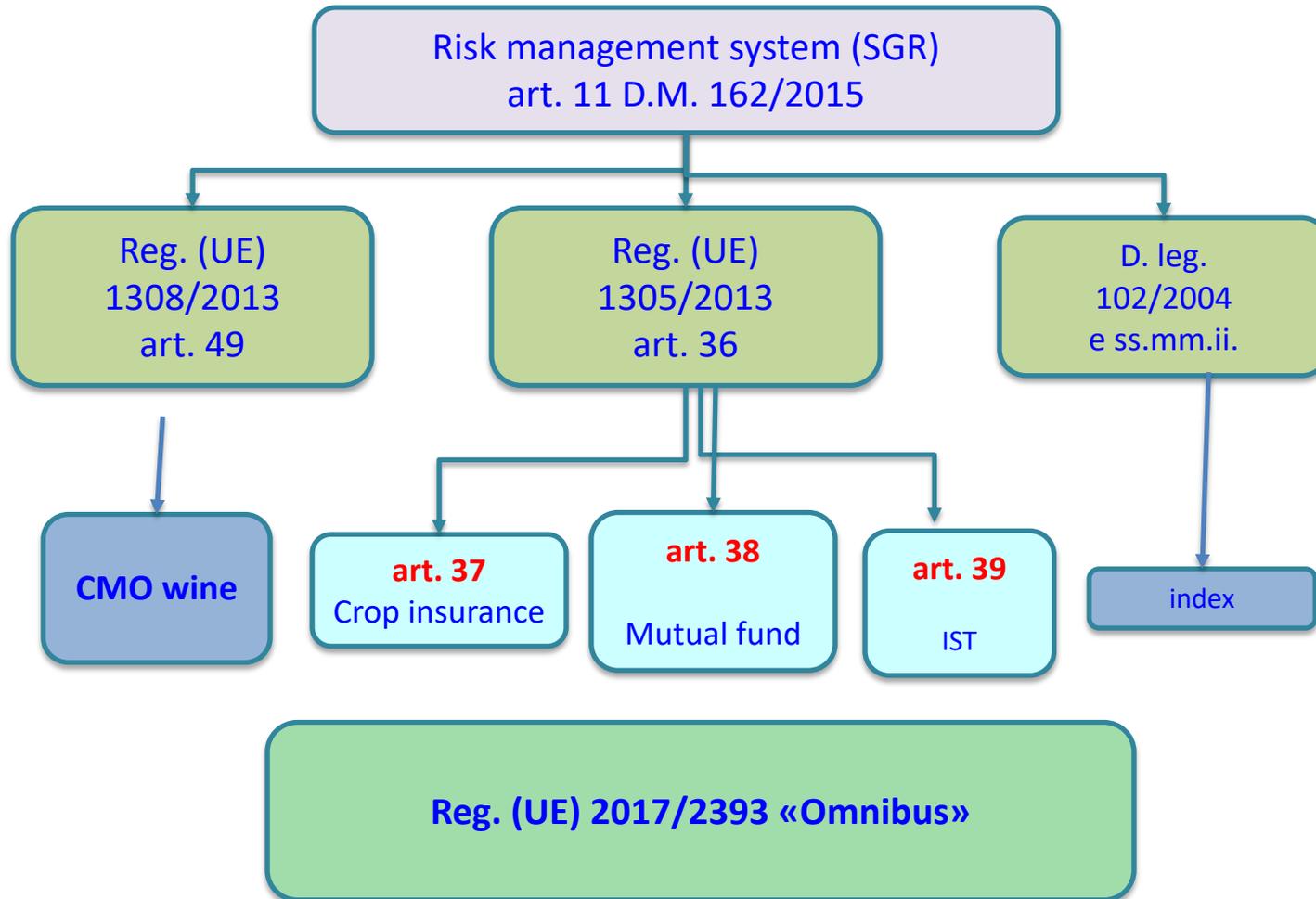
# Risk Premium

## Risk Premium

- Maximum amount of money that a risk-averse person will pay to avoid taking a risk
- Maximum amount a person will pay in premiums above actuarially fair premiums

Note: Even risk loving people consider themselves risk averse for large purchases.

# Public support framework



# Analysis Risk management proposal 2013

- Risk management moves from first to the second pillar of the CAP (exception for CMO wine, fruit and vegetables)
- Will be a measure of risk management with three operational tools:
  1. Financial contribution to insurance for adverse weather conditions, plant diseases and animal diseases
  2. Financial compensation to mutual funds for plant diseases, animal diseases and environmental emergencies.
  3. Financial compensation to mutual funds for sever drop of income.

