



Cambridge Day 2 Entrepreneurship Winter School Food Security



Food Systems & Security

Institute for Global Food Security

Queen's University Belfast

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Food and agriculture

“Food and agriculture worldwide is fundamental for the preservation and advancement of human life on this planet”

(Food and Agriculture Organisation, 2016)

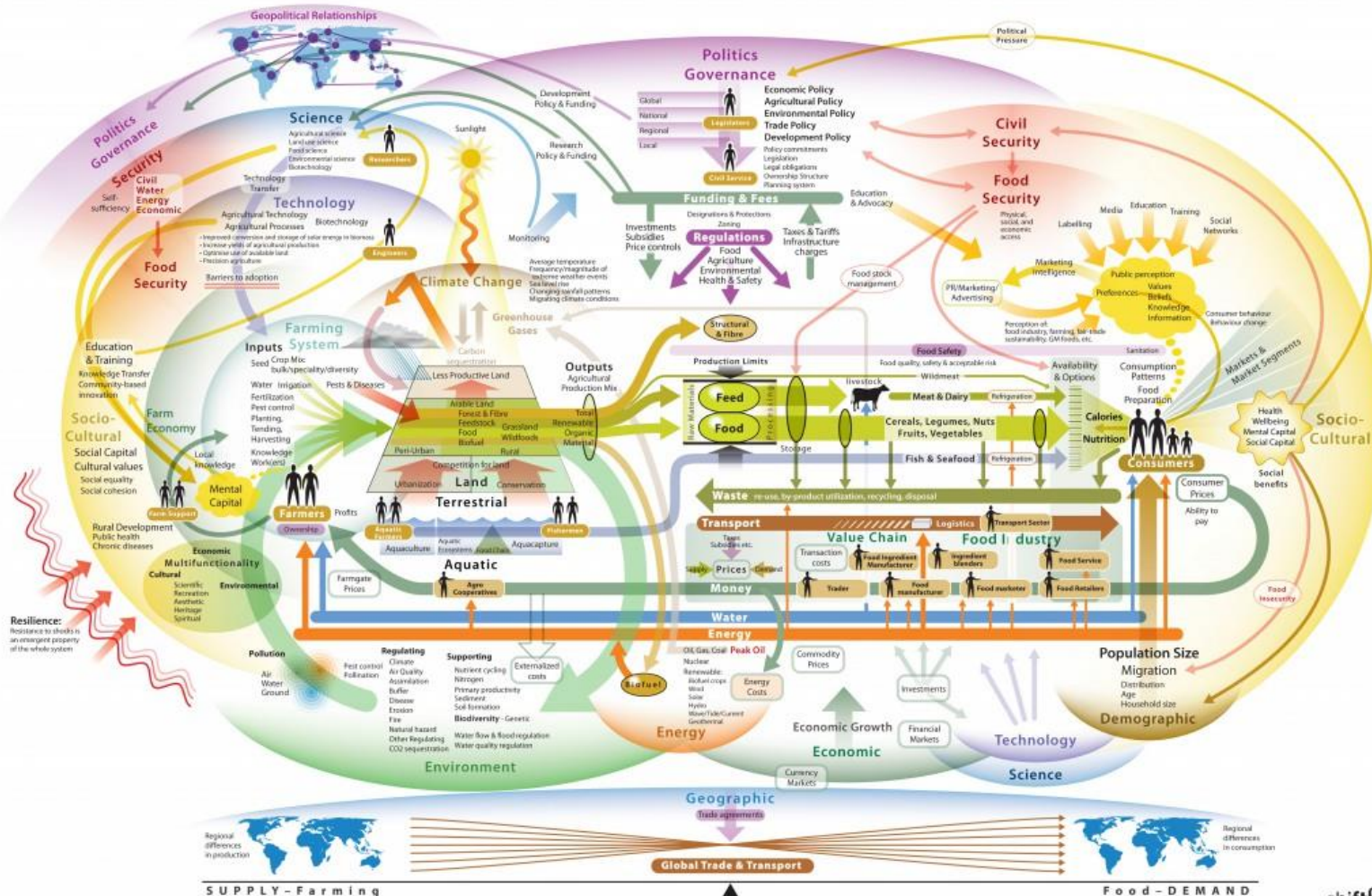
“ When we think about threats to the environment, we tend to picture cars and smokestacks, not dinner. But the truth is, our need for food poses one of the biggest dangers to the planet. ”

Richardson (2014)



Global Food System

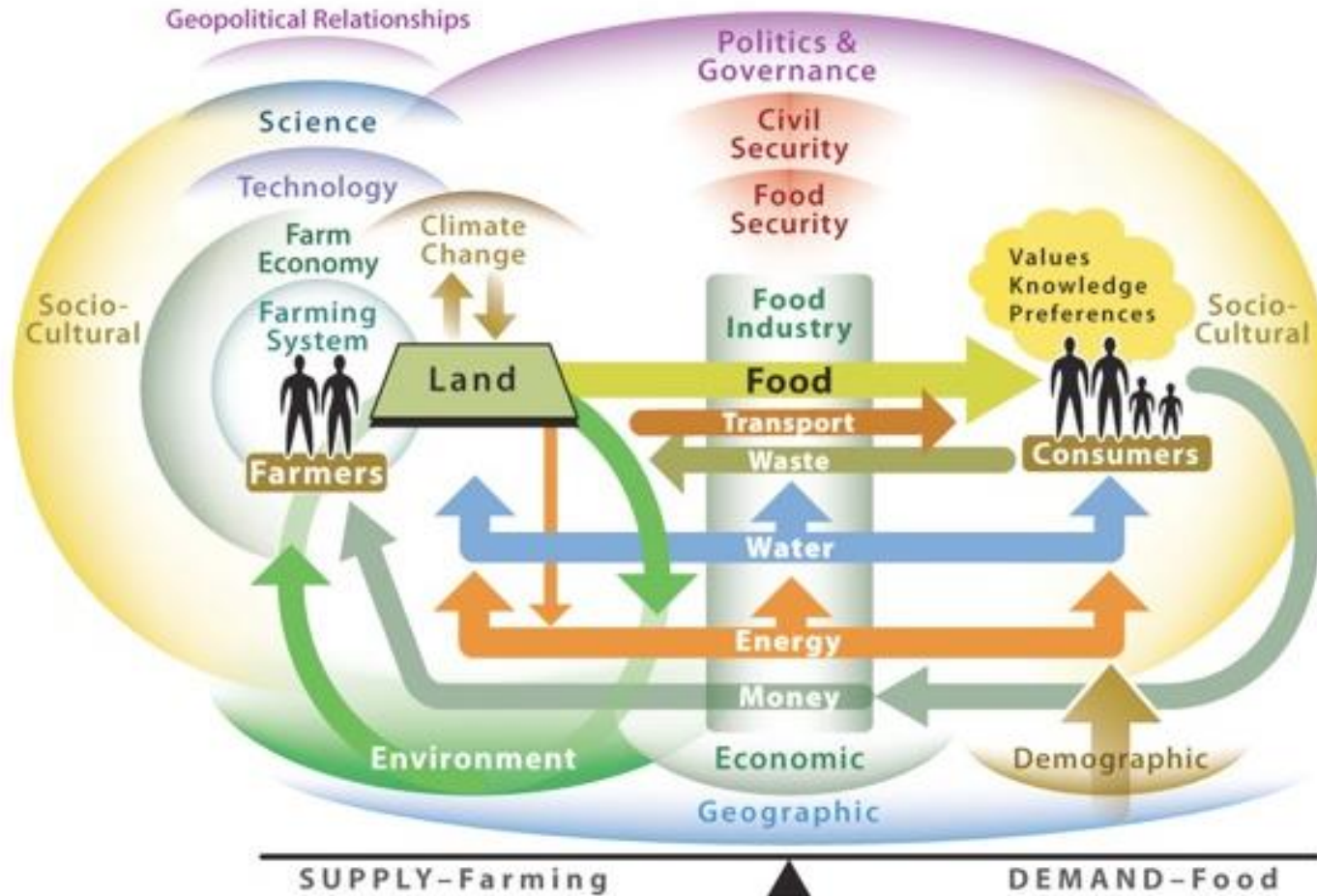
Global Food System Map



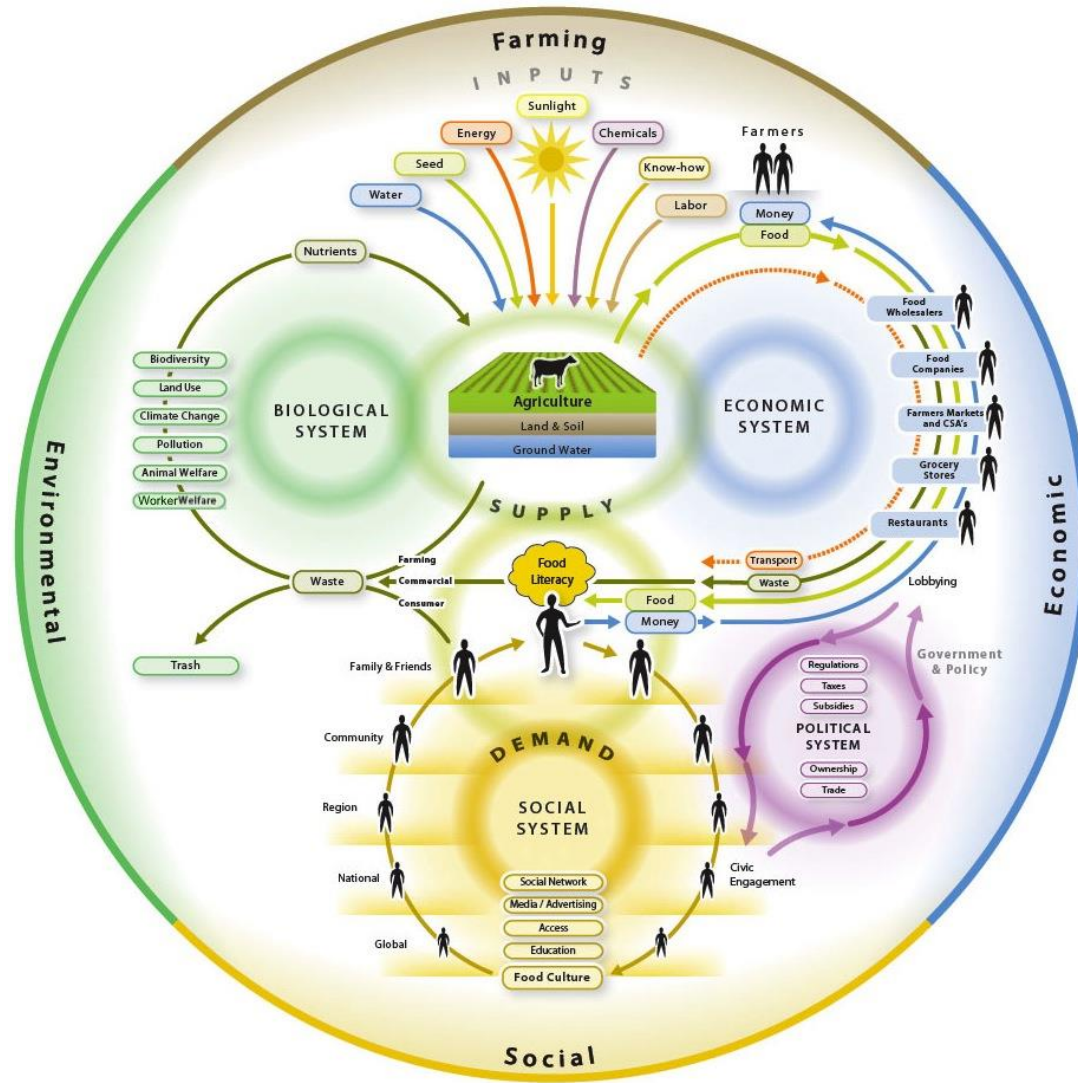
© copyright 2009 shift® clarity in complexity

