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INTERNATIONAL SCIENTIFIC SYMPOSIUM

BIODIVERSITY AND SUSTAINABLE DIETS
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FAO HEADQUARTERS, ROME
• Demographic trends and food consumption

• Sustainability of the food chain

• Environmental impact

• Mitigation and Adaptation

• Possible answers by scientific research
Problem: Continuous growth, based on a linear consumption of energy and raw materials, on a planet that has limited resources.

1900 >1,6 billion people >1,3 billion hectares of arable land
2000 >6,5 billion people >1,5 billion hectares of arable land
2050 >9 billion people > +/- 1,5 billion hectares of arable land (abandonment / urbanizat.)

Resources:
Water (3.000 sqm/year/inhabitant of virtual water, hydric stress / penury),
Soil (salinization: 20-30 mil.ha/260 irrigated land),
Forestry (Deforestation 13 mil.ha/year),
Biodiversity (-30%),
Sea (Oceanic fisheries, 75% over carrying capacity),
Air (Fossil fuels +70% CO2 in 30 years, 49 billion ton., largely over 450 ppm).

(Global Footprint Network)
Ecologic footprint of the Planet: consumption/waste
1961-2001> Energy consumption +700%
1961-2008> Use of nature: from 55% to 140% of the biocapacity of the Planet
2009> Overshoot Day 23th September, 266th day of the year (in 1986 on 31st December)

Energy and Natural resources Consumption level> USA (5,4 Earths), Canada (4,2), UK (3,1), DE (2,5), IT (2,2), Arg(1,2), Emergent countries, India (0,4)

Food consupption at global level: Reduction of the gap between malnutrition (food security) and obesity (food safety)

(Global Footprint Network)
The sustainability of the food chain (Production, Transformation, Distribution, Consumption) is to be expressed in terms of:

- Use of natural resources (water, soil and biodiversity / patents on living matter);
- Energy and contribution to the emission of greenhouse gases (CO₂ eq.);
- Food choices of the consumers (healthy food / Mediterranean diet / local consumption).
Sustainability of food products: Responsibility of the whole food chain

Agriculture
- soil
- feed
- water
- fertilizers
- pesticides
- energy

Food processing
- water
- energy
- additives
- refrigeration
- packaging

Transport
- fuel
- refrigeration

Distribution
- energy
- refrigeration
- packaging

Domestic preparation
- water
- energy
- refrigeration
- packaging

Loss of soil
Polluting
Greenhouse gases
Emissions
Waste water
Organic waste

Waste water
Polluting
Greenhouse gases
Polluting emissions

Greenhouse gases
Polluting emissions

Greenhouse gases
Polluting emissions
Food and Packaging waste

OUTPUT
Available data on global warming and on energy specifically used to produce food differ depending on the setting being investigated.

The different estimates depend on the relative importance of the various energy sources.

- In Sweden: EN 46.6%; Eldro 46.8%

- In Italy:
An indicator of the unsustainability of the contemporary food system is the Sustainability Index (SI)*

1910 (pre-industrial societies) SI = 1
1970 SI = 10
Today SI >100

e.g.: salad imported in UK by plane from USA: SI » 127
Asparagus importated from Chile: SI » 97
Carrots imported from South Africa SI » 66
(Church, 2005)

*SI= Energy required to produce the food / Energy content of the food
Food miles is another indicator that is being increasingly adopted in UK (several supermarkets – Tesco, Marks & Spencer, Sainsbury’s – provide labels for their products) and Carbon footprint labels (e.g., Km0) are being taken to the attention of Italian mass-media.

The transport of food is only one of the factors that determine its global environmental impact.

How the food is produced and using what kind of energy should be taken into account.
Life Cycle Assessment LCA

A better strategy would be to examine the whole life cycle of the food products by means of a Life-Cycle Assessment (LCA) of the food supply chain, rather than considering only Food Miles.

**LCA allows to:**

evaluate and optimize the environmental impact of a product / process / activity along its whole life cycle, from production of the raw material and ingredients to transformation, distribution, consumption and disposal of the residuals, including all movements.
In Italy, the agro-industry is responsible for about 18% of the total emission of greenhouse gases (details below)

Source ISMEA 2009, Rapporto Agricarbon

<table>
<thead>
<tr>
<th>Agro-industrial chain</th>
<th>Mt CO2 eq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (fertilizers, plowing, use of water, etc.)</td>
<td>47.1</td>
</tr>
<tr>
<td>Enteric fermentation (methane* from animal breeding)</td>
<td>11.6</td>
</tr>
<tr>
<td>Solid and liquid waste (Nitrous oxide** and Ammonia )</td>
<td>6.9</td>
</tr>
<tr>
<td>Industrial processing</td>
<td>5.5</td>
</tr>
<tr>
<td>Packaging</td>
<td>13.1</td>
</tr>
<tr>
<td>Transport</td>
<td>19.8</td>
</tr>
<tr>
<td>**Total ***</td>
<td><strong>104.00</strong></td>
</tr>
</tbody>
</table>

* Methane has a greenhouse effect 20 times that of CO2  
** Nitrous oxide has a greenhouse effect 300 times that of CO2  
*** An estimate of the contributions of consumption modalities and food waste during distribution is still missing.
Global Environmental Changes (GEC)

Human induced global environmental changes (GEC)

Intrinsic vulnerability of ecosystems

Vulnerability induced by the impact of GEC

Climate, Environment and territory
Economy
Social structures
Human health

Climate change is one of the most critical factors, in terms of speed and intensity, underlying the observed processes.
Map 1.5 Aridity zones

Source: CRU/UEA, UNEP/GRID

Approximate equatorial scale 1:104 million
Scenarios for the Mediterranean

- Increase of temperatures
- Increase of extreme events
- Increase of evaporation
- Seasonal variation of precipitation and reduction in some areas
- Unpredictable changes, beyond our experience
Climate change + Human activities

- Desertification
- Agricultural crisis
- Hydrogeologic instability
- Coastal areas at risk
- Loss of biodiversity
- Health
Mitigation and Adaptation for Agriculture and Food Security

Theme issues around agriculture and climate change

**Impacts**

- Climate change
- Agriculture and forestry
- Net greenhouse gas
- Food security
- Land use change
- Water
- Biodiversity

**Adaptation**

- Aim at reducing risks and damage

**Mitigation**

- Use scarce resources more efficiently

**Act both on natural systems and on human activities to make ecosystems “climate proof”**
There is no universal recipe that is valid for all problems, but we have some general guidelines. Among these:

- **Optimizing the use of agricultural inputs** (Precision farming, Conservative farming, Organic farming, etc.);

- Using waste, residuals and sub-products along all the food chain to recover energy, chemicals and nutraceuticals;

- **Innovating industrial processing and packaging**;

- Improving intermodal logistics for the transport of agro-industrial products;

- **Promoting the adoption of Mediterranean diet**, as example of sustainable food production.
Life Cycle Energy Input (LCEI) and Global Warming Potential (GWP) of several food items

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fillet of beef, cooked</td>
<td>FBC</td>
</tr>
<tr>
<td>Fresh cheese (Mozzarella)</td>
<td>FCM</td>
</tr>
<tr>
<td>Ripened cheese (Grana)</td>
<td>RCG</td>
</tr>
<tr>
<td>Tuna in oil, drained</td>
<td>TOD</td>
</tr>
<tr>
<td>Pork steak, cooked</td>
<td>PSC</td>
</tr>
<tr>
<td>Butter</td>
<td>B</td>
</tr>
<tr>
<td>Roast chicken, skinless</td>
<td>RCS</td>
</tr>
<tr>
<td>Roast potatoes</td>
<td>RP</td>
</tr>
<tr>
<td>Olive oil</td>
<td>OO</td>
</tr>
<tr>
<td>2-4 biscuits (Shortbread)</td>
<td>BS</td>
</tr>
<tr>
<td>Eggs</td>
<td>E</td>
</tr>
<tr>
<td>Margarine</td>
<td>M</td>
</tr>
<tr>
<td>Whole milk yogurt</td>
<td>WMY</td>
</tr>
<tr>
<td>Fresh legumes (Frozen peas)</td>
<td>FLFP</td>
</tr>
<tr>
<td>Bread</td>
<td>B</td>
</tr>
<tr>
<td>Pasta</td>
<td>PAS</td>
</tr>
<tr>
<td>Fruit or fruit juice (Orange)</td>
<td>F/FJO</td>
</tr>
<tr>
<td>Vegetables (Tomatoes, lettuce)</td>
<td>VTL</td>
</tr>
<tr>
<td>Semi-skimmed milk</td>
<td>SSM</td>
</tr>
<tr>
<td>Dried legumes (Peas)</td>
<td>DLP</td>
</tr>
</tbody>
</table>

Graph showing LCEI (MJ/Kg) and GWP (KgCO2e/Kg) for various food items.

LCAfood.dk
Mediterranean diet: the double pyramid

Food Guide Pyramid
A Guide to Daily Food Choices

- Fats, Oils, & Sweets
  USE SPARINGLY
  KEY: Fat (naturally occurring and added), Sugar (added)
  These symbols show fat and added sugars in foods.

- Milk, Yogurt, Cheese, Group
  2-3 SERVINGS
- Vegetable Group
  3-5 SERVINGS

- Meat, Poultry, Fish, Dry Beans, Eggs, Nuts Group
  2-3 SERVINGS
- Fruit Group
  2-4 SERVINGS
- Bread, Cereal, Rice, Pasta Group
  6-11 SERVINGS

Source: U.S. Department of Agriculture/U.S. Department of Health and Human Services

Suggested consumption
Environmental impact
Enea has competences, laboratories and facilities that are available to enterprises for activities of industrial research and precompetitive development on these themes.
Thank you