


# Sustainable Agricultural Innovation Systems (SAIS) for Food Security and Green Economies

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# World Economic and Social Survey (WESS) 2011: The Great Green Technological Transformation

**Chapter I: Why a green technological transformation is needed**

**Chapter II: The clean energy technological transformation**

**Chapter III: Towards a truly green revolution for food security**

**Chapter IV: Reducing human harm from natural hazards**

**Chapter V: National policies for green development**

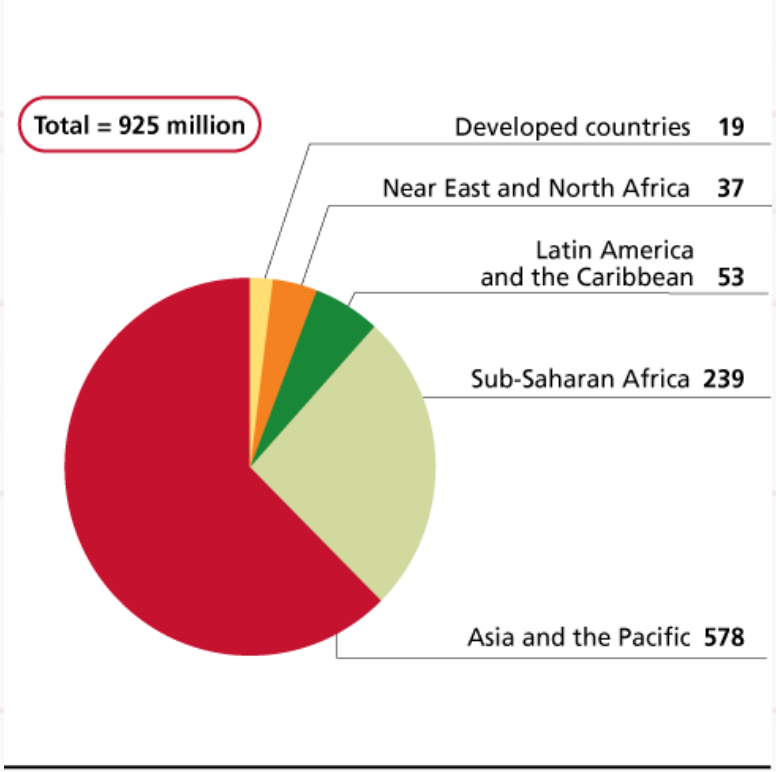
**Chapter VI: Building a global technology development and sharing regime**

# Famine and food insecurity in recent years

- Famine in the Horn of Africa was produced by a combination of factors:
  - Military conflict in Somalia
  - Exceptional conditions of drought
  - Unprecedented increase in food prices in the region
- But unsustainable availability, access and utilization of food is becoming a major development concern