Supply vs Demand

Food System Map – Basic Elements



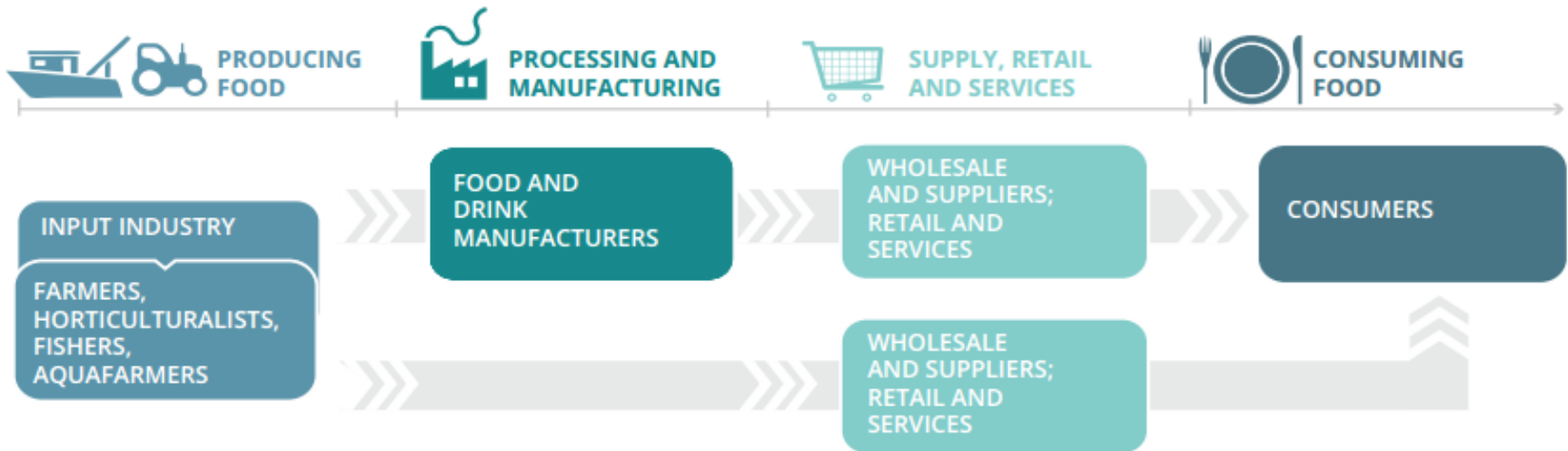
Factors contributing to food systems



TRADITIONAL VALUE CHAIN



INTERMEDIATE VALUE CHAIN



MODERN VALUE CHAIN



Source: EEA based on UNEP, 2016.



The big issues

By 2050, the world's population 9.6 billion

Renewable

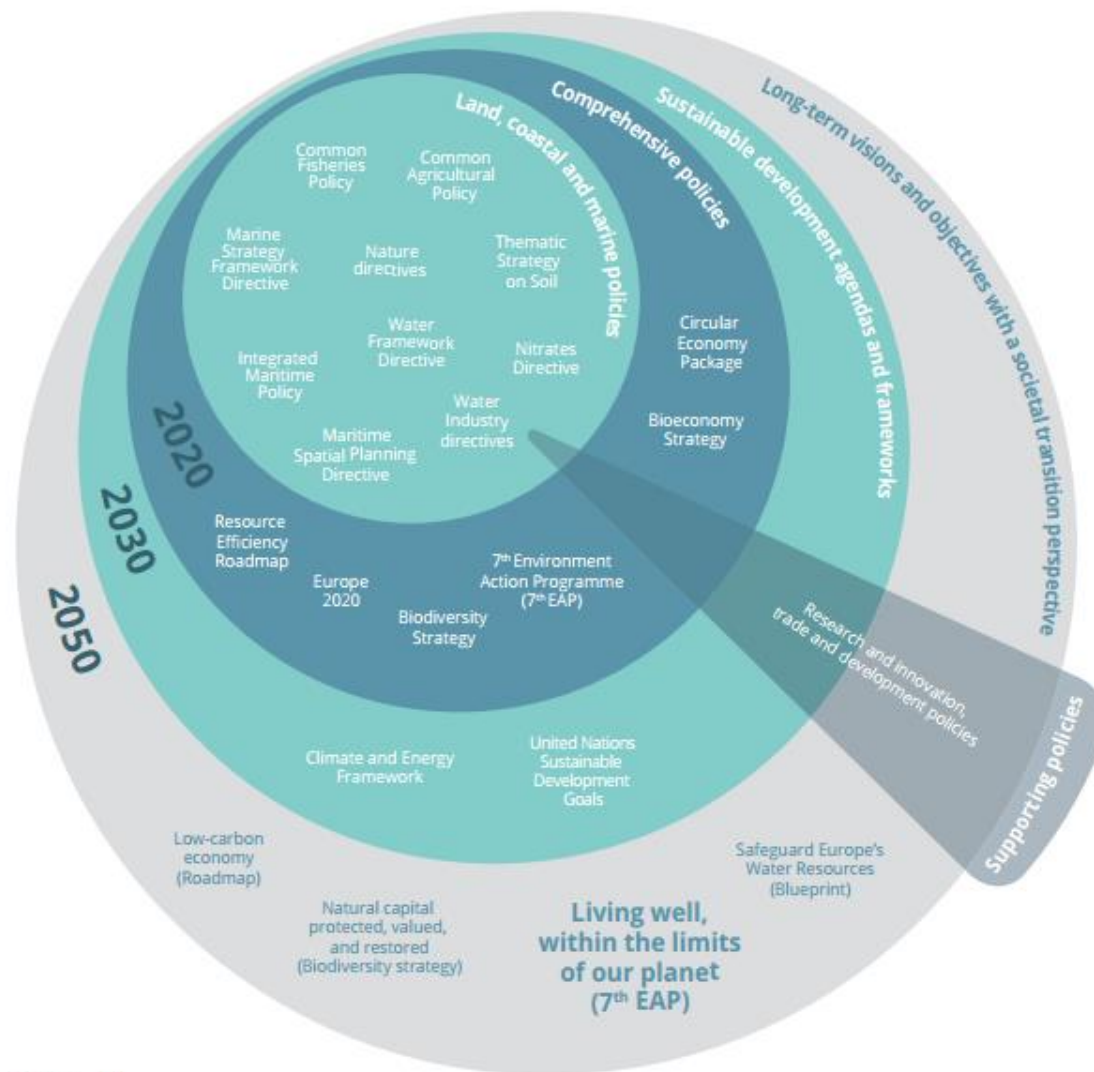
- Soil: 33% degraded
- Fresh water: 20% aquifers overexploited
- Biodiversity: 60% of loss
- Marine resources: 29% over-fished; 61% fully-fished

Non-renewable

- Minerals: >80% losses farm-to-fork
- Fossil fuels: ~30% of all fossil fuel use
and 24% of total GHG emissions



Big picture Policies to food systems



Source: EEA.



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Food Security

The World Food Summit of 1996 defined food security as “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”.

New caveat is
“produced by ethical and respectful means”

