Sustainable Agriculture, Food Security and the Global Food System

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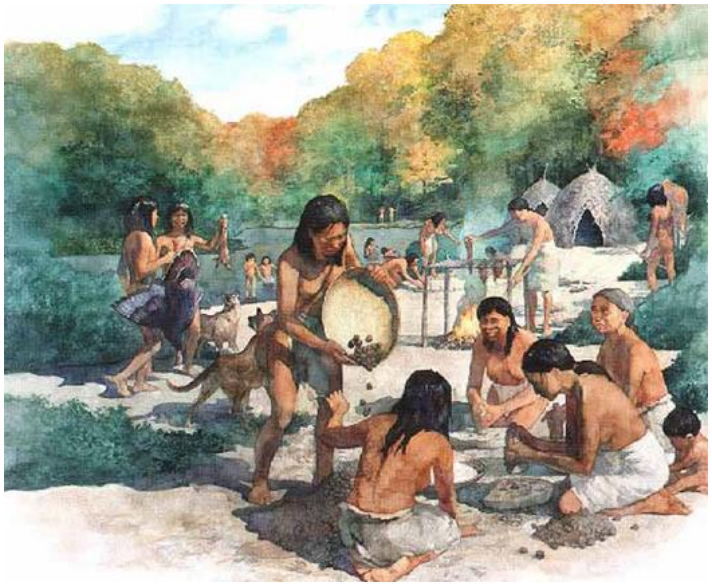
Outline

- History of the Global Food System
- Sustainable Development Goals
- Major Structural Transformations
- Value Chain Approach
- Healthy Diets from Sustainable Agriculture
- Discussion: Colombia in 2030

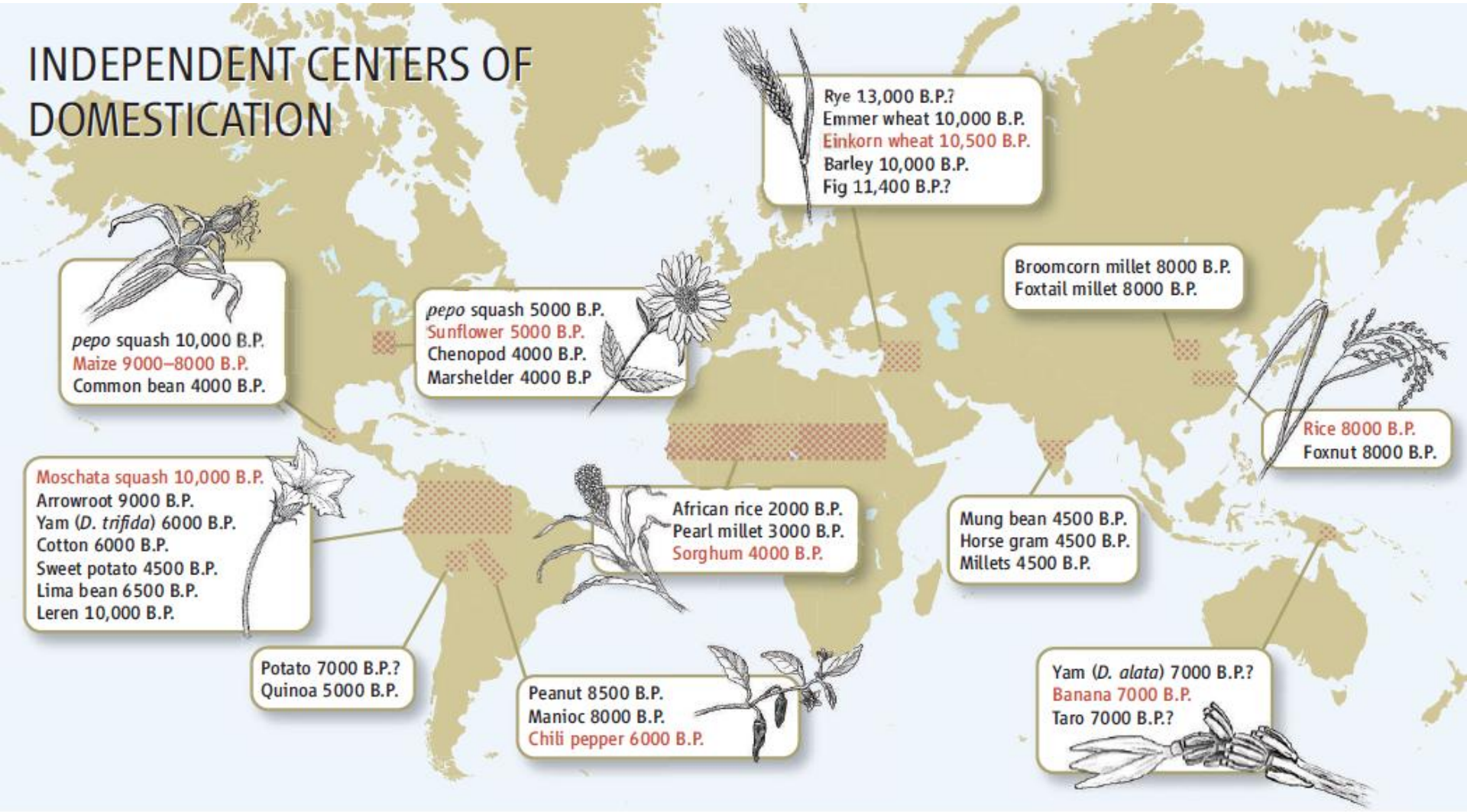
A Short History of the Global Food System



12,000 BP

2015

Domestication – adapting plants (and animals) to human cultivation – led to greater control over the food system



Multiple birth. People in many different parts of the world independently began to cultivate and eventually domesticate plants.

Balter (2007)
Science **316**: 1830-35

Subsistence agriculture

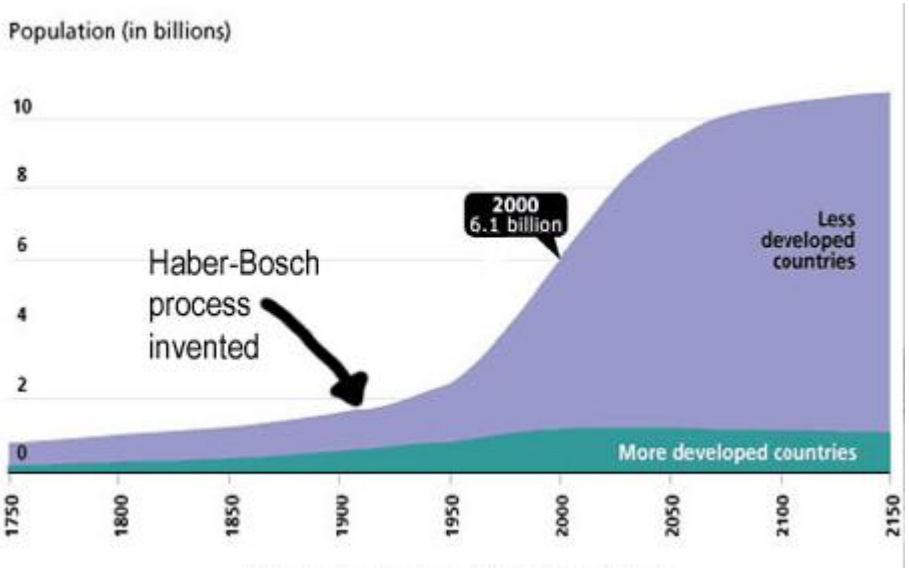
Market-oriented smallholder production

"The power of population is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race…….gigantic inevitable famine stalks …and with one mighty blow levels the population with the food of the world".
—Malthus T.R. 1798. *An essay on the principle of population*. Chapter VII, p61

A field of Broadbalk wheat crop at Rothamsted Research in Harpenden, England.
Photograph: Rothamsted Research

Nitrogen Fertilizer

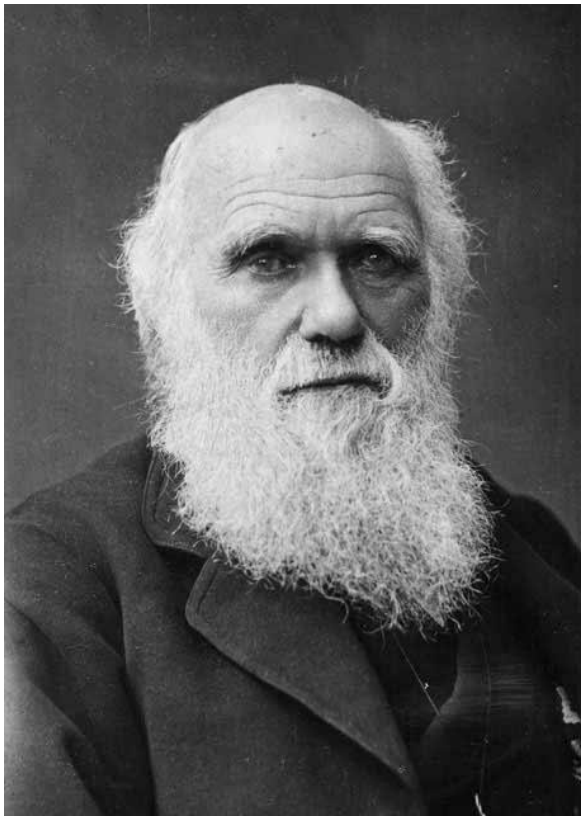
- Guano and Sodium Nitrate (*Chile* or *Peru Saltpeter*)
- **Haber-Bosch process**: N_2 (g) + 3 H_2 (g) $\rightleftharpoons$ NH_3 (g)
- N_2 from atmosphere; H_2 from natural gas
- Various formulations: **urea** (45% N) and ammonium nitrate (34.5% N) are most common



Corn response to nitrogen

Gregor Mendel (1822-1884)

- **Heredity**
- **Genetics**

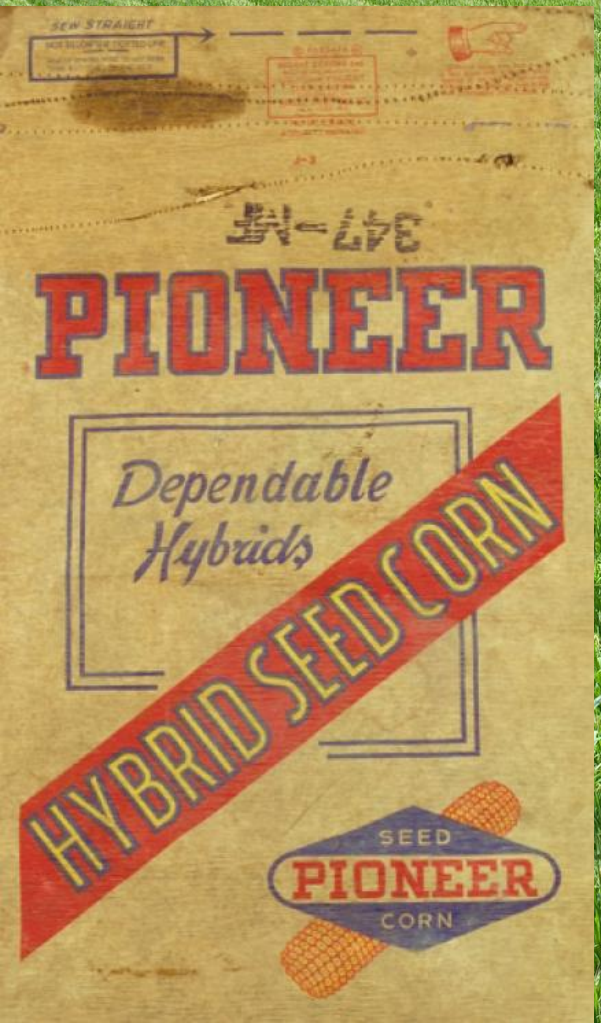


Charles Darwin (1809-1882)

- **Diversity**
- **Inheritance**
- **Selection**
- **Accumulation over time**

“There is grandeur in this view of life,” he said, “from so simple a beginning, endless forms most beautiful and most wonderful have been and are being evolved.” Origin of the Species (1859)

Hybrid Corn/Maize



What about the Tropics?

Extensification

Intensification

International Rice Research Institute

CIMMYT

INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER

Celebrating 100 Years of

DR. NORMAN BORLAUG

25-28 March 2014

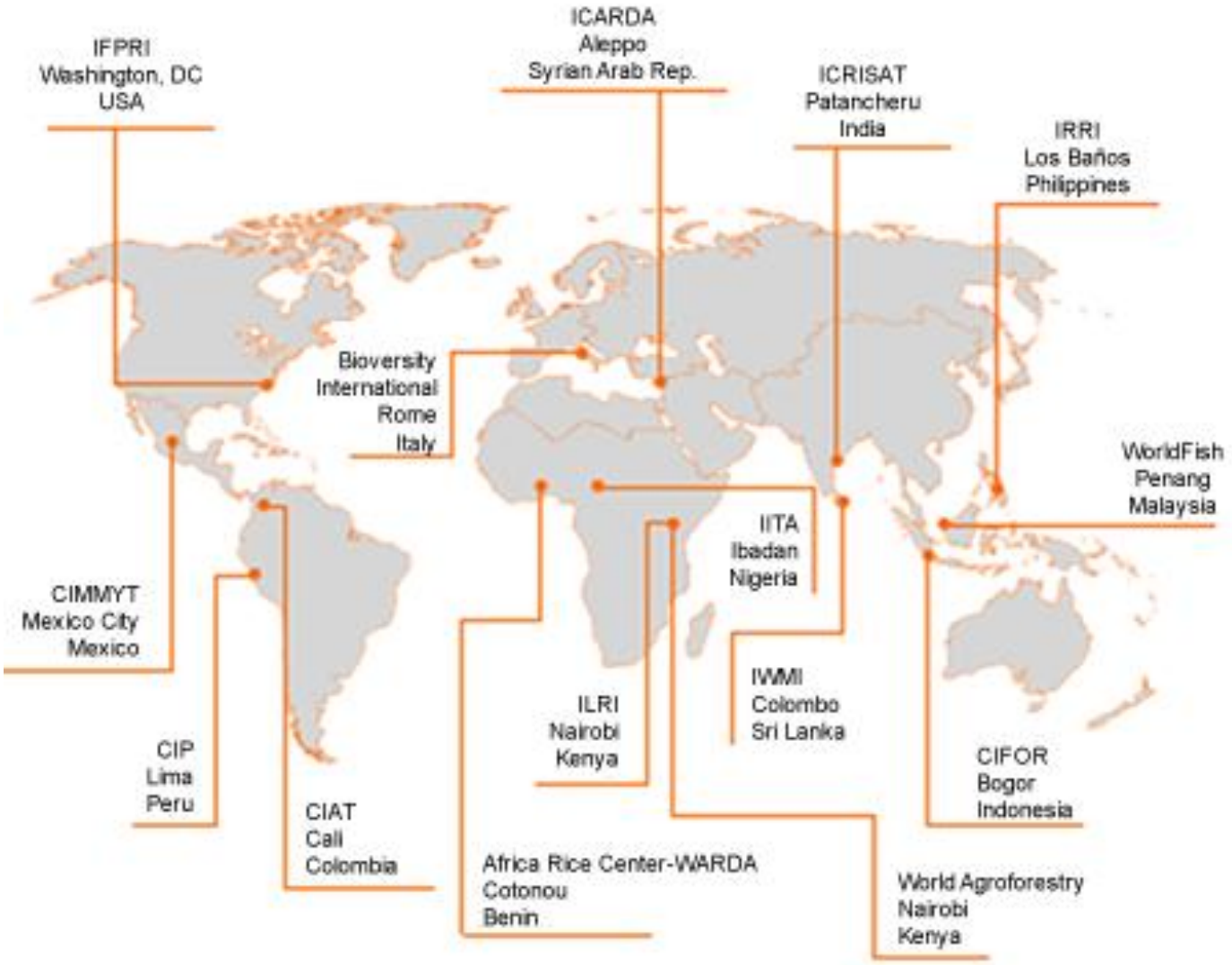
Cd. Obregón, Sonora, Mexico

CIAT

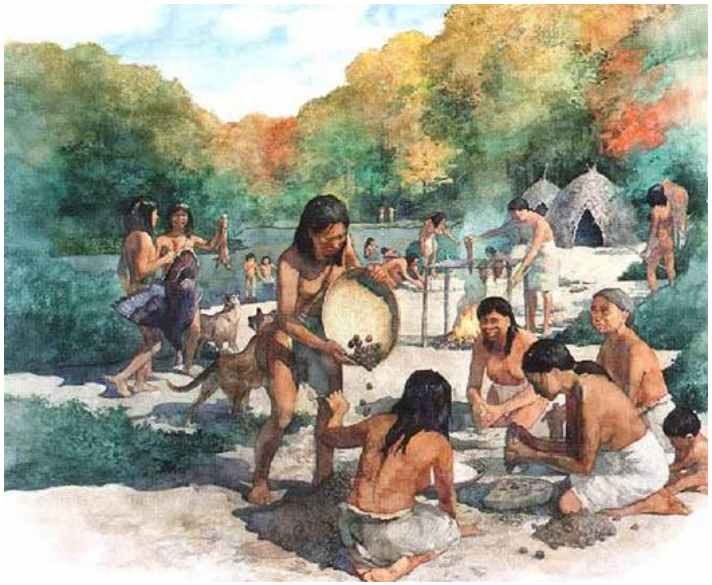
International Center for Tropical Agriculture

Since 1967 ***Science to cultivate change***

CGIAR


IFPRI
Washington, DC
USA
ICARDA
Aleppo
Syrian Arab Rep.
ICRISAT
Patancheru
India
IRRI
Los Baños
Philippines
Bioversity
International
Rome
Italy
WorldFish
Penang
Malaysia
IITA
Ibadan
Nigeria
CIMMYT
Mexico City
Mexico
IWMI
Colombo
Sri Lanka
ILRI
Nairobi
Kenya
CIP
Lima
Peru
CIFOR
Bogor
Indonesia
CIAT
Cali
Colombia
Africa Rice Center-WARDA
Cotonou
Benin
World Agroforestry
Nairobi
Kenya

A Short History of the Global Food System



12,000 BP

2015


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

Target 1.C:
Halve, between 1990 and 2015, the proportion of people who suffer from hunger

MDG1

ERADICATE EXTREME POVERTY AND HUNGER

2 ZERO HUNGER

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

SDG 2 Targets

- By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round
- By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons
- By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment
- By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality
- By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed
- Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries
- Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round
- Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility


SUSTAINABLE DEVELOPMENT GOALS
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17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

Food and Agriculture Organization
of the United Nations

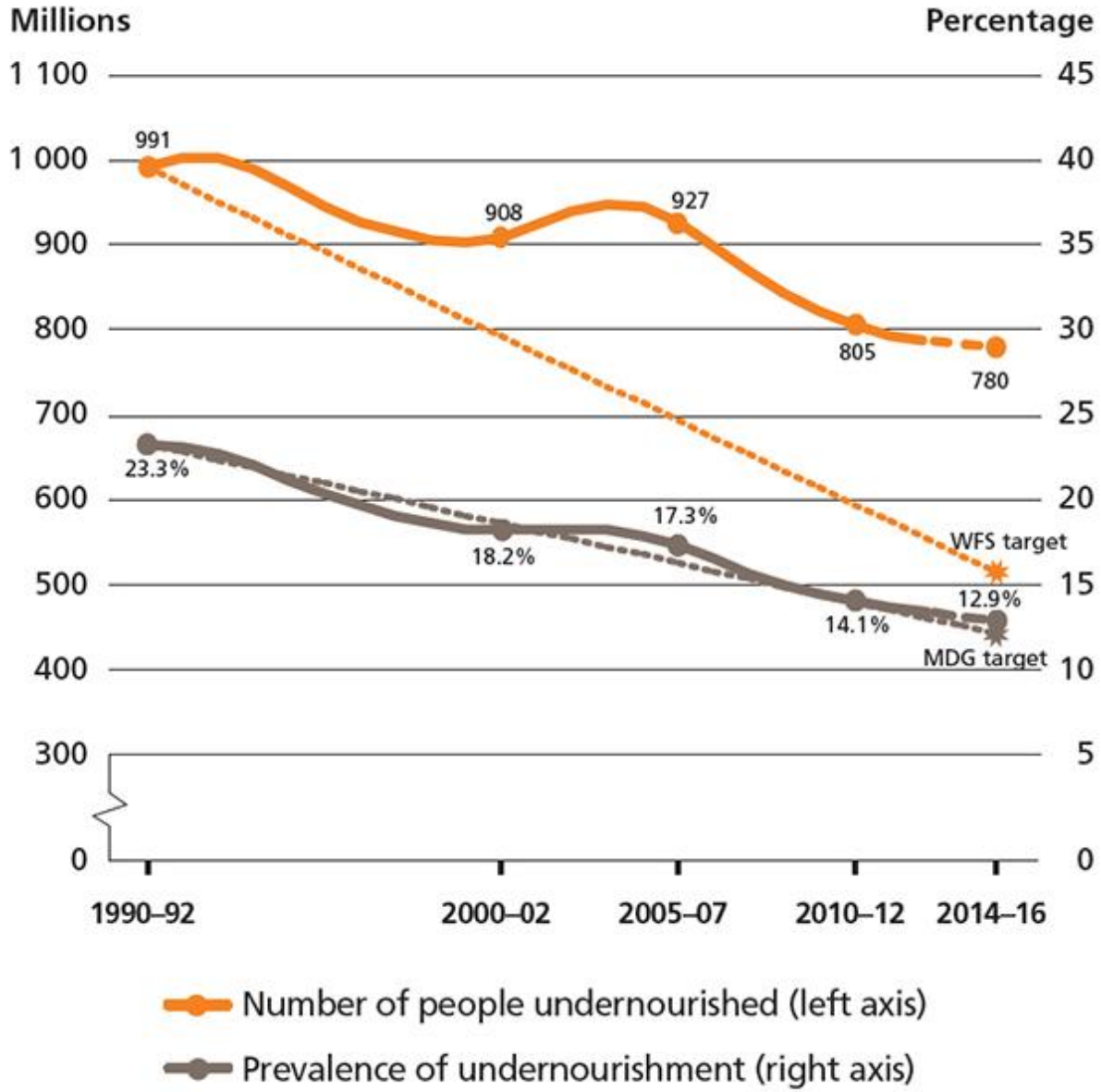
World hunger falls to under 800 million, eradication is next goal

72 countries have achieved the Millennium Development target of halving proportion of the chronically undernourished

A woman farmer in The Gambia shows a dry tuft of rice in a drought period.

27 May 2015, Rome - The number of hungry people in the world has dropped to 795 million – 216 million fewer than in 1990-92 – or around one person out of every nine, according to the latest edition of the annual UN hunger report (*The State of Food Insecurity in the World 2015* - SOFI).

In the developing regions, the prevalence of undernourishment - which measures the proportion of people who are unable to consume enough food for an active and healthy life – has declined to 12.9 percent of the population, down from 23.3 percent a quarter of a century ago reports SOFI 2015, published today by the Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP).

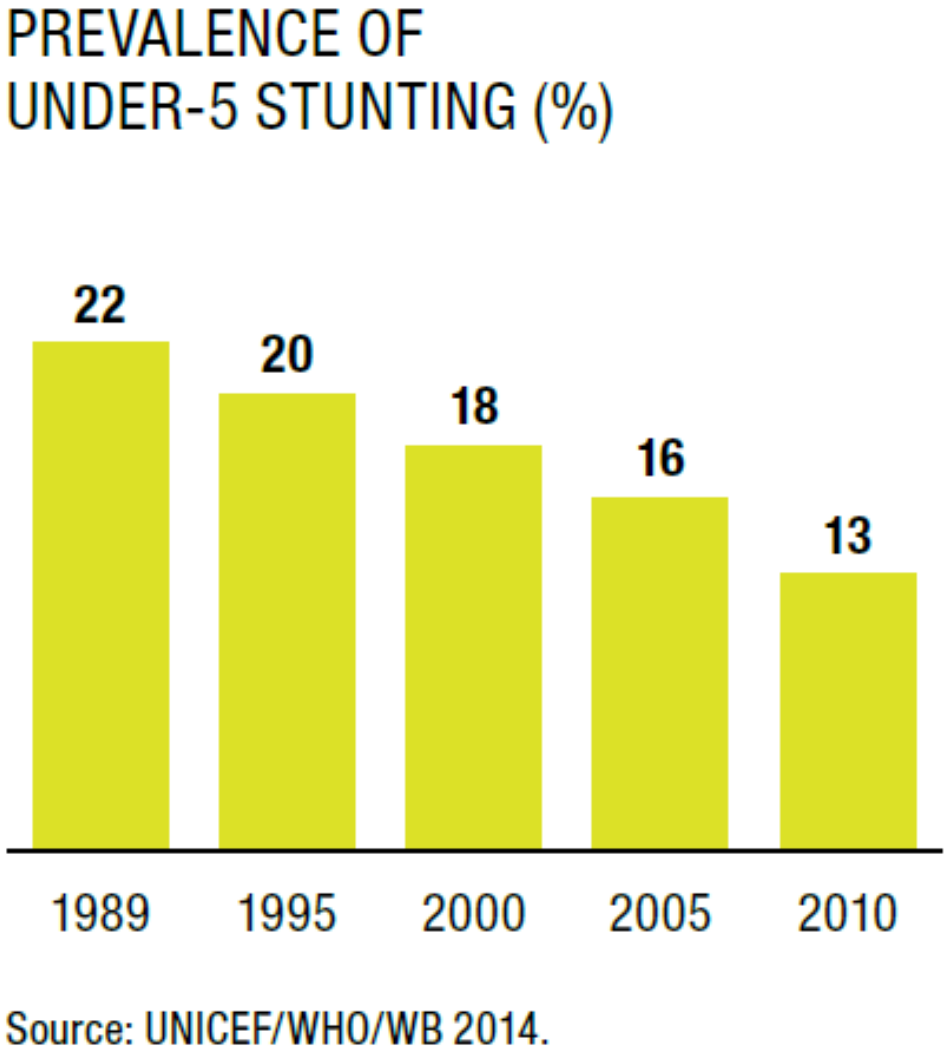


Note: Data for 2014–16 refer to provisional estimates
Source: FAO

Key Statistics and Direction

- About 795 million people are “hungry” (FAO)
- 2 billion people have micronutrient deficiencies (CDC)
- 159 million children are stunted (UNICEF)
- 3.1 million children (45% of all deaths under 5) die from malnutrition each year (90% in Asia and Africa) (Lancet)
- 1.9 billion adults are overweight (600 million are obese) (WHO)
- We “waste” 1/3 of food produced (FAO)

Undernutrition in Colombia



2.1 **by 2030 end hunger** and ensure access by all people, in particular the poor and people in vulnerable situations including infants, to safe, nutritious and sufficient food all year round

2.2 **by 2030 end all forms of malnutrition**, including achieving by 2025 the internationally agreed targets on stunting and wasting in children under five years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women, and older persons

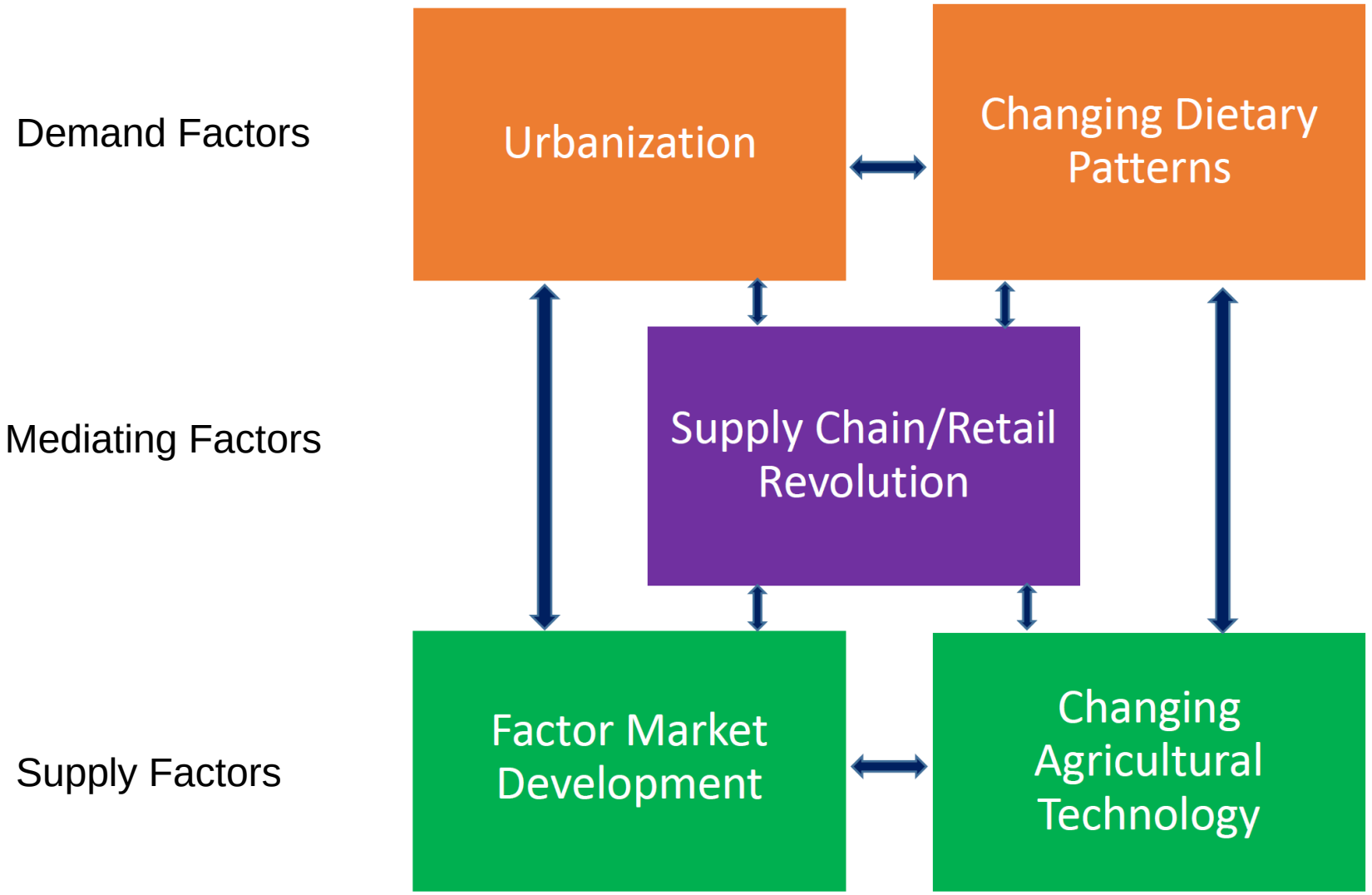
2 ZERO HUNGER

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

IT ALWAYS SEEMS IMPOSSIBLE UNTIL IT'S DONE.

-NELSON MANDELA

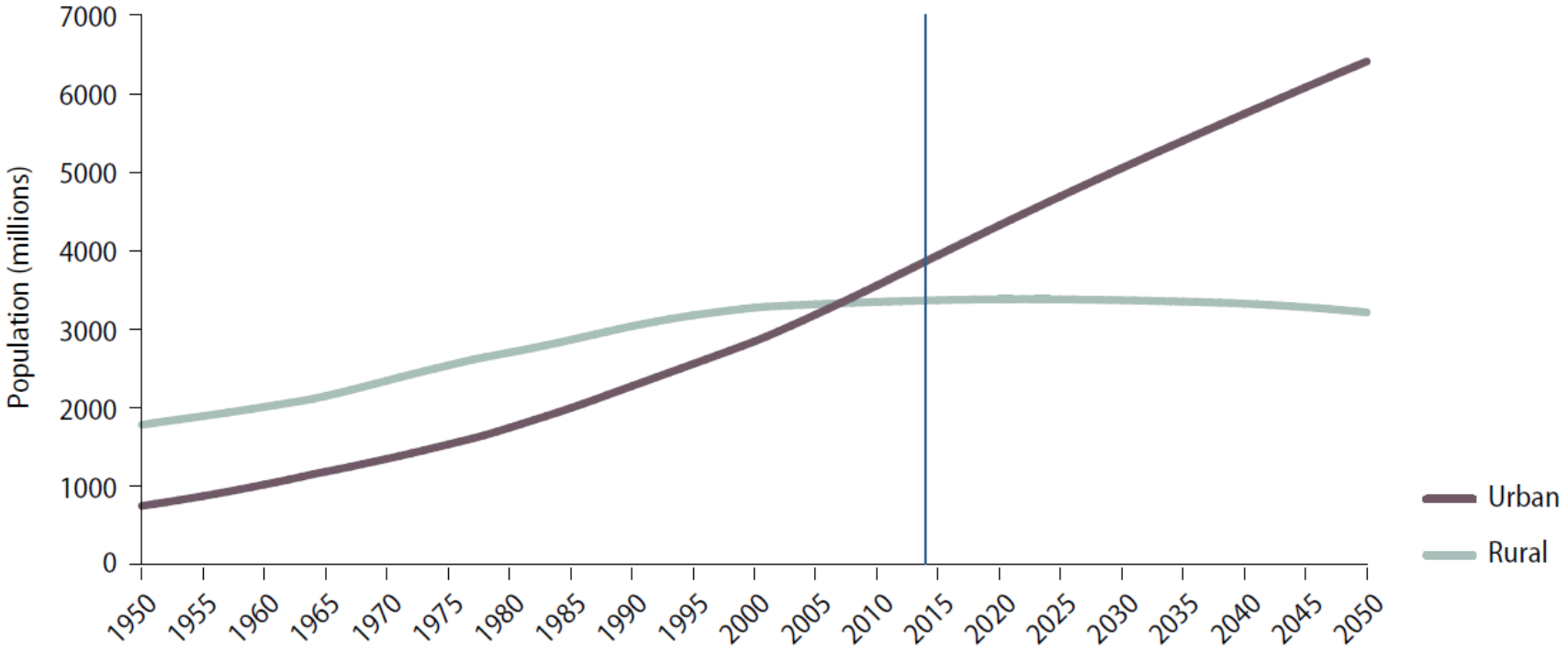

Major Transformations in
the Global Food System
PEPSI
PEPSI
Horlicks
MONACO
Dairy Milk



Five Interlinked Transformations of the Food System

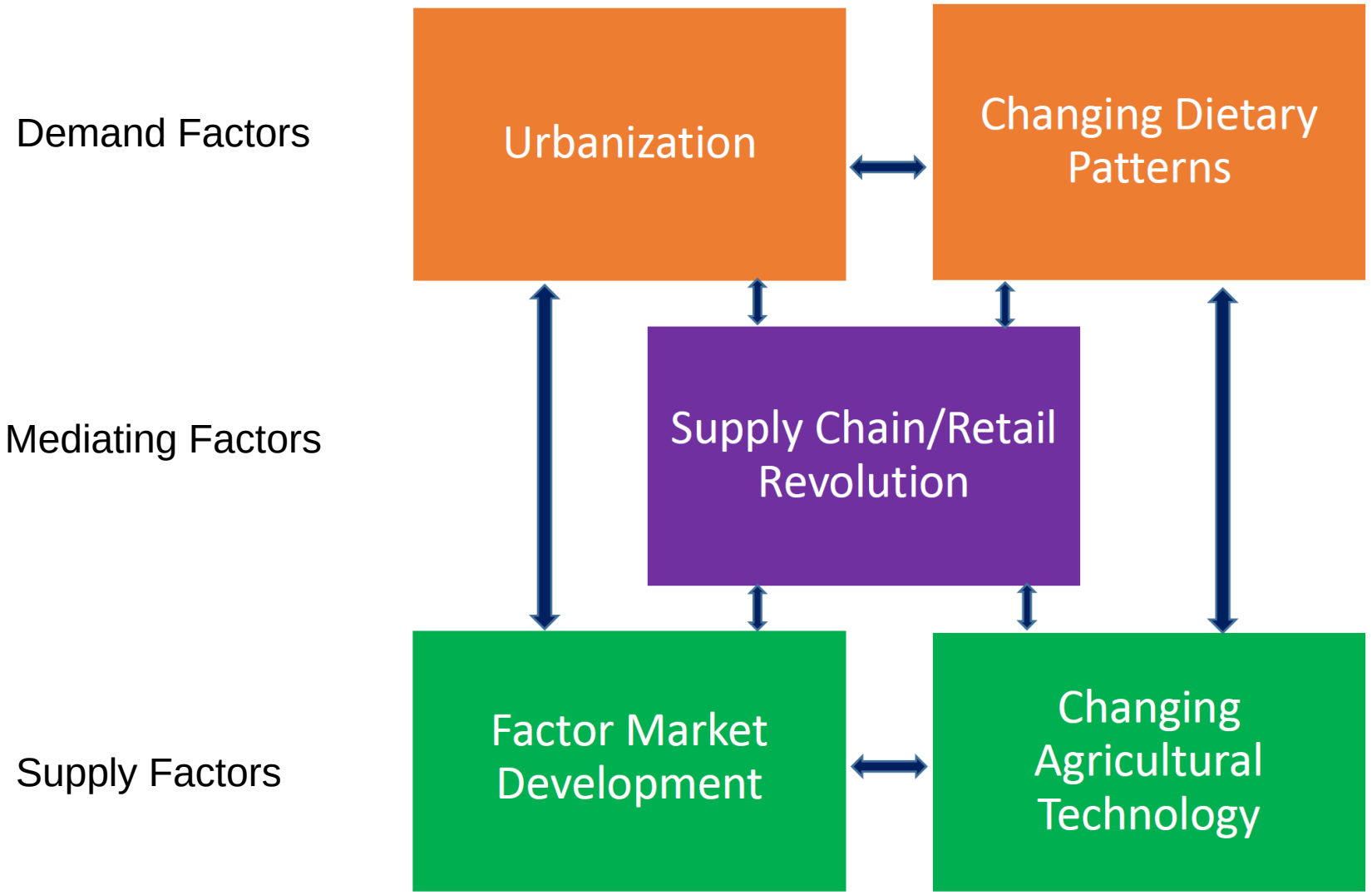
Adapted from Reardon,T.,Timmer,C.P., Five inter-linked transformations in the Asian agri-food economy: Food security implications. *Global Food Security* (2014), http://dx.doi.org/10.1016/j.gfs.2014.02.001i

Urban and rural population of the world, 1950–2050



United Nations, Department of Economic and Social Affairs, Population Division (2014).
World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352).

76% of Colombians now live in cities



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http://time.com/8515/hungry-planet-what-the-world-eats/

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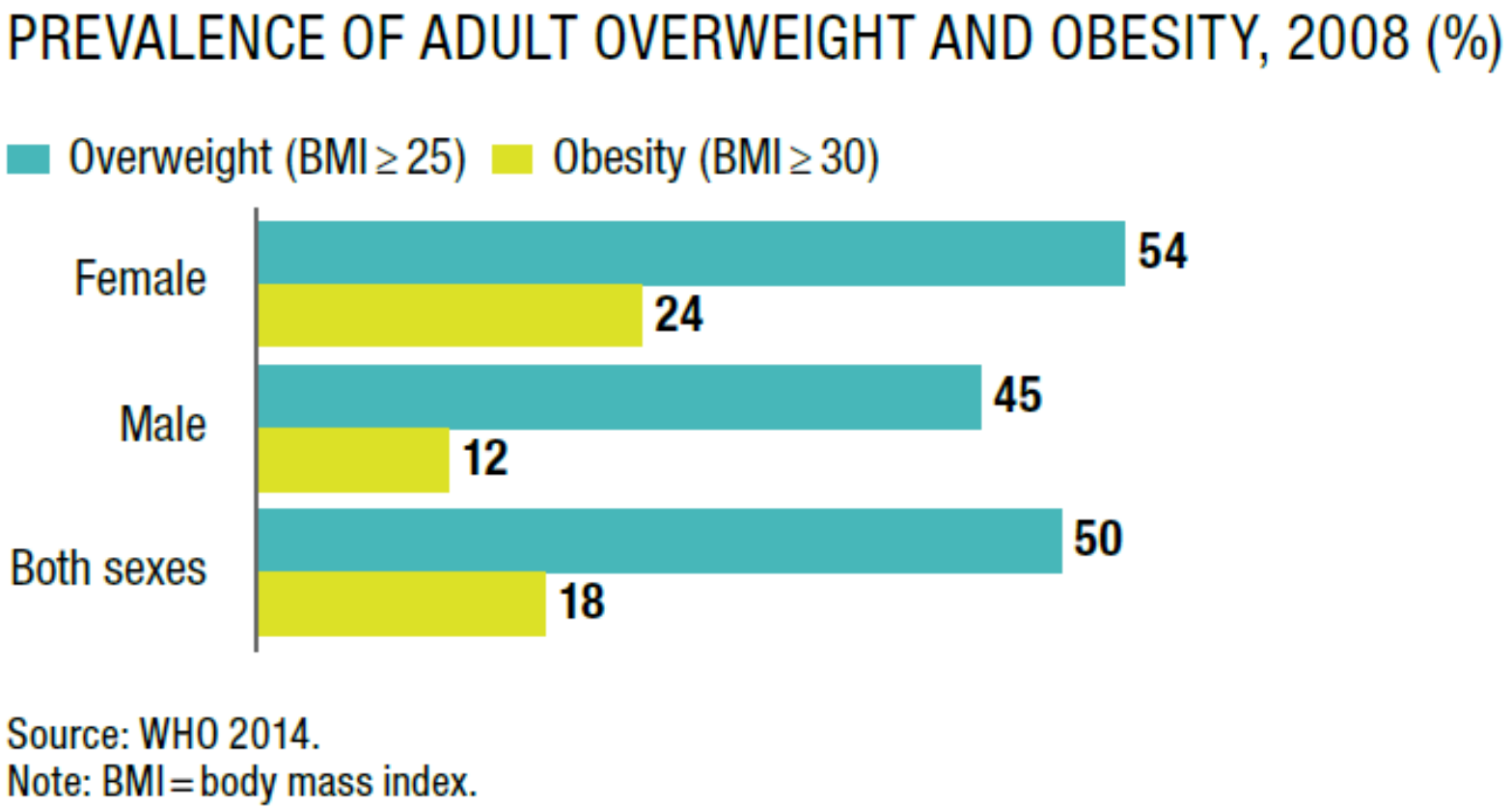
Some Colombian Dishes

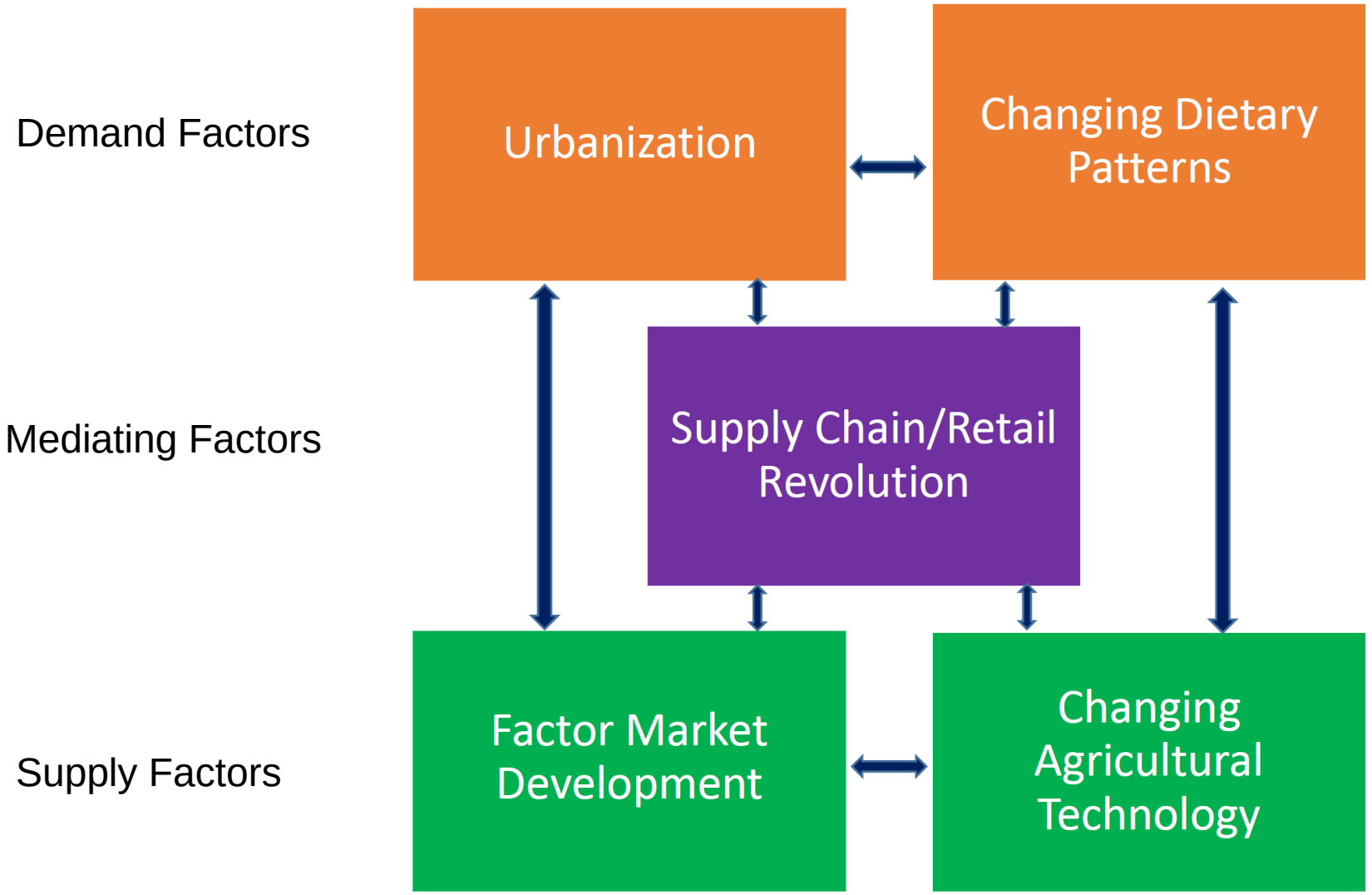
Some Colombia Statistics



3.4 By 2030, **reduce by one third premature mortality from non-communicable diseases through prevention and treatment** and promote mental health and well-being

3 GOOD HEALTH & WELL-BEING

Ensure healthy lives and promote well-being for all at all ages



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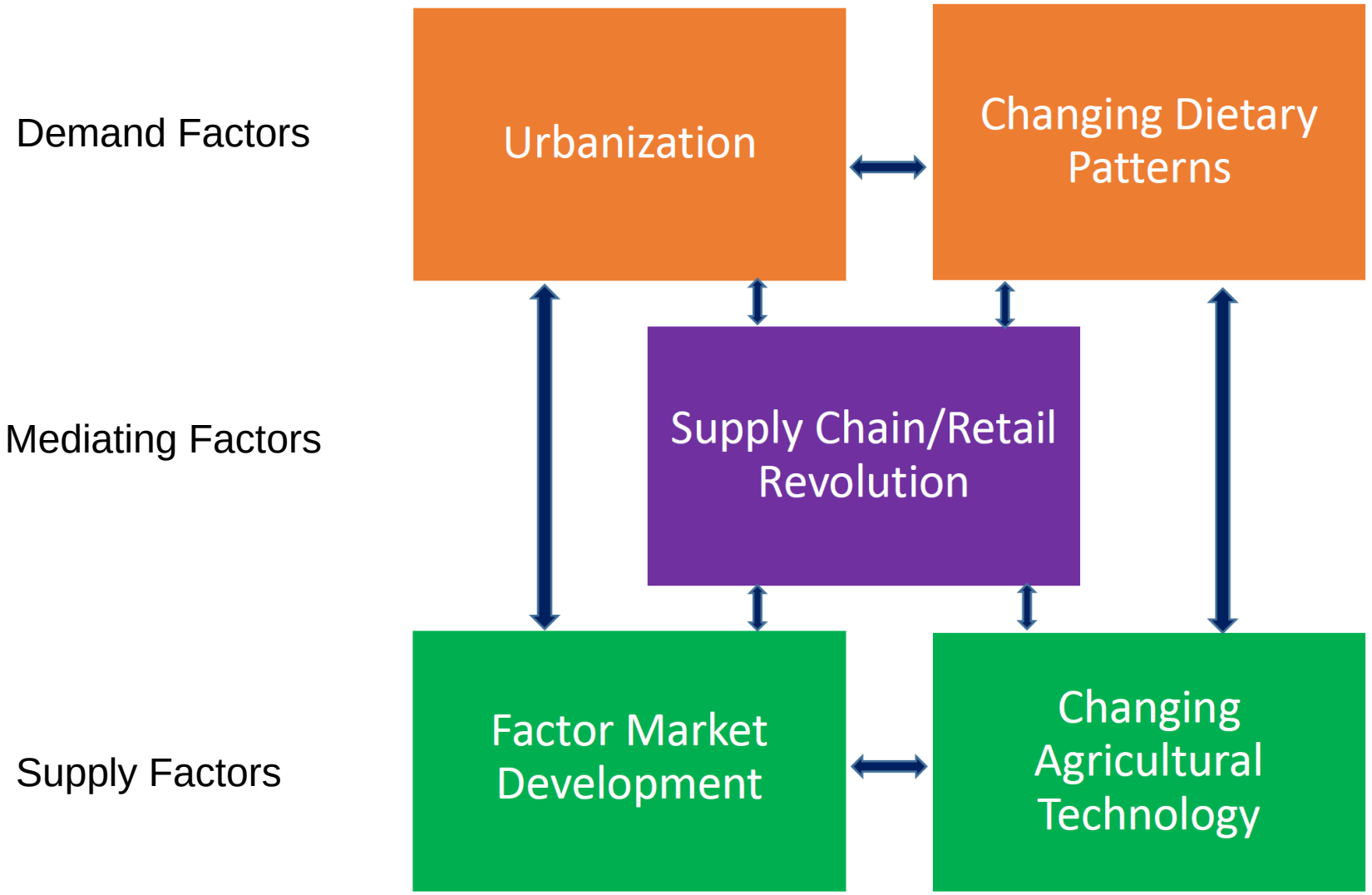
Growth of Supermarkets in Colombia



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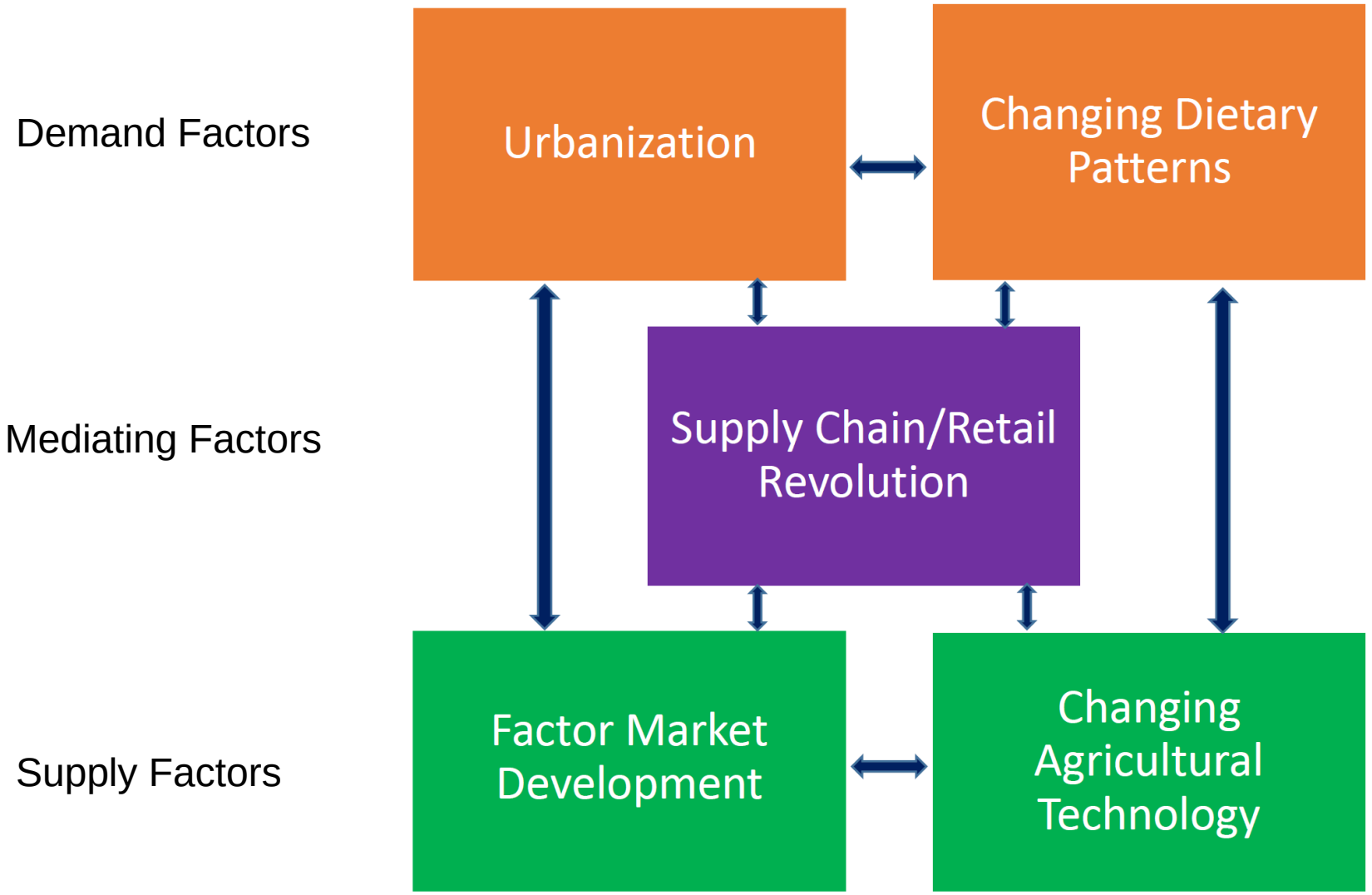
Aerial photo of the lands taken by Addax Bioenergy for its sugar cane plantation in Sierra Leone. (Photo: Le Temps)



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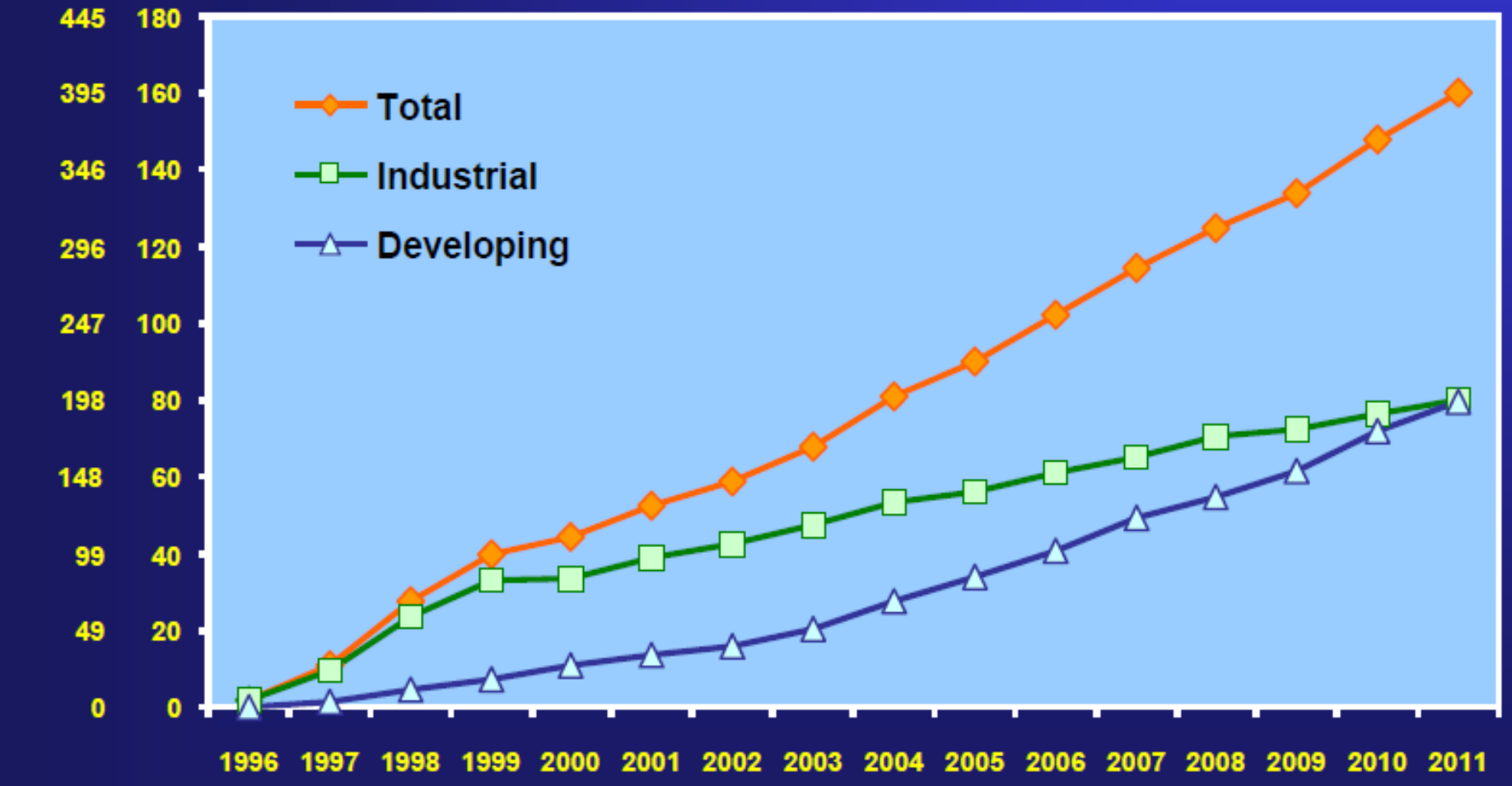
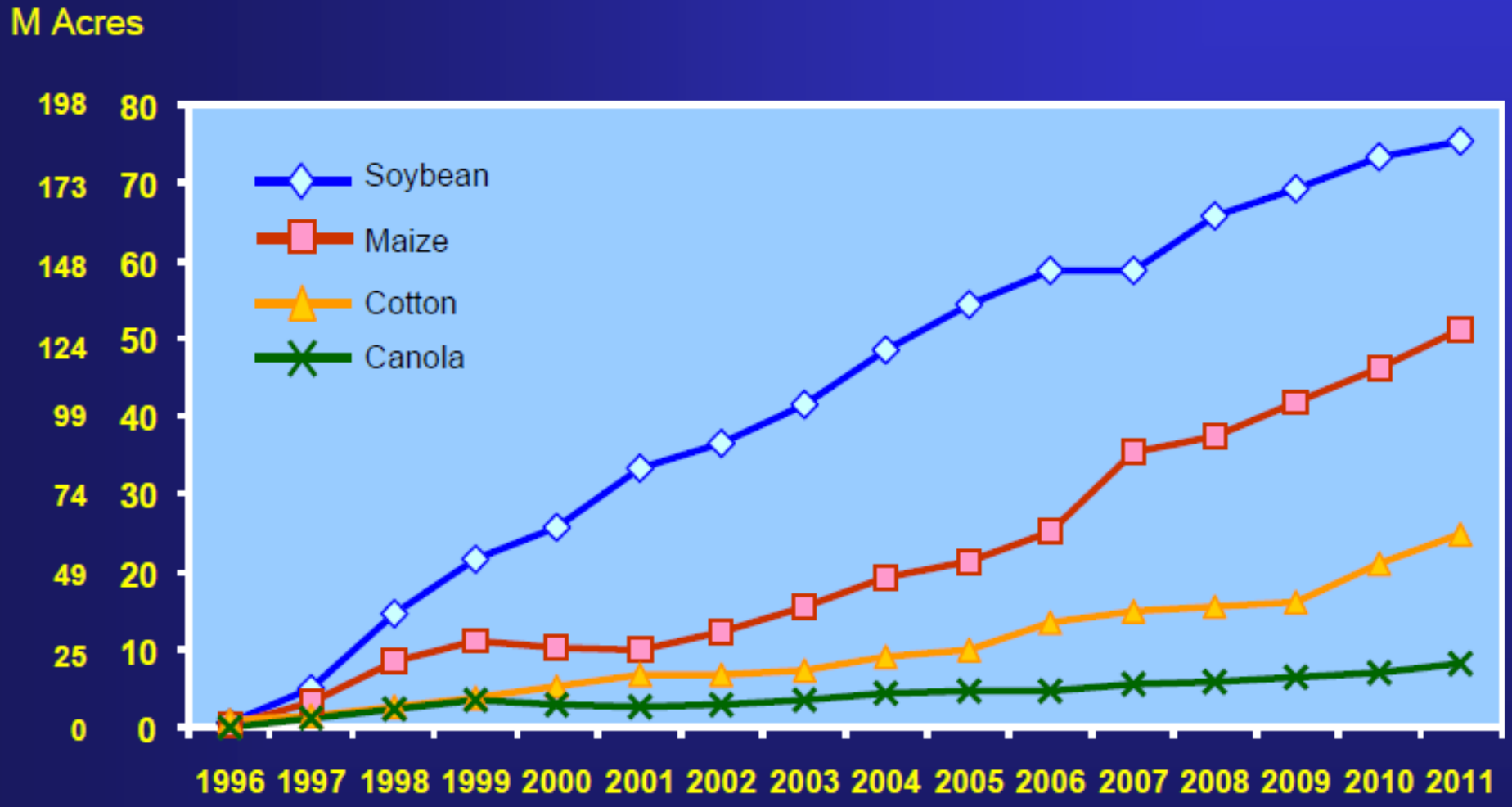
Global Area of Biotech Crops, 1996 to 2011: Industrial and Developing Countries (M Has, M Acres)



Source: Clive James, 2012

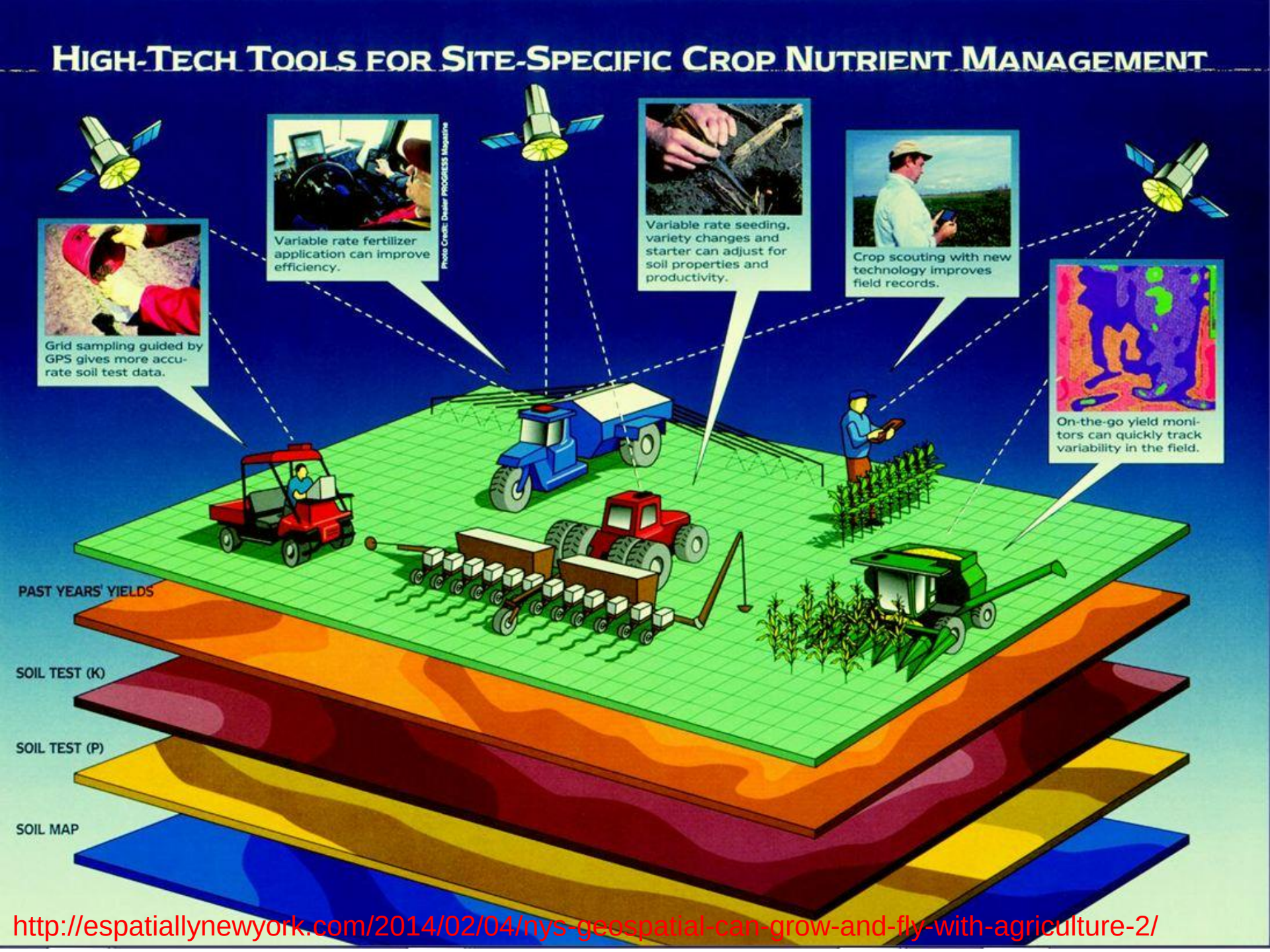
Global Area of Biotech Crops, 1996 to 2011: By Crop (Million Hectares, Million Acres)



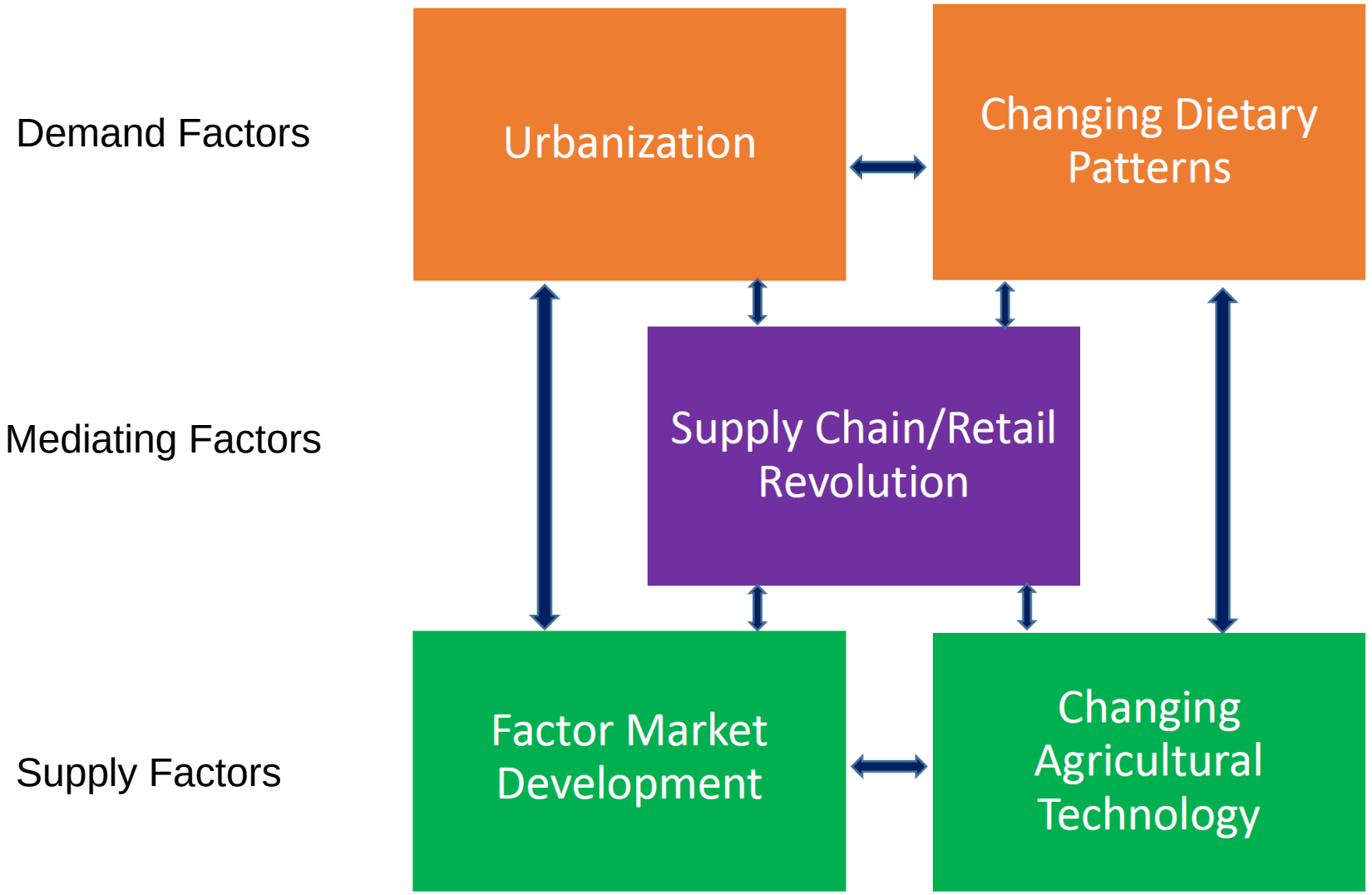
Source: Clive James, 2012

Rice and Better Nutrition: Vitamin A, iron, zinc, and Glycemic Index (GI).

HIGH-TECH TOOLS FOR SITE-SPECIFIC CROP NUTRIENT MANAGEMENT



http://espatiallynewyork.com/2014/02/04/nys-geospatial-can-grow-and-fly-with-agriculture-2/



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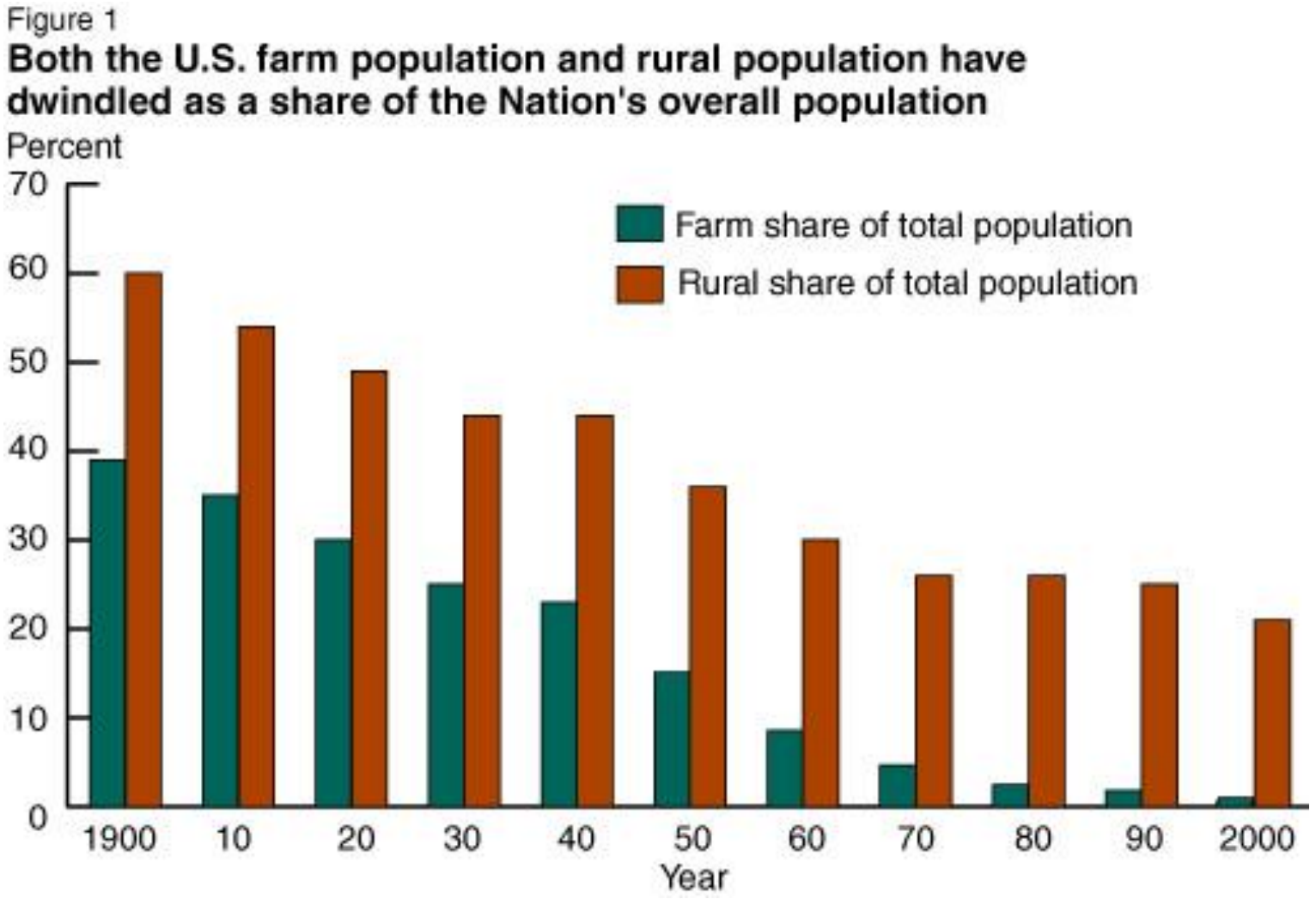
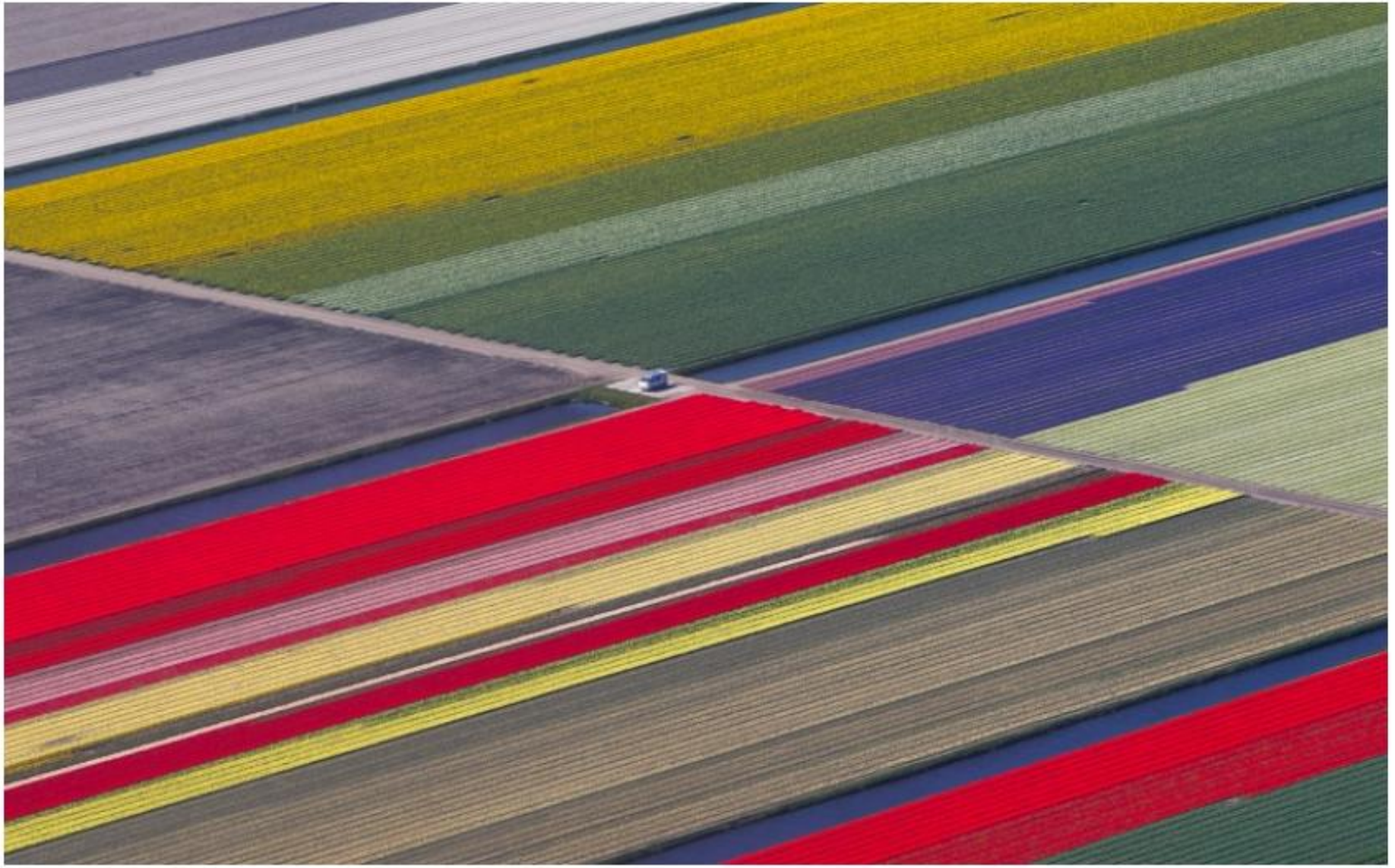


Source: USDA http://www.ers.usda.gov/publications/eib3/charts.htm#fig1

USA: with <2% of population in agriculture ; 15% of workforce in agribusiness and <1% of GDP, world's largest agricultural exporter

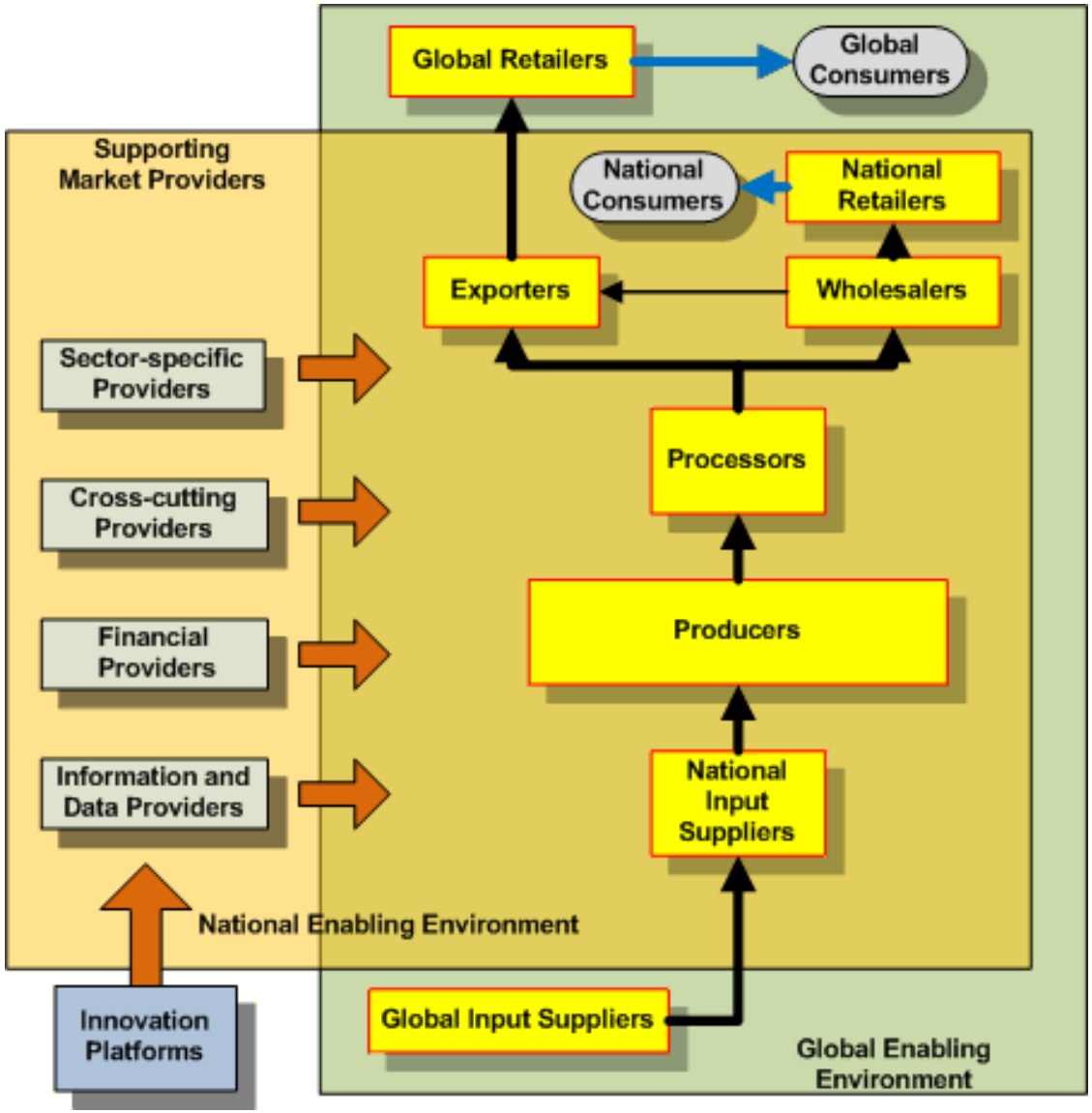
A *Rainbow* Revolution for Colombia?



Flower fields in the Netherlands, April 2015. (Reuters / Yves Herman)

Connecting Farmers to Markets

Adding Value though Value Chains



Context of Value Chain Approach

- **Food and agricultural product systems** are becoming increasingly integrated
- **Competitiveness**: the ability to develop and maintain an edge over market rivals
- **Globalization of markets** ties the sustainability of small and large firms to the competitiveness of the industries in which they participate.
- **Firms compete** with their neighbors, and firms in their own countries, but also with firms in other countries
- **Inter-firm cooperation and coordination** is crucial to competitiveness
- **Relationships among firms** in a value chain can influence the distribution of learning and benefits
- **Learning and innovation** are essential for creating and sustaining competitiveness

>>> a market-based approach to enterprise competitiveness

Figure 1: Value Chain Project Cycle

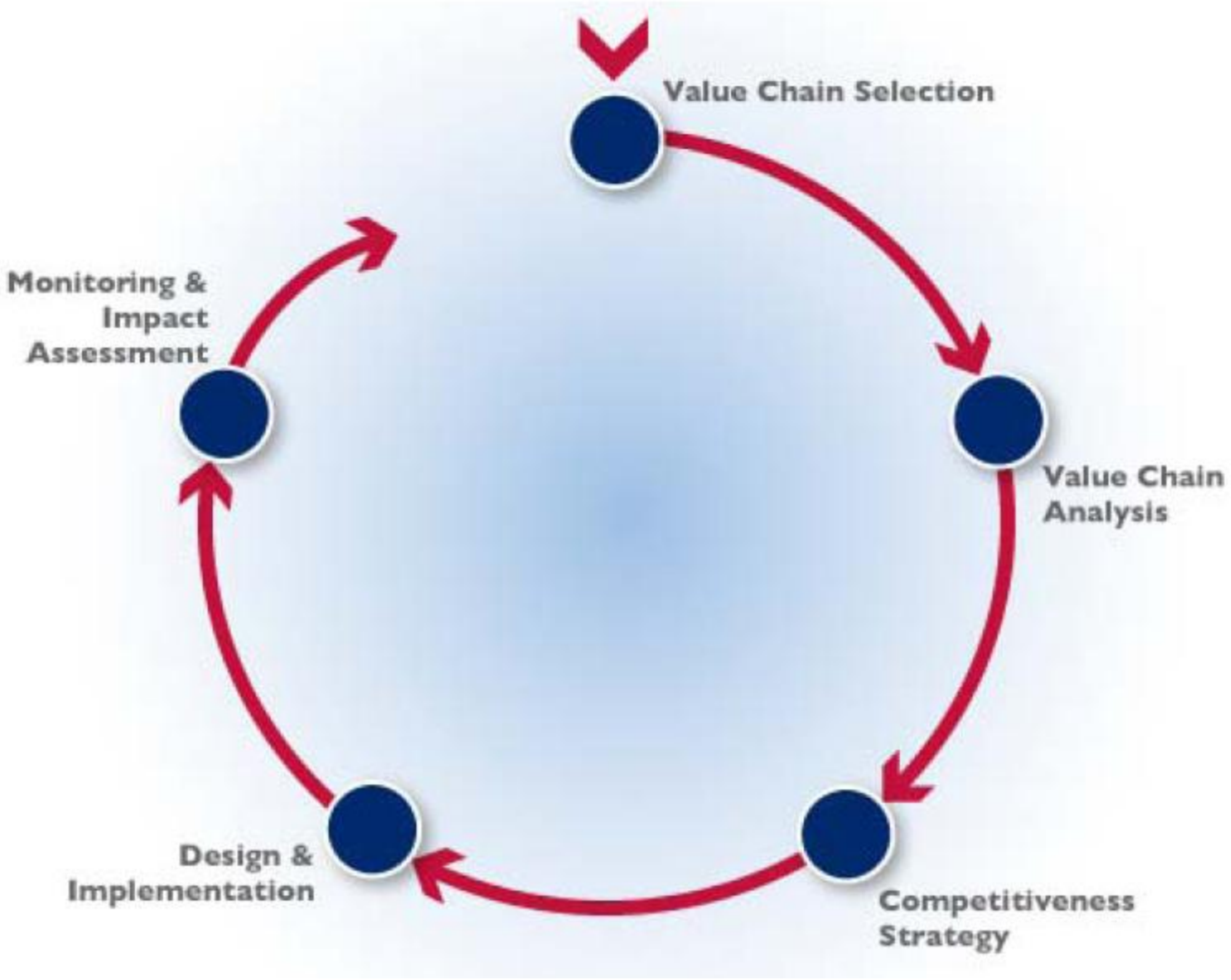