# Omnibus

«ex ante capitalization of Mutual Fund and Income Stabilization Tool»

	Soglia	Contributo
Sottomisura 17.1 - Assicurazioni art. 37 del Reg. (UE) 1305/2013	20 %	70 %
Sottomisura 17.2 - Fondi di mutualità art. 38 del Reg. (UE) 1305/2013	30 %	70 %
Sottomisura 17.3 - IST art. 39 del Reg. (UE) 1305/2013	30 %	70 %
Sottomisura 17.3 - IST Settoriali art. 39 bis del Reg. (UE) 1305/2013	20 %	70 %

«index are allowed to calculate indemnities»

# Climate Change effects on probability

We have 3 elements in a lottery:

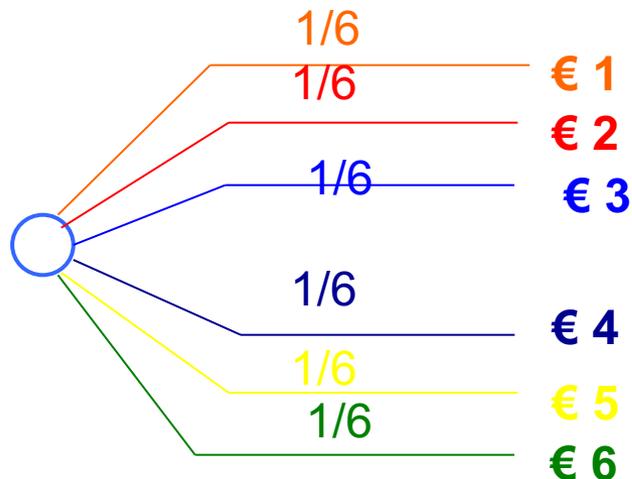
- i) The sets of possible outcome, «world state»;
- ii) The linked probability for each world state;
- iii) The corresponding value for each world state.

# What we're talking about .....

If we throw a dice we face uncertain outcome; the linked lottery is characterized by:

- i) **Outcomes:** six possible outcome(6 dice face)
- ii) **Probability:** each outcome have the same probability, eg.  $1/6$
- iii) **Value:** e.g., amount of euro corresponding to the number of the face dice.

We could represents the lottery with a decision tree:



# Expected value

The expected value of a random variable  $X$  is the value of  $X$  which manifests itself «on average».

Aiming to find the  $X$  value, we need to weigh the  $X$  value in each state of world with the probability that the single state of world could happen.

The expected value of a lottery bounded with two possible outcomes would be:

$$EV = p \cdot v_1 + (1 - p) \cdot v_2$$

where  $p$  is the probability of the first outcome, and  $v_j$  represents the value linked to the outcome  $j$ .

If  $v_j = v$  for  $j = \{1, 2\}$ , then:

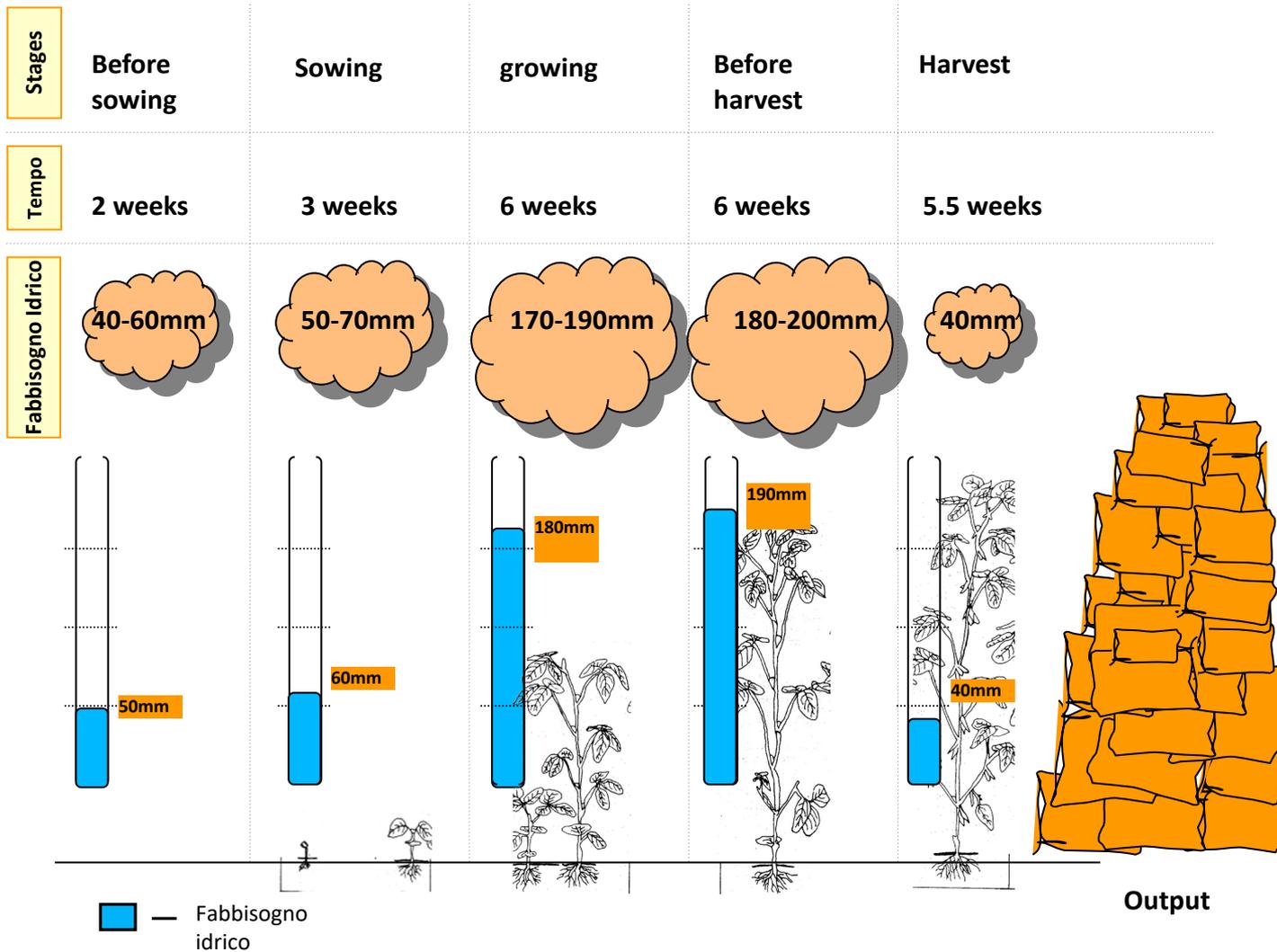
$$EV = p \cdot v + (1 - p) \cdot v = v \cdot (p + 1 - p) = v$$

# Summing up

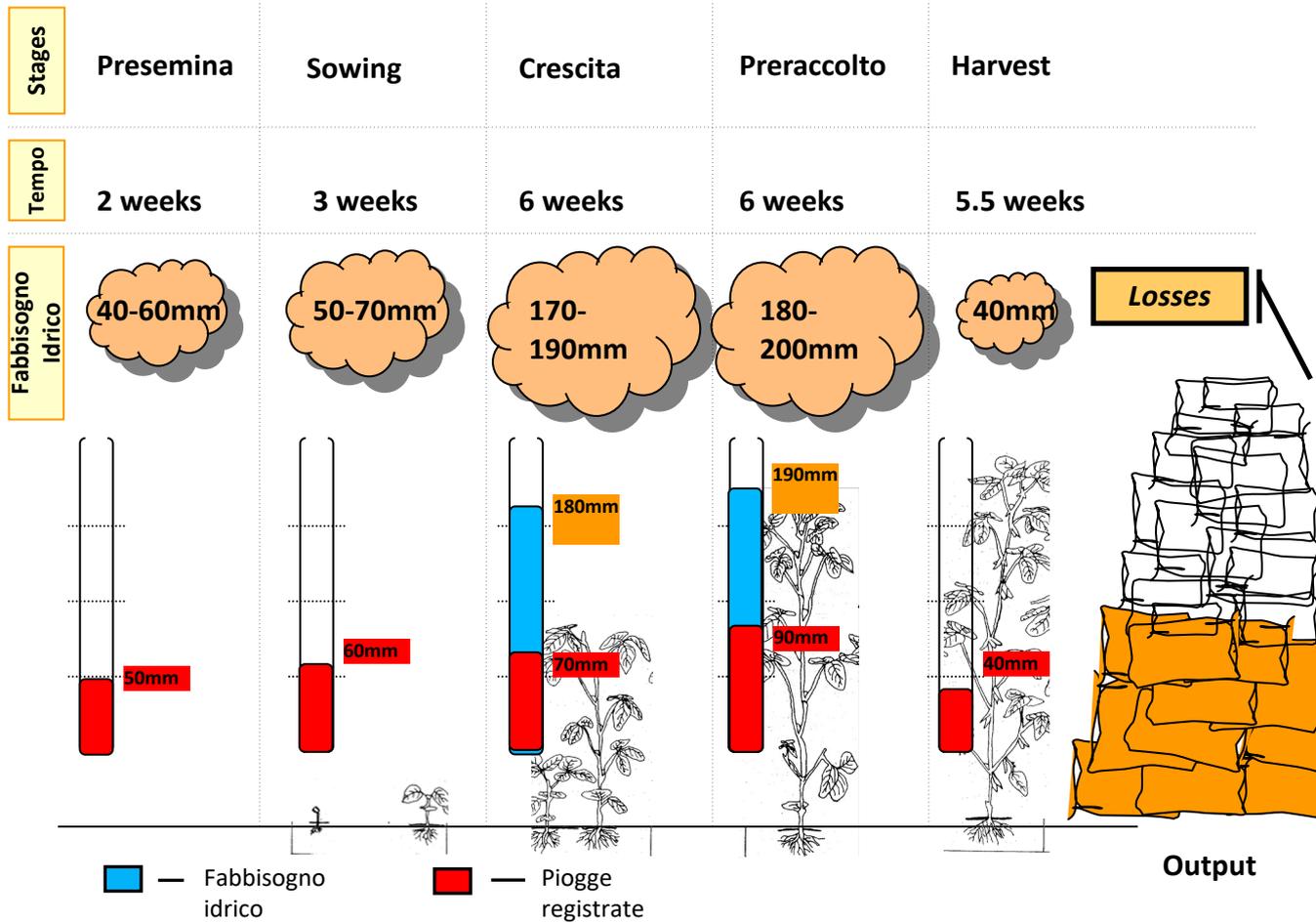
Farmers choice crucially depends of personal risk aversion, regional and wheather characteristics, crop cultivated, market volatility, credit and loan, crop and revenue diversification ,....

How many we know about that?  
Almost nothing!!!!

# Index insurance : how's work



# Index insurance : how's work



# Index insurance pay-off

Time

1st May / 31 rd August

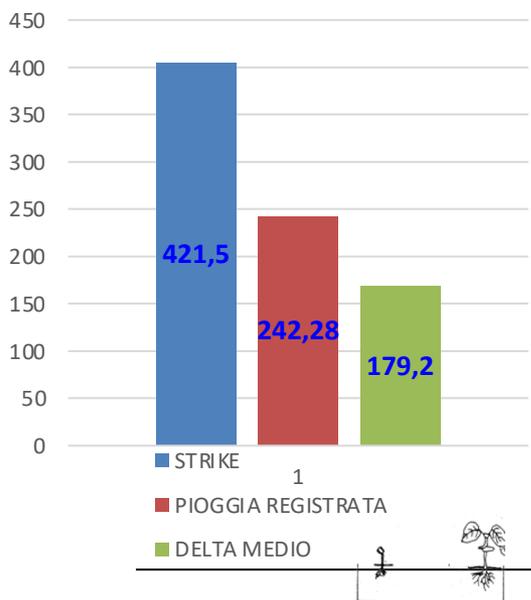
421,5 mm

Fabbisogno idrico

**Payout:**  
 (Strike – pioggia reg.)  
 \* Coefficiente,  
 e.g. x quintali\_ha/mm

deductible

Water average DEFICIT



Output

# index: Payout corn Crema 2012

## resa media 136,2 q

2012

Strike  
421,5  
mm

242,3mm

Missing  
179,2 mm

registriati

### Payout 2012:

(421,5 – 242,3)

\* Coefficiente

Franch.30 = 60,36 q

Franch.40 = 46,74 q

Franch. 50 = 33,13 q

Franch. 60 = 19,51 q

### Premium

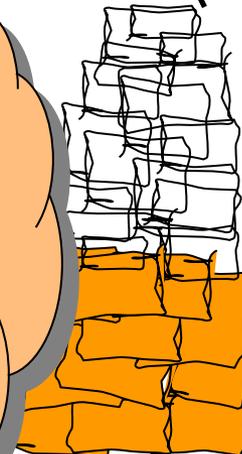
5,9%

3,2 %

1,9%

1,1%

Losses



Outp  
ut

# Agricultural sector is weak in the new scenario (climate/market)

- Revenue losses due to climate disaster+151% (1998-2018 vs 1978-1997);
  - 2 billion of Euro of damages in average in the last 15 years;
  - Foresee of 20 billion of Euro of losses in land value till 2040.
- 
- **Lack of risk management tools demand in Southern Region in Italy;**
  - **Need for technical assistance;**
  - **Need for a new model of public intervention**

# Suggestion

- Need for supplementary knowledge on territory and farmers characteristics (R&D);
- **Multidisciplinarity;**
- **New tools for technical support(training);**
- **New delivery model of the Cap.**