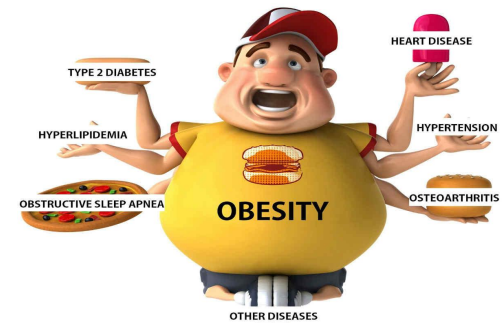


Food Security

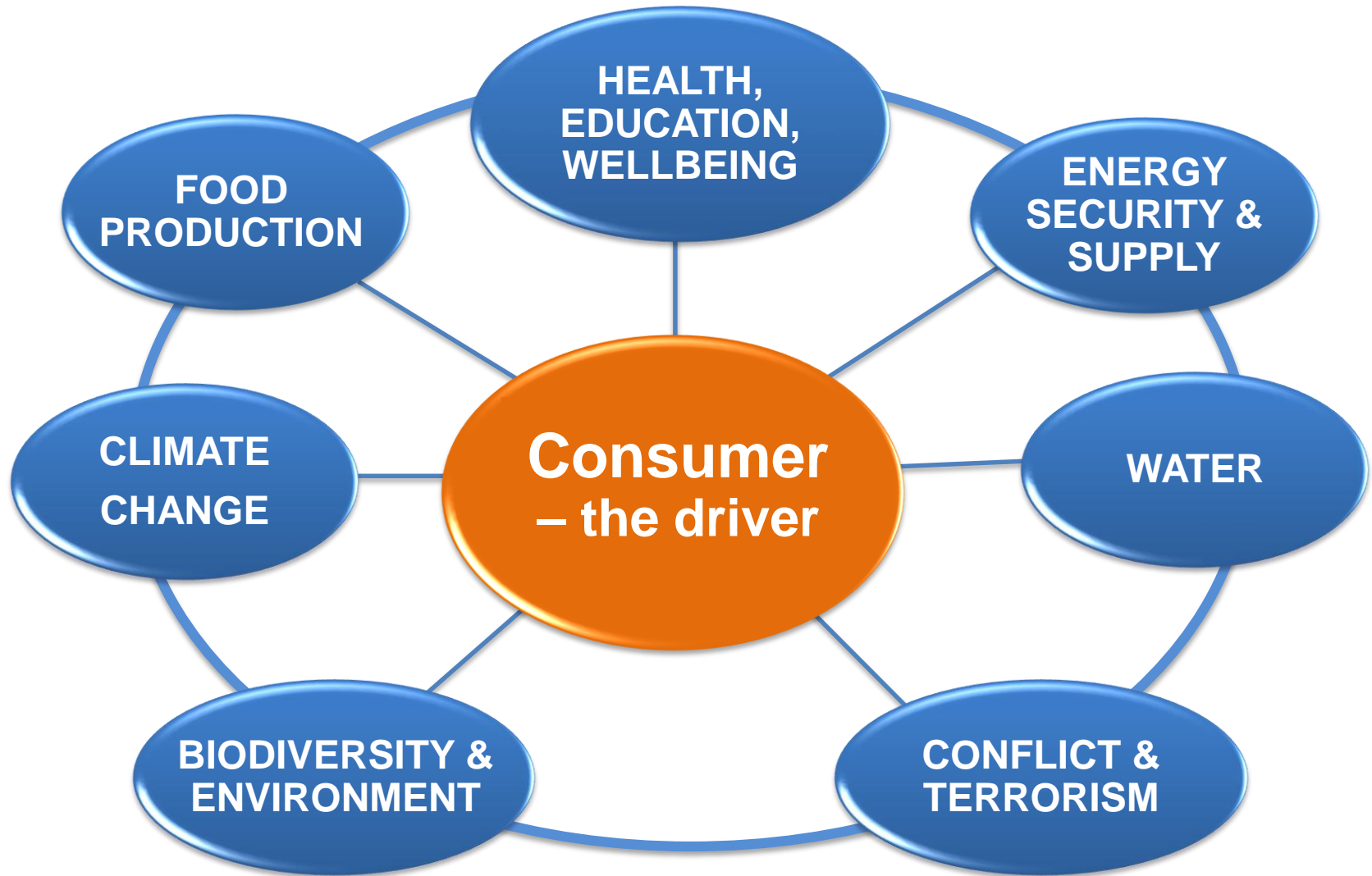
Worldwide, people's health and well-being are affected by food
E.g. some modern diets that are rich in fat, sugar, salt and meat.



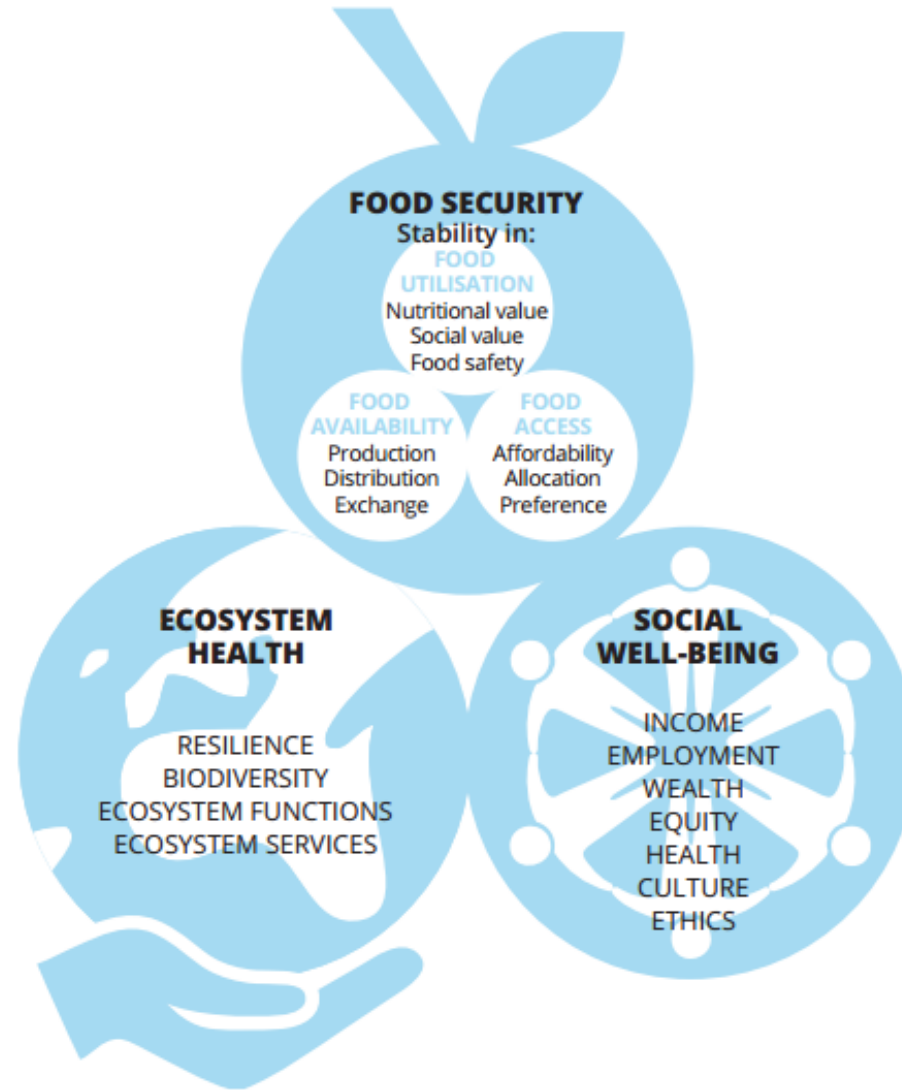
- ~ 800 million people are hungry
- >2 billion suffer from micronutrient deficiencies, which affect their growth and development
- ~2 billion people are overweight
>600 million of those are obese
- Slave labour in particular child labour in the food production is high
 - 16 million people were in forced labour in 2016.
 - >1 in 10 worked in agriculture or fishing
 - 15% manufacturing
 - Approx. 25% children