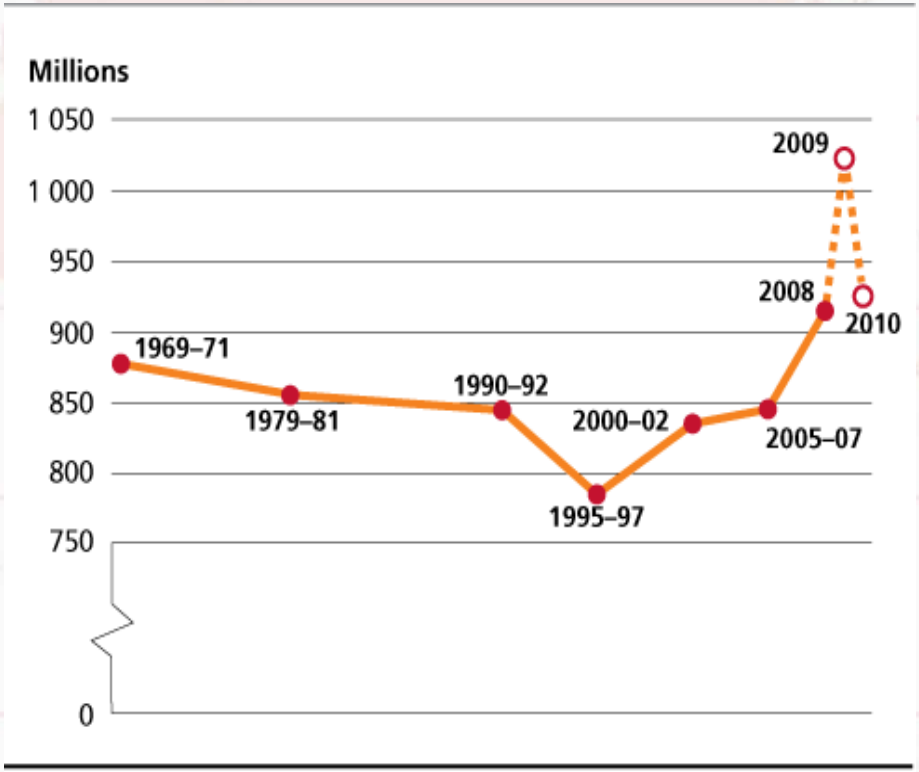
# Food insecurity by region

**Figure 1: Undernourishment in 2010 by region**




*Source:* FAO.

**Figure 2: Global undernourishment, 1969-2010 (millions)**




*Note:* Figures for 2009 and 2010 are estimated by FAO with input from the United States Department of Agriculture, Economic Research Service. Full details of the methodology are provided in the technical background notes (available at www.fao.org/publication/sofi/en/).

*Source:* FAO.

# Supply and demand factors

**Two overlapping crises:**

1. **supply-side** crisis of production
2. **demand-side** crisis: hike in food prices

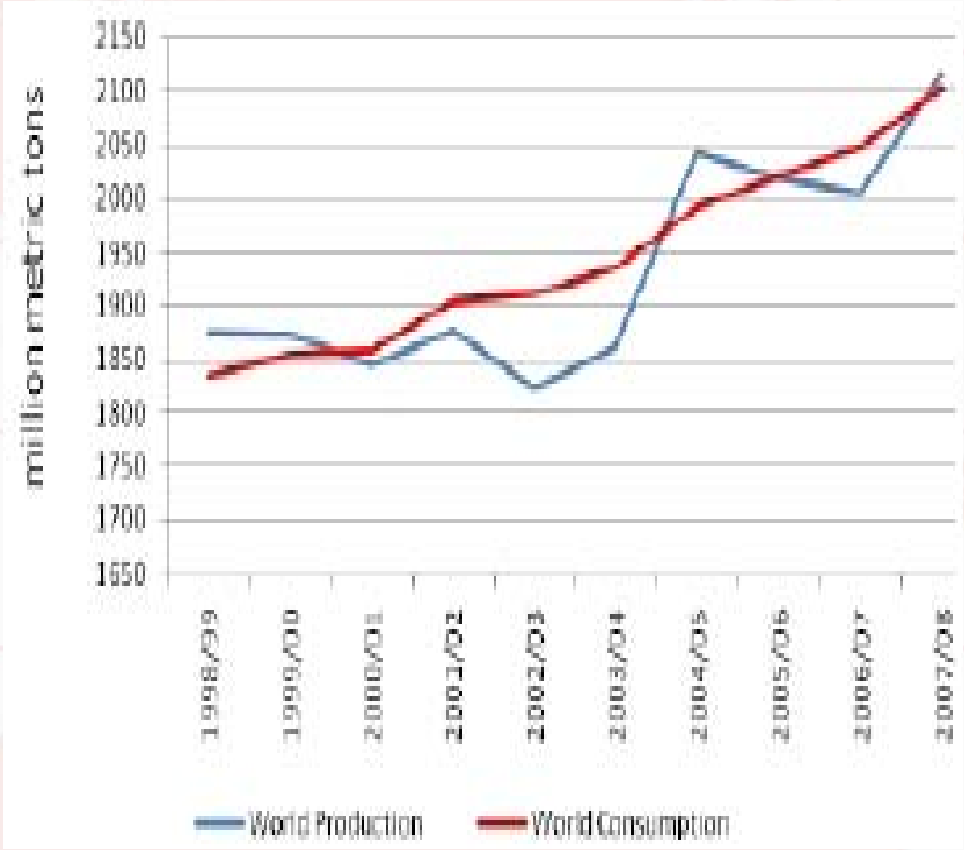
**Demand- side:**

- High oil/energy prices
- Financial speculation in commodities
- Policies (trade restrictions)
- World population growth
- Improvements in incomes
- Diversification of diets
- US $ depreciation

**Supply side:**

- Climatic conditions
- Biofuel demand
- Low stock level & food reserves
- Post-harvest losses
- Structural problems in production & investment

**Figure 3: World production & consumption of maize, wheat, rice, sorghum and barley**




**Source:** FAPRI (2008)

# Adverse climate change

While it is not possible to draw a direct link between the drought in the Horn of Africa and human-induced climate change, changing temperature, precipitation and climate variability has been estimated to produce large losses (40m combined tons for wheat, maize and barley).

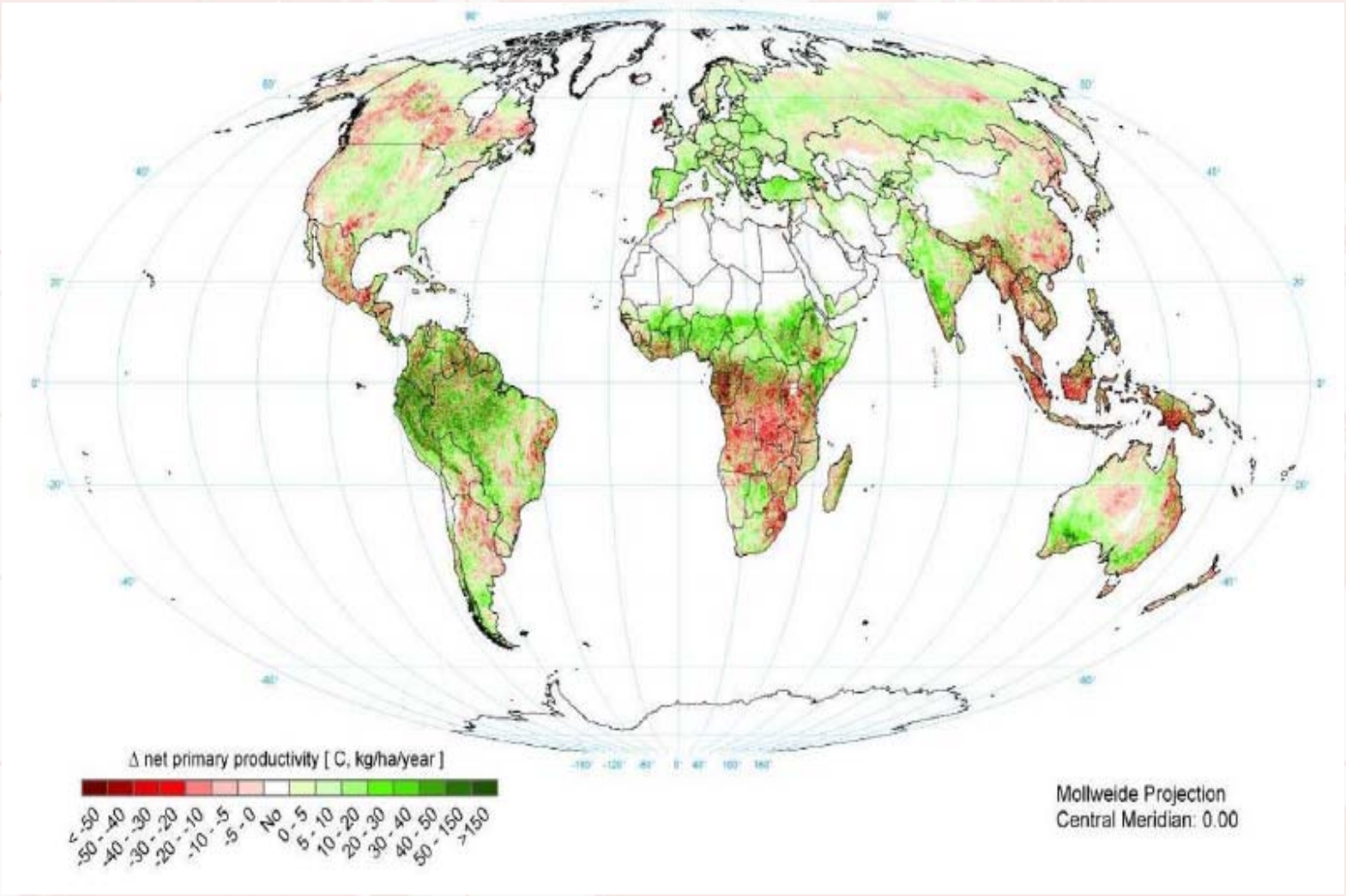
Impacts through:

- alters timing and length of growing seasons and yields
- exacerbates land degradation
- contributes to water scarcity

Impacts will vary by regions: agricultural productivity will

- increase at mid-high latitudes and
- decrease at lower latitudes (Southern Africa yields -50%)

## Figure 4: Global change in net primary productivity, 1981-2003




**Source:** Bai et al. (2008)

# What are the challenges?

- How to increase food production with sustainable agriculture
- Currently, agriculture is major emitter of GHGs
- Food production will need to increase by 70% in 2050; 100% in developing countries
- Increasing food production has to be compatible with green technology, sustainable agriculture (intensive agriculture to avoid expanding the agricultural frontier) and sustainable use of natural resources
- Great transformation in agriculture as part of greening of the economies – innovation and new technology

# GHG emissions & degradation of natural resources

**Land degradation, a threat to sustainable land use and food security**

➢ **Impacts**

Global **impacts** of land degradation can be classified in several ways:

- environmental system affected (e.g. climate, biodiversity, human development indicators)
- impact on ecosystem service (e.g food provision, water regulation, soil formation & retention)
- type of land degradation process (e.g. land erosion, deforestation, CO2 emission)
- production system/eco-region impacted on (e.g. rain-fed/irrigated land, rangelands & pasture, forests)
- type of management practice causing degradation (e.g. over-grazing, vegetation clearance, inappropriate tillage)

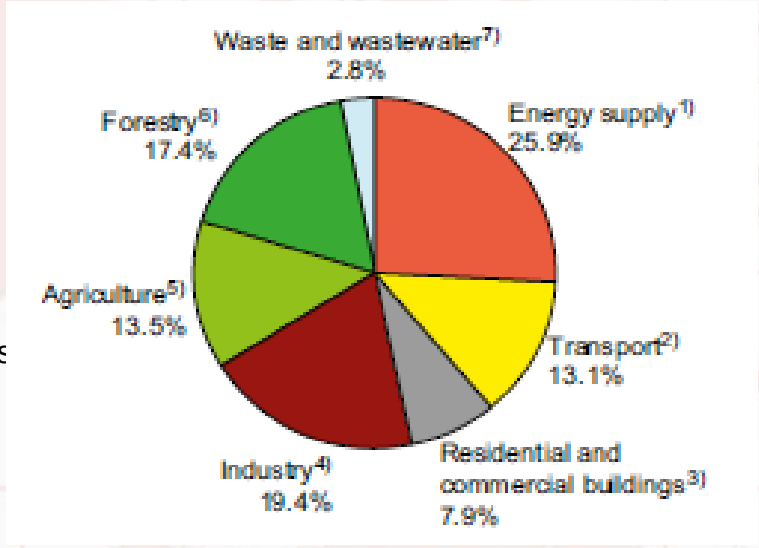
Consequences of land degradation include lower productivity; migration; food insecurity; resource & ecosystem damage; biodiversity loss

Land degradation has important implications for **climate change (CC)** Mitigation & adaptation by reducing the C sequestration capacity of land & affecting the quality of soil & its ability to hold water & nutrients, creating adverse local weather patterns

**Agriculture, forestry & land use change account for c. 30% of GHGs**
**LD costs an estimated US$40 billion annually worldwide**
(excluding costs of higher fertilizer use & loss of biodiversity & landscapes

Conversely, CC exacerbates LD through changes in precipitation patterns & > extreme meteorological events

**Figure 5: GHG emissions by sector**




Source: IPCC (2007)

➢ **Causes**

Accelerated LD is mainly caused by human intervention in the environment (poor land management, especially in agriculture – e.g. overgrazing; over-cultivation; water-logging & salinization of irrigated land; deforestation; pollution; industrialisation)

# Small scale farmers at the centre of concern

- Between 80-90 % of the food consumed in developing countries is locally produced
- Most food producers in developing countries are small scale farm-holders.
- Majority of extremely poor and half undernourished people live in 500 million farms in developing countries with less than 2 hectares of land (90% of farms worldwide)
- Poverty and liquidity constrains may create incentives for non-sustainable use of resources. Higher land and food prices may exert additional pressure on poor farmers to migrate to lower quality lands

# Food security, poverty reduction & growth

- Small-scale diversified farming still has higher yields and environmental protection

- In countries with large agricultural sectors: 20-40% of GDP in SSA, staples have larger multiplier effects on the rest of the economy than export crops (8% growth of staples in Zambia for 1% GDP growth. Export growth needs to be 23%)

- Food security, poverty reduction, and environmental sustainability largely depends on removing the barriers faced by small scale farmers to expand their productive capacity

# Large portfolio of available technology

➢ **Technologies for sustainable agriculture**

♦ **Traditional technologies**

Agro-ecological approaches often increase productivity; ensure sustainability (> efficient water use, improved soil quality, & pest/weed control with little/no chemical pesticides); reduce rural poverty & improve rural livelihoods.

**E.g.** low-till farming, crop rotation & diversification, water harvesting & recycling, integrated pest management, agroforestry

⇒ Larger share of research budget should be spent on further advancing these approaches.

♦ **Green Revolution technologies**

Conventional research approach underlying GR successful in increasing yields & thus enhancing food supplies, food security & poverty reduction; but approach has led to ecological stress in some cases.

**E.g.** high yield crop varieties, irrigation, fertilisers

⇒ Such research should continue to play a major role in efforts to ensure food security.

♦ **New technologies**

Modern technologies can significantly help poor farmers & consumers.

**E.g.** biotechnology, genetic engineering, ICT, food irradiation, urban agriculture (hydroponics, permaculture), anaerobic digestion

⇒ New incentives for private sector & expanded public investment needed to develop technology needed by the poor. Developed countries should facilitate access to appropriate technology via trade, property rights & aid policies.

⇒ **The problem is how to take technology and innovation to address context specific needs to increase productivity with environmental sustainability. For food security, present and future, the question is innovation and technology relevant to small scale farmers**

# Success stories of technological innovation for sustainable agriculture

Thousands of experiences of successful innovation, most of them part of survival strategies in response to soil depletion, water scarcity, HIV/AIDS, catastrophic events, among others

Large experience among women in the management of forestry, biodiversity and traditional knowledge for sustainable agriculture difficult to bring to scale because of poor access to land, credit, inputs, markets

Some examples of large scale innovations include:

- **Integrated Pest Management**
- **System for Rice Intensification**
- **Farm Field School Approach**
- **Watershed development in India**

Their success due to a number of factors:

- **Direct involvement of farmers in learning and innovation to adapt knowledge, technology and management practices to local level**
- **Active participation of various actors (governments, NGOs, multilaterals and donors) to scale up innovation, disseminate knowledge, capacity building, build trust and reduce risk**
- **Institutional reform to adjust the norms, values and rules of agric. R&D institutions, behavior of farmers and redefine the role of women**

# Sustainable Agriculture Innovation Systems (SAIS)

- **Most experiences of successful innovation in response to degradation of natural resources and food insecurity bypassed the traditional National Agricultural Research Systems**

**Agricultural Innovation System (AIS)**

**Network of economic and non-economic actors and the linkages amongst them to enable technological, organizational and social learning of the kind needed to devise context-specific solutions (UNCTAD):**

**major agents (e.g. universities, firms & other organizations) assimilate & adapt knowledge to local needs & create new technology & products**

**Recognizes that many types of innovation — related to technology, new organizations & partnerships, processes, products & marketing — can take place at any time in different places within overall system**

**Stresses role of connecting institutions & actors across whole food system – support research, extension, & education in coordinated way & foster innovation partnerships & links along & beyond agric. value chains**

**Participatory; experimental; technology-driven; knowledge-based; monitored & evaluated; flexible design**

# National strategies for education, science & technology

- ⇒ **Rebuild (in some countries build) national capacities in agric. R&D: public good – adequate and sustainable public financial support:**
  - ⇒ In crops and processes relevant to the poor
  - ⇒ Multi-disciplinary (soil, water, nutrition, socio-economic conditions)
  - ⇒ Responsive to women's special needs and with direct participation of women scientists
- ⇒ **Technical support and extension services**
  - ⇒ Restore role of public extension services
  - ⇒ Sensitive to needs of different local contexts
  - ⇒ Direct participation of farmers
  - ⇒ Gender sensitive in content and delivery format
- ⇒ **Basic education and peer learning**
  - ⇒ Extension of basic education to rural areas (quality and relevance)
  - ⇒ Expand access to informal learning (adult education)
  - ⇒ Farmer-to-farmer learning
  - ⇒ Greater access to ICT
  - ⇒ Gender sensitive in content and delivery format