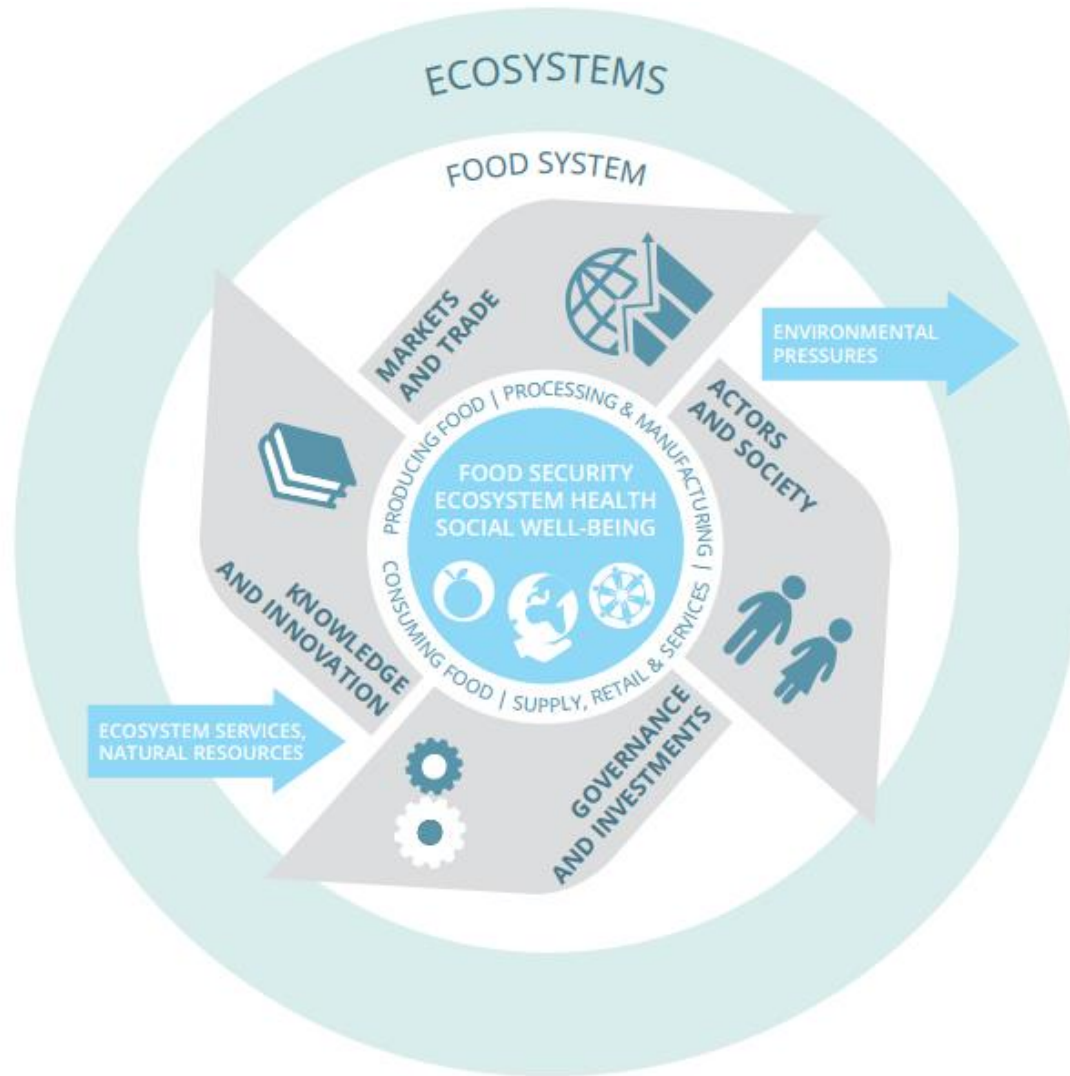
21st Century Challenges



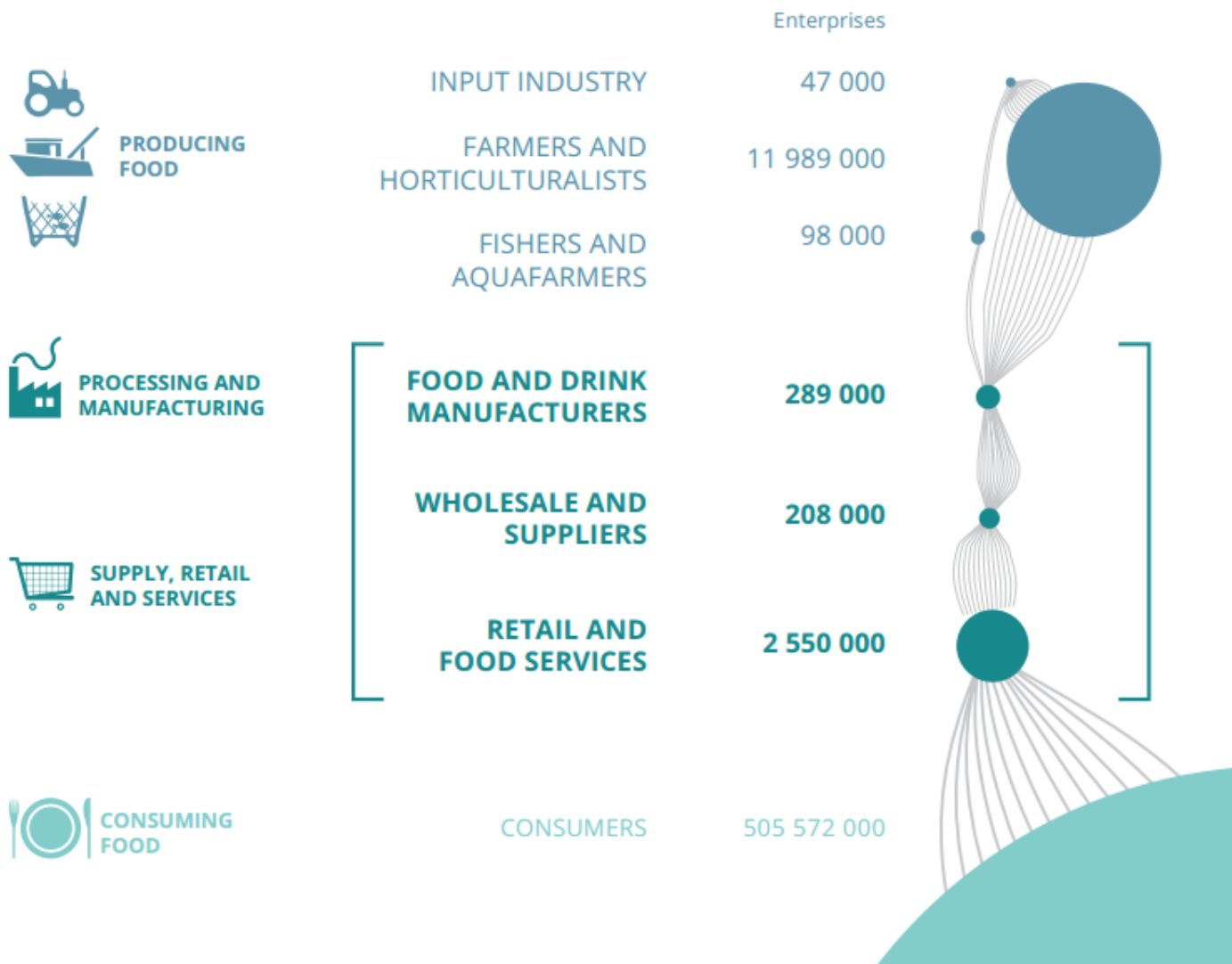
Food Systems



Food EcoSystems



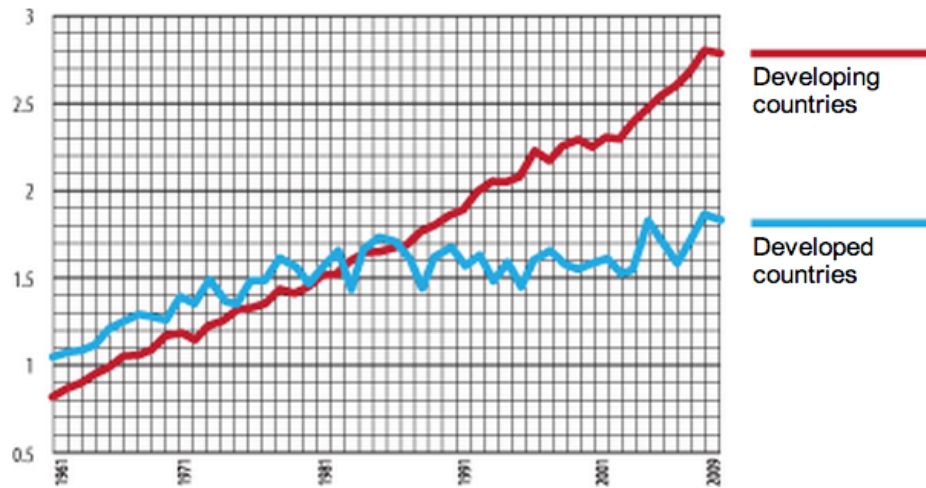
Europe's food supply chain by the number of enterprises in each food system activity



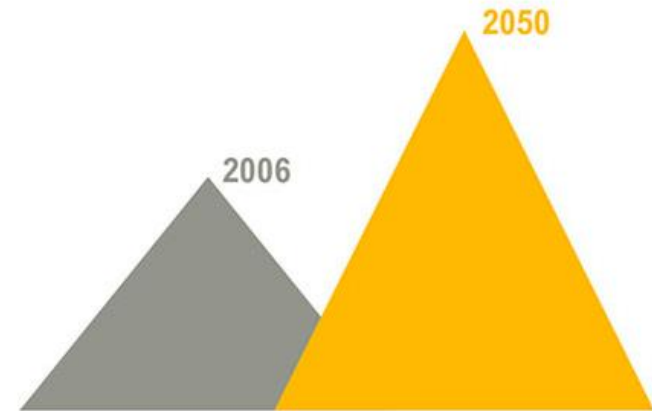
21st Century Challenges – Food Production

To feed 9 billion people by 2050, food supplies need to increase by 60% globally and 100% in developing countries

World production of major crops*, 1961-2009
(billion tonnes)



FAO Save and Grow, 2011



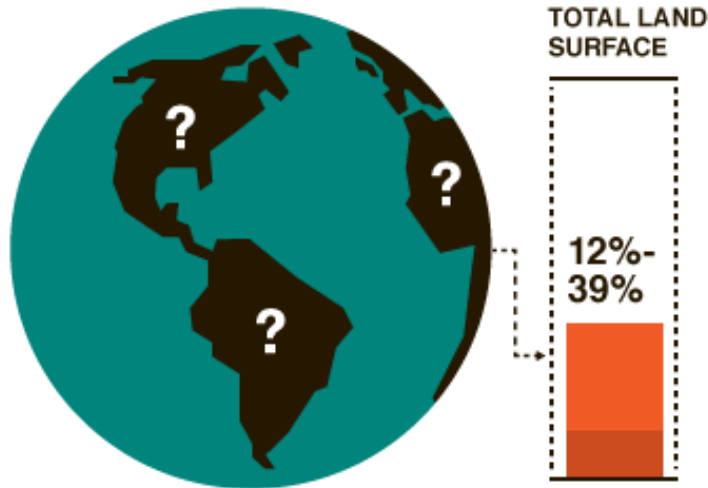
60%

Required increase
in food calories
to feed 9.6 billion
people by 2050

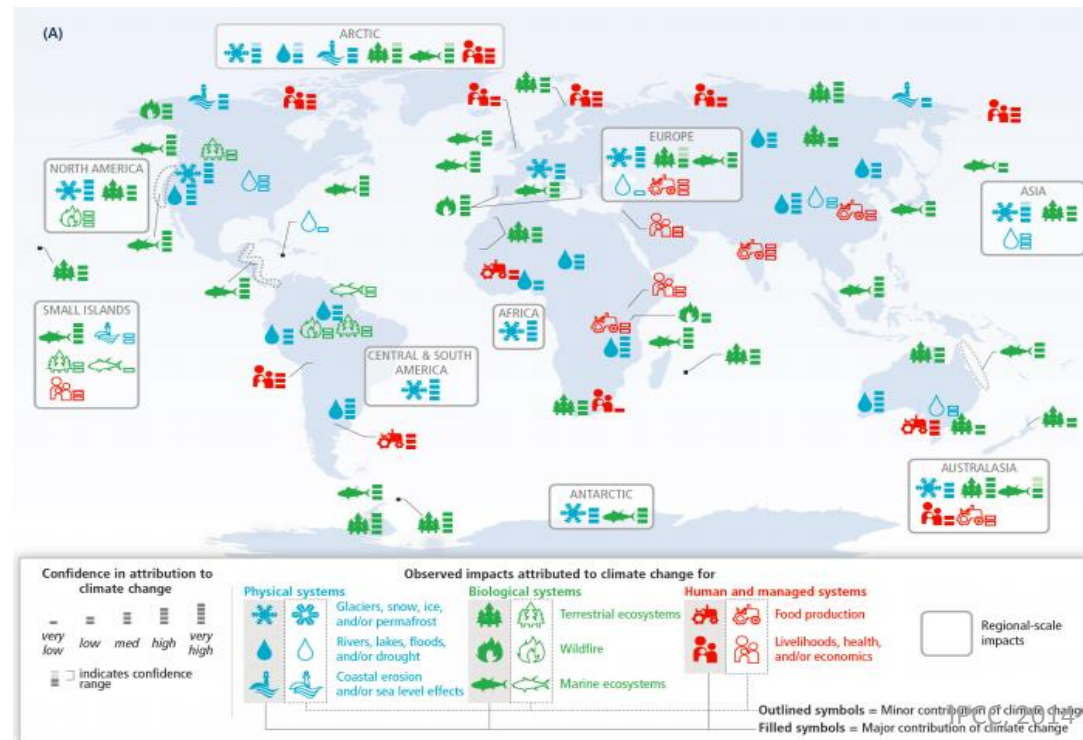
21st Century Challenge – Climate Change

Climate change may reduce agricultural production 2% each decade while demand increases 14%. Up to 40% of the world will develop unfamiliar climates.

At high emissions levels,
12-39% OF THE EARTH'S LAND SURFACE
 will develop novel climates.



CCAFS, 2014



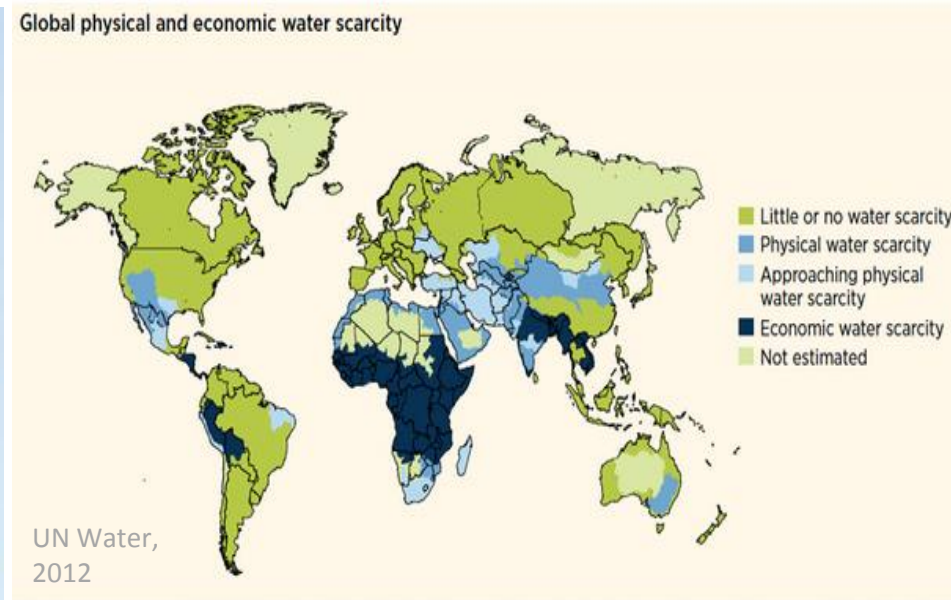
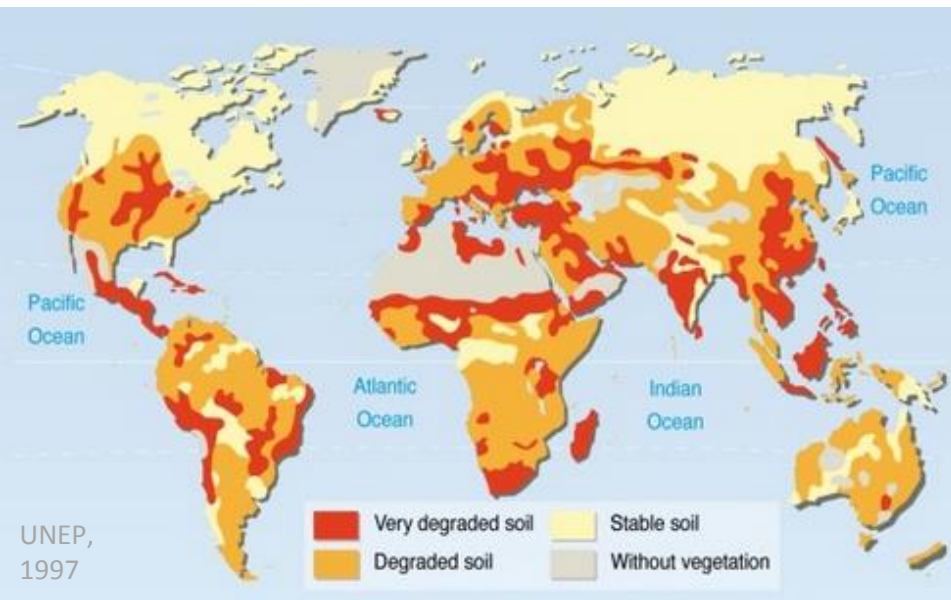
Climate Change & Water Scarcity

- How can Europe food supply and primary production adapt to more extreme weather events?
- How can the sustainability of primary production be improved without expanding social and environmental footprints overseas?
- How can water resources be better managed to improve water-use efficiency for food production?
- How can efficiency be improved and greenhouse gas emissions reduced with respect to water and energy inputs in food processing (e.g. reduction of heating then cooling or wetting then subsequent drying steps across the food chains?)



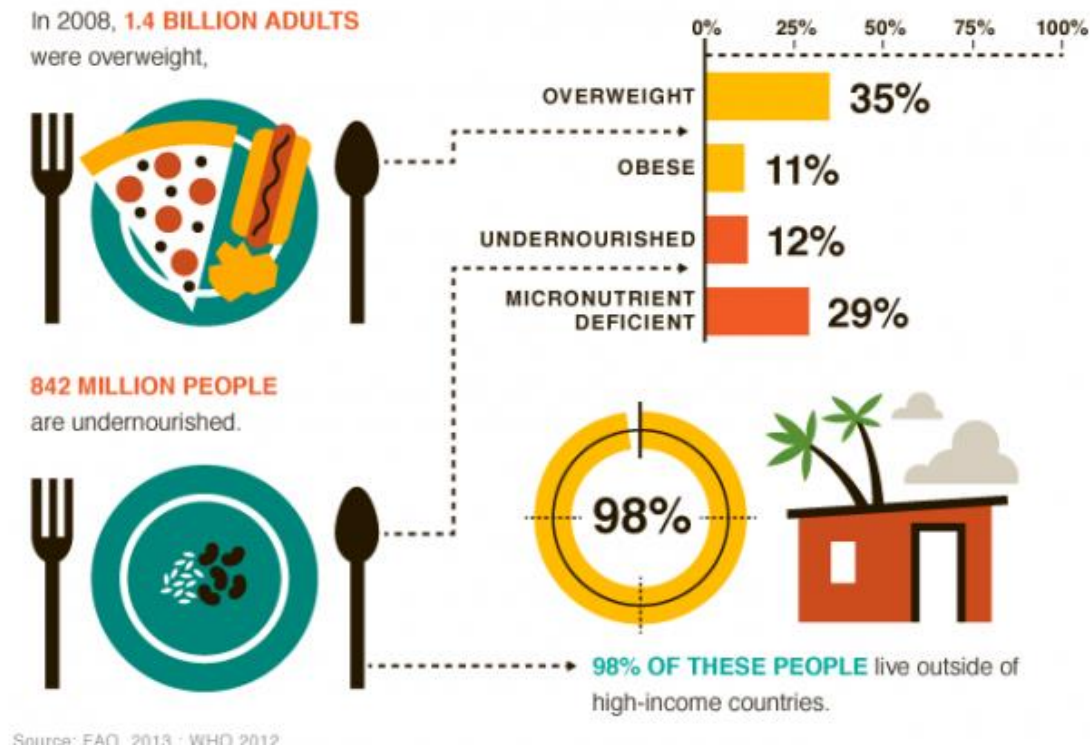
21st Century Challenge - Vulnerability

Most increased food production will take place on marginal and fragile lands, where yields are extremely variable



21st Century Challenge - Malnutrition

Once considered a high-income problem, overweight and obesity are on the rise in low and middle-income countries, especially in urban settings. At the same time, 1 billion people suffer from “hidden hunger.”



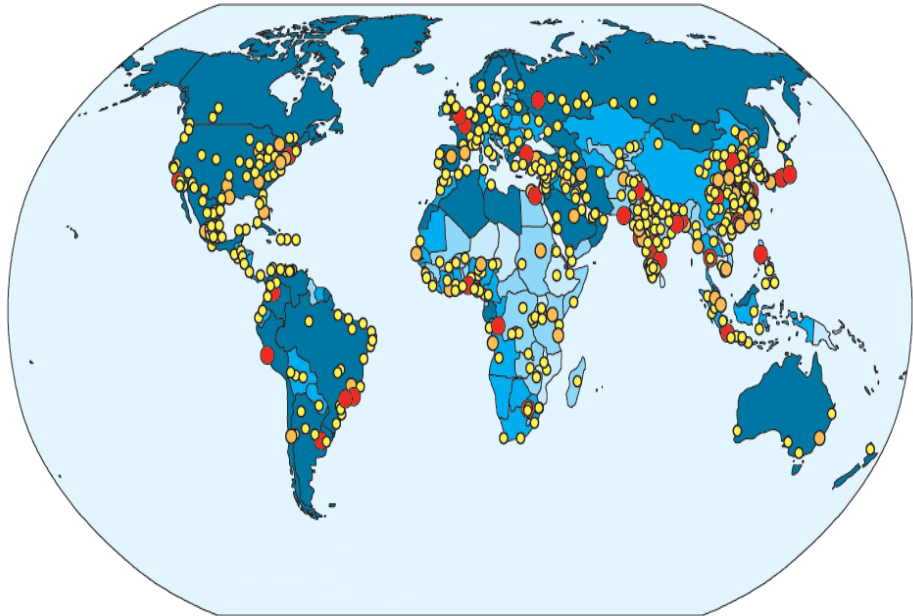
Food Security & Sustainable Nutrition

- What factors influence the allocation of food within Europe households, and what are the implications for health?
- How can the fat, sugar, preservative and salt content of foods be reduced while ensuring that palatability is maintained, waste is minimised, and food remains safe and does not spoil?
- How will novel, emerging and re-emerging pathogens be prevented, detected and controlled rapidly and accurately to enhance food security?
- Which EU groups (e.g. socioeconomic, regional) are, or are likely to become, food insecure in the near future, and why?
- How do we define a healthy and sustainable diet and what is the role of governments, businesses and civil society in driving healthy and sustainable food behaviours?



Pressures on natural resources are increasing

Population growth and urbanisation



City population

- 1 - 5 million
- 5 - 10 million
- 10 million or more

Percentage urban

- 0 - 25
- 25 - 50
- 50 - 75
- 75 - 100



Climate change



Supermarketisation



Dietary changes

Demographic Change

- Will aspiring consumers in emerging economies follow the same food consumption model as in the West?
- Will China import more food and thus also water, nutrients and energy from other countries? How can it transform its own agriculture to produce enough food in a sustainable and safe manner?
- How can emerging economies direct more of its economic growth towards rural development and eradicating widespread poverty and malnutrition?



Challenge

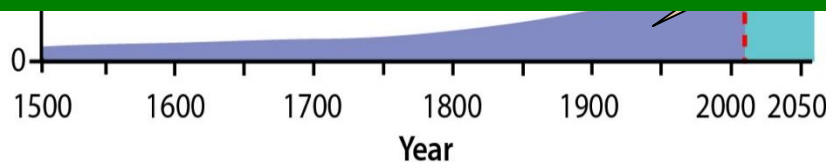
produce as much food in the next 50 years as in the last 500 years

50
45

Estimated total food

Cereal production will have to increase by almost a billion tonnes from 2.1 billion today

Meat production will have to grow by more than 200 million tonnes to reach a total of 470 million tonnes in 2050.



Source: CSIRO.Au

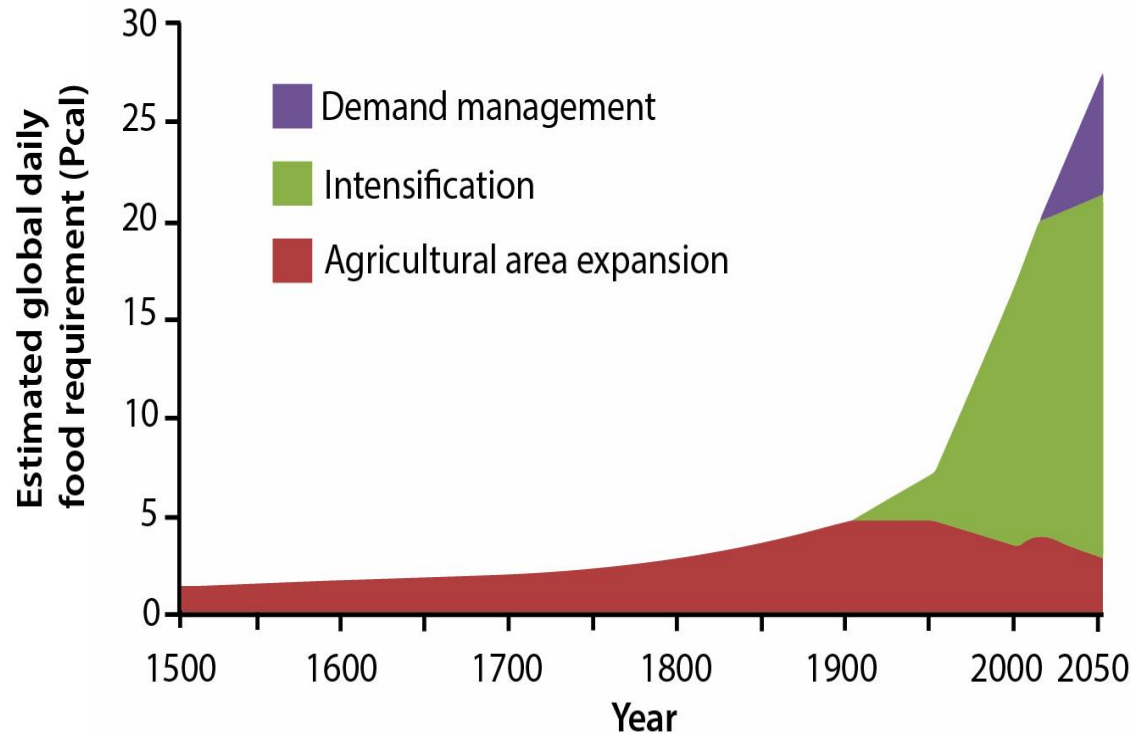


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How will food demand be met ?



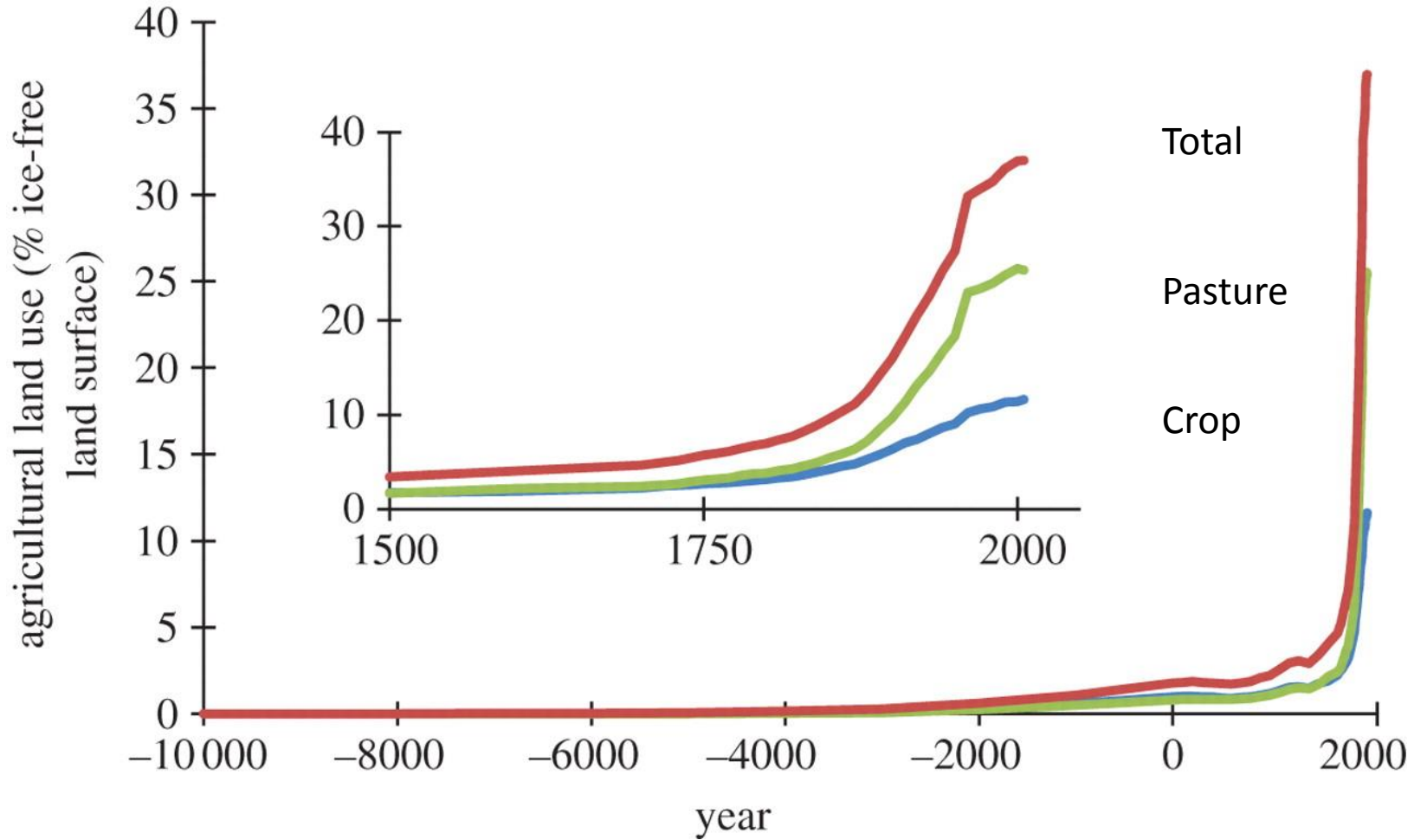
Need to
“produce more
responsibly”
and manage
“demand”

Smith (2014)



Changes in land use

Singarayer & Davies-Barnard (2012)



Land Use & Biodiversity

- How might we make farming more profitable and more sustainable in our generation?
- How can we transform the food system to ensure that healthy proteins, an essential nutrient for human health, are available to a global population estimated to reach from 7.5 to 9 billion people by 2050?
- How can we ensure proteins are produced within environmental limits and in a way that contributes rather than degrades key ecosystems?
- How can biotechnology best contribute to future food and nutritional security and serve the needs of the poor?
- How should EU soils be managed for optimum productivity and environmental protection in field vegetable, arable and grassland livestock systems in the long term



Smart systems for sustainable development goals



These are food systems in which the environmental bases to deliver food security for current and future generations is not compromised



Interconnected resources



Towards sustainable and efficient food systems

Consumer Side



Reduced food waste



Balanced diets



Packaging

4 tips for eating sustainably - [Harvard T.H. Chan School of Public Health](https://www.youtube.com/watch?v=cYCPqoosYXI)
<https://www.youtube.com/watch?v=cYCPqoosYXI>



Consumer behaviour

- What food information system would allow EU consumers to make an informed choice about each product's impact on different aspects of sustainability (environmental, economic, health and social)?
- Which intervention (or combination of interventions) would be most effective in achieving changes in consumption decisions and which types of intervention (e.g. awareness raising campaigns, choice editing, education, legislation or regulatory) are most appropriate for specific contexts and decisions?
- What dietary choices would EU consumers make if their intake of meat and dairy products was reduced, and what impact would this have on health and sustainability?



Food Waste

- Under which circumstances are the various channels for using food waste (including anaerobic digestion, feeding it to animals, composting, land-spreading etc.) socially, environmentally and economically preferable?
- How can ways of influencing behaviour be most cost-effectively designed and targeted to reduce food waste in EU homes?
- How can waste of primary production be minimised by ensuring efficient conversion to secondary products?



The Grand Challenges

Farms of the Future



Towards sustainable and efficient food systems

Production side



Better land management



Sustainable intensification



Biological pest control



Coupling crop and livestock systems

A Global Leader in Smart farming and food

New science, technologies and tools for

“This is complex and requires a step change within our production systems”

We must work together locally, nationally and internationally



Driving productivity and efficiency

**Improved
health**

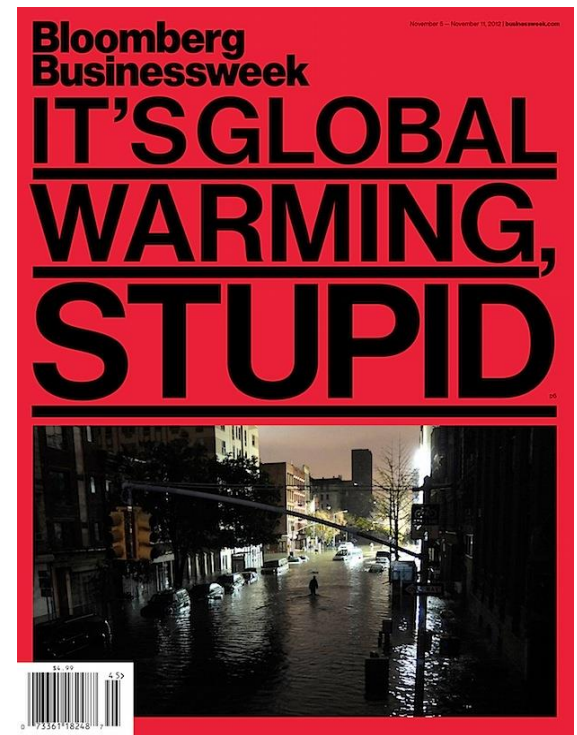
**Improved
fertility**

**Improved
genetics**

**Improved
nutrition**



The expectations of Science & Research



- Large increase in scientific understanding
- Link excellence in science to the grand challenges
- Translation into jobs, processes etc...



The Grand Challenges

Nutritional Challenges in the 21st Century

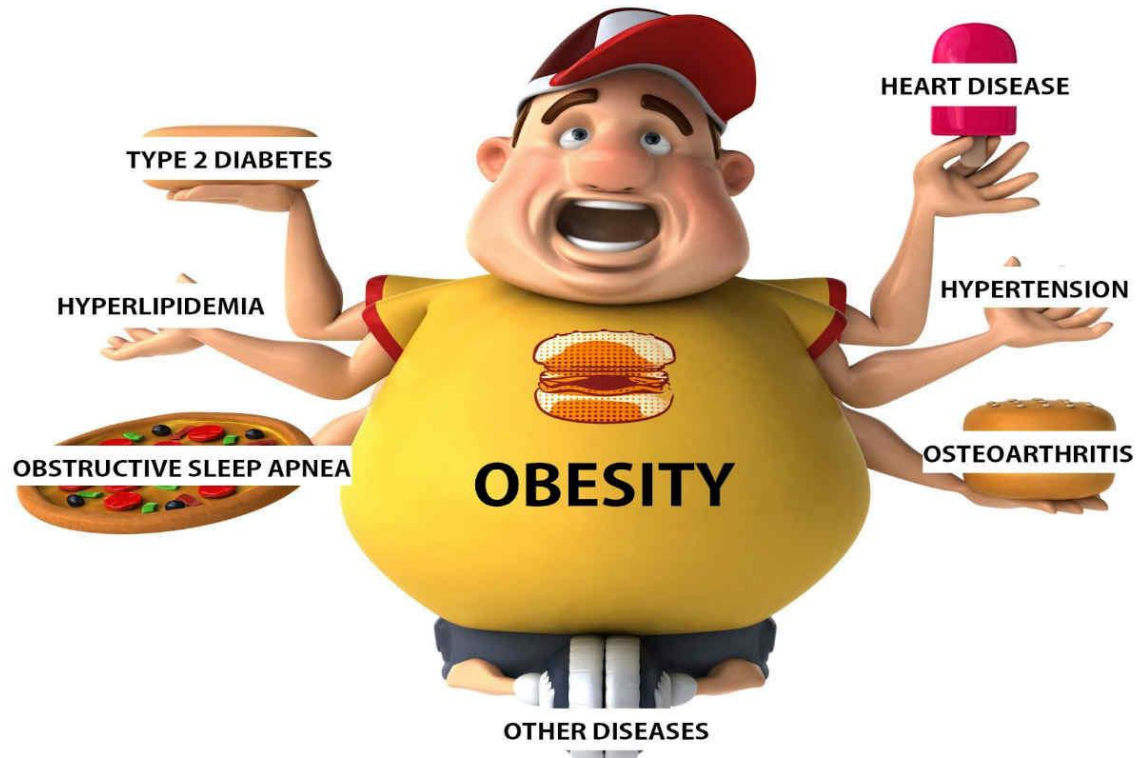


Improved human health

Genetics
Knowledge

Improved
nutrition

Improved
health



Connected Food & Health - Personalised Nutrition



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The Grand Challenges

Integrity of Global Food Supply



- Ensure the food we produce is safe, authentic and nutritious
- The systems used to produce our food are sustainable
- Our food is produced to the highest ethical standards
- We respect the environment and all those who work in our food industry



Safeguarding our food supply

Diagnostic Solutions for Enhanced Food security

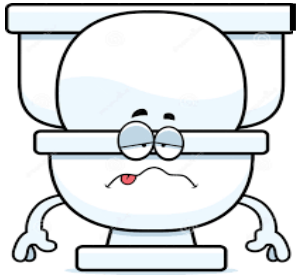


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Food Safety



Quite a few people will have had the misfortune of eating some dodgy food and getting unwell as a result
⇒ HEALTH IMPACT



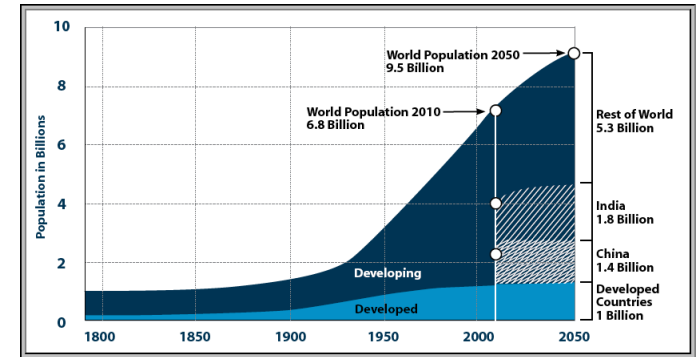
In the USA the health consequences due to the consumption of **naturally occurring pathogens and marine toxins in seafood** costs US\$350 million per year.
⇒ ECONOMIC IMPACT



From a food safety perspective even more important to the adulteration of food and the horse-meat scandal as natural toxins can kill.

Why securing Seafood?

By 2050 the world's population will be >9 billion
34% more persons than today.
Mainly in developing countries.
Urbanization will grow at 70%
Food production must increase by 70 percent.



BasilioChen.com

Challenge: Sufficient safe food produced

Risks: Climate change and competition for land for biofuels

Opportunities: Scientists to address these challenges and risks



Land to Seas



Agriculture to Aquaculture Products

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25 July 2013 Last updated at 15:00

K5 WESTERN WASHINGTON'S HOME NEWS A TEGNA COMPANY

HOME WEATHER 50° LOCAL NATION NOW TRAFFIC

Shetland shellfish toxin levels for

All shellfish harvesting sites closed and mussels from the withdrawn from sale after un levels of toxins were detected

The Food Standards Agency s occurring toxins can cause ac

The move came after about 70 east England reported sympto shellfish poisoning.

The cases have been linked to mussels from Shetland.

It was after the harvest of these levels of toxins during its week

According to the FSA, the toxin and levels are typically higher

A total of 11 harvesting areas have been shut by Shetland IS

VICE NEWS A Hu

TIPPING POINT

A Huge Algal Poisoning

By Esha Day
August 10, 2015 | 6:55 pm

VICE News is closely following this story. [Point to blog here.](#)

A poisonous algae that has been found in the Pacific Ocean, is causing a massive algal bloom

MercoPress
South Atlantic News Agency

CURRENT EDITOR

BBC NEWS

Wednesday, August 12, 2015

Galician mussel farms are a danger because

The Xunta of Galicia says that 55 floating mussel farms are a danger because of the massive algal bloom

England

Dorset

Mussel farms are a danger on the Galician coast

NEWS

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Tasmania's wild east coast shellfish carrying high level of toxins; Health Department warns of 'serious, fatal illness'

By [Damian McIntyre](#)
Posted 2 Oct 2015, 5:23am

Tasmania's Health Department is warning people not to collect or eat wild shellfish from the state's east coast because of high toxin levels.

An extensive area of the east coast is affected by naturally occurring algal blooms.

Acting director of public health Doctor Mark Veitch said eating wild shellfish from the affected area could cause paralytic shellfish poisoning from toxins produced by algae.

"Shellfish feed on algae and concentrate the toxin, which makes them dangerous to eat and may cause serious and even fatal illness," he said.




PHOTO: Tasmanian are being warned not to eat wild shellfish including mussels from the state's east coast. (ABC)

MAP: TAS

Natural Toxins are a global concern



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SeaFood Safety Monitoring



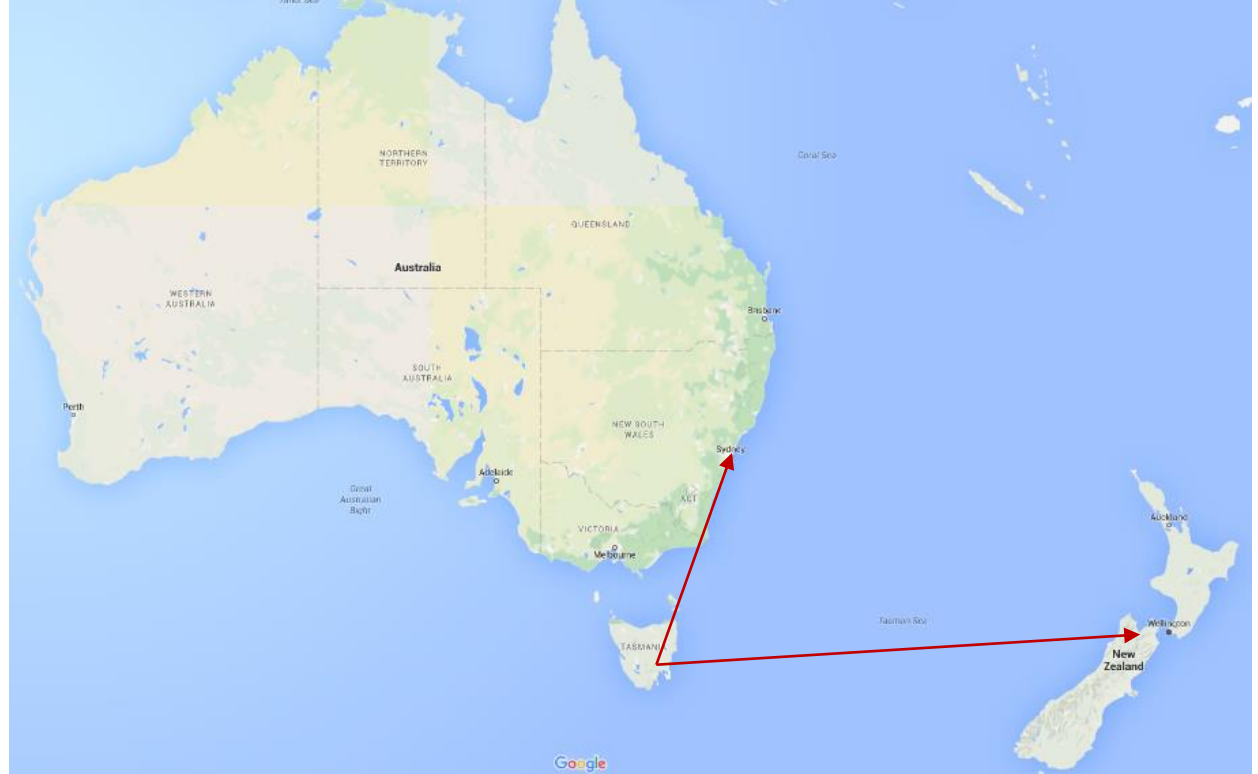
Reference method: Mouse BioAssay
Death / Illness in Mouse means toxic shellfish
European Union: Unethical



Laboratory based Analytical Methods
Highly expensive equipment
Requires trained experts to use
Not suitable at the shellfish sites



Logistical Nightmare



During harvesting sampling occurs for food safety monitoring
Turnaround time on testing can be a week
Water conditions do not remain static
In 2012 this management system cost the Australian industry
23million AUD in recalls from contaminated batches going to Japan

Alternative Food Safety Monitoring

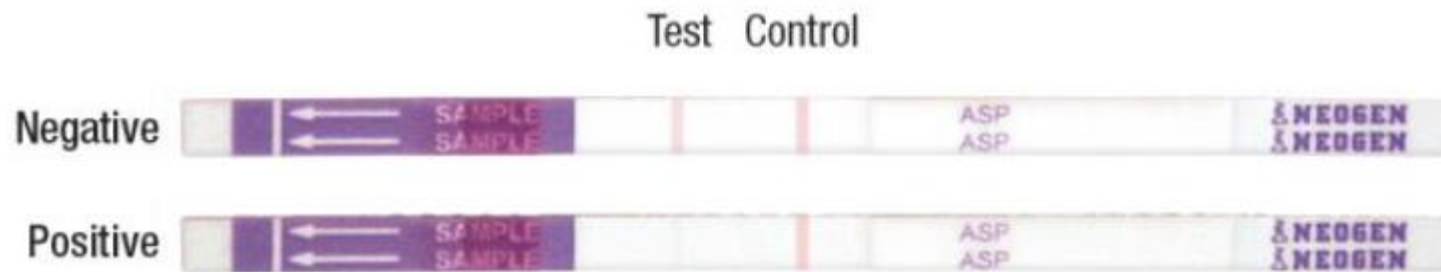
Rapid Immunodiagnosics

Lost Cost Testing

No training required

Fast Results

Suitable for use throughout the food supply chain
(production, processing, distribution, marketing, retail)



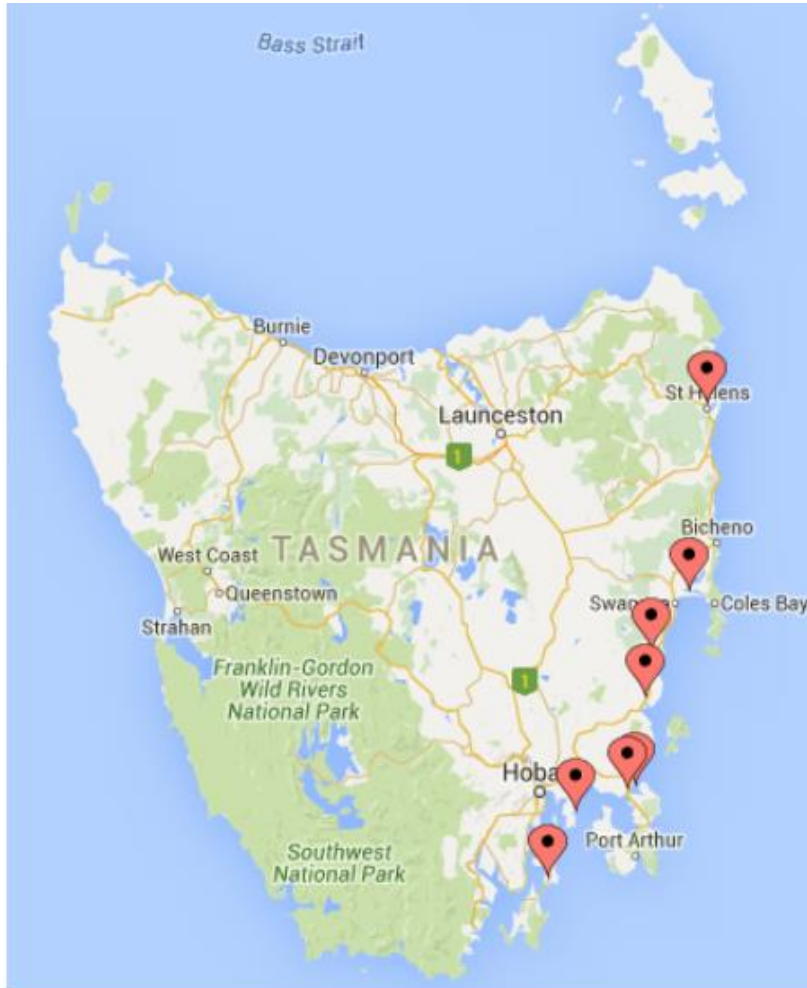
My wee journey



University of Tasmania – IMAS, Hobart



Industry Perspective



‘..pretty bloody exciting from an Industry perspective! Got to say we are really loving this test.’

So it's great to have that peace of mind and reassurance on harvesting. We are finding this test quite easy and straight forward to use,

As well as being very practical, plus not having to stress about possible recalls is a major bonus! ..found it very simple to use and took relatively no time at all’

Empowering allowing real time decisions



Conclude

Aquaculture is a potential growth area to enhance food security especially for developing countries facing increased urbanisation

To safeguard our food supply chain:

- Awareness of the **current and emerging risks**
- Apply analytical tools that are fit for purpose throughout the food supply chain for **safety and sustainability**
- Engage with the industry and regulators to find the **right solutions**



Spinout StartUp

Xenobics Limited



Contact

info@xenobics.com

www.xenobics.com



@Xenobics

**Delivering Advanced Solutions
For Food safety Diagnostics**

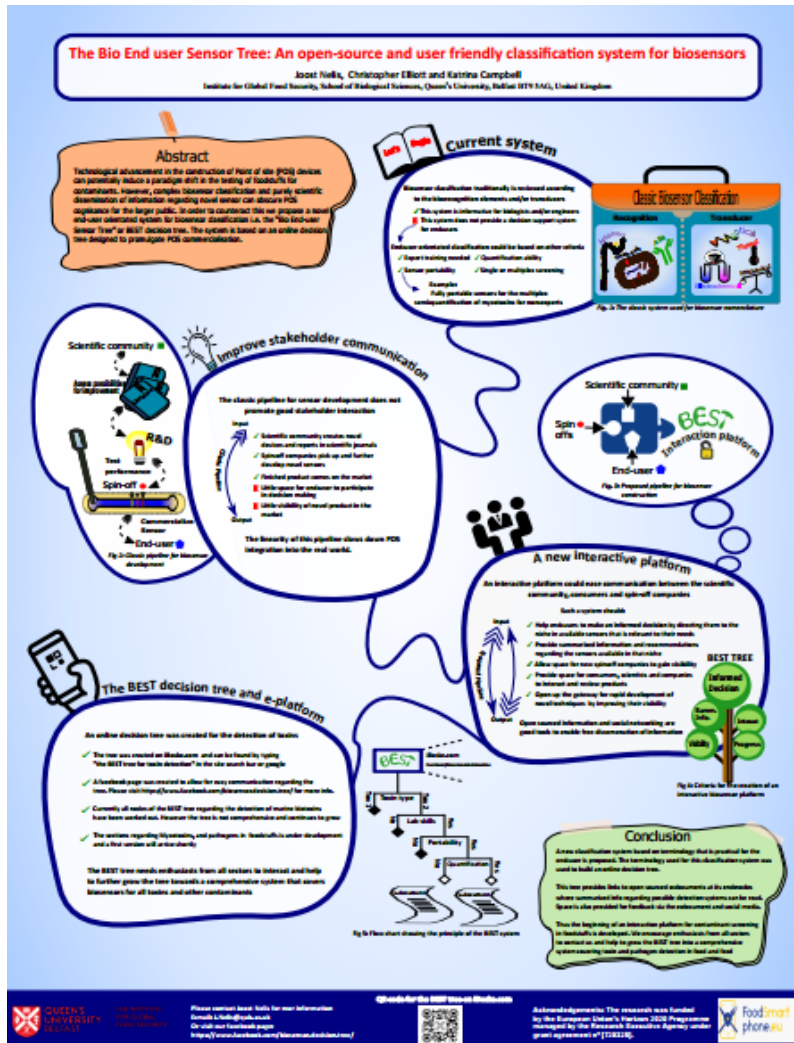


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BEST Biosensor for End User



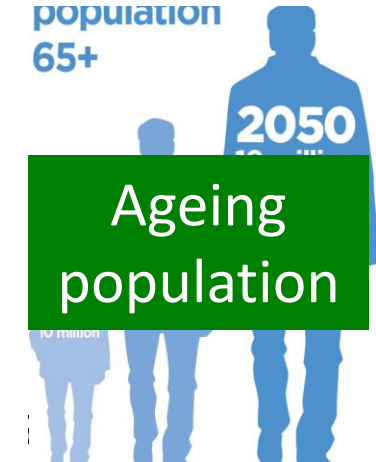
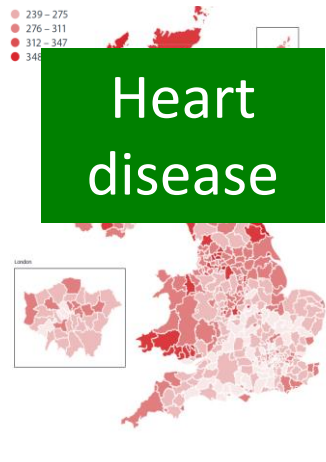
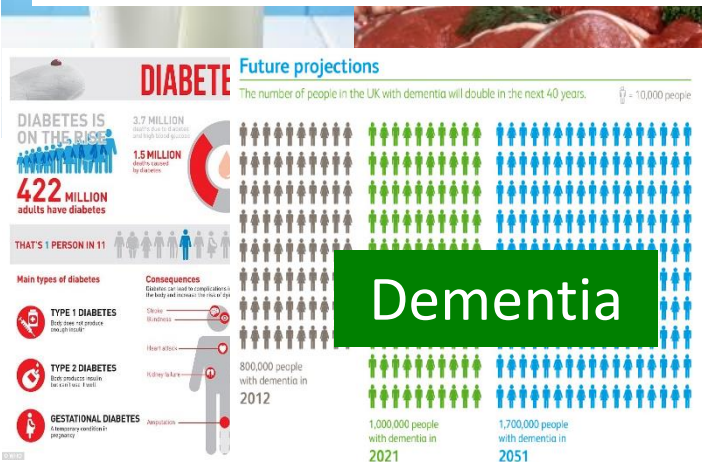
<https://www.iboske.com/Jordi/281149440/the-best-tree-for-toxin-detection>

H2020 Project: <http://www.foodsmartphone.eu/>

Thought For Food



Soil to Society and Discovery to Recovery



Save the Date and Book your place

<http://www.asset2018.eu/>



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FOOD
IS OUR
FUTURE**

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ASSET 2018

WATERFRONT HALL 28TH-31ST MAY

BELFAST SUMMIT ON GLOBAL FOOD INTEGRITY

Ensuring the integrity of the world's food supply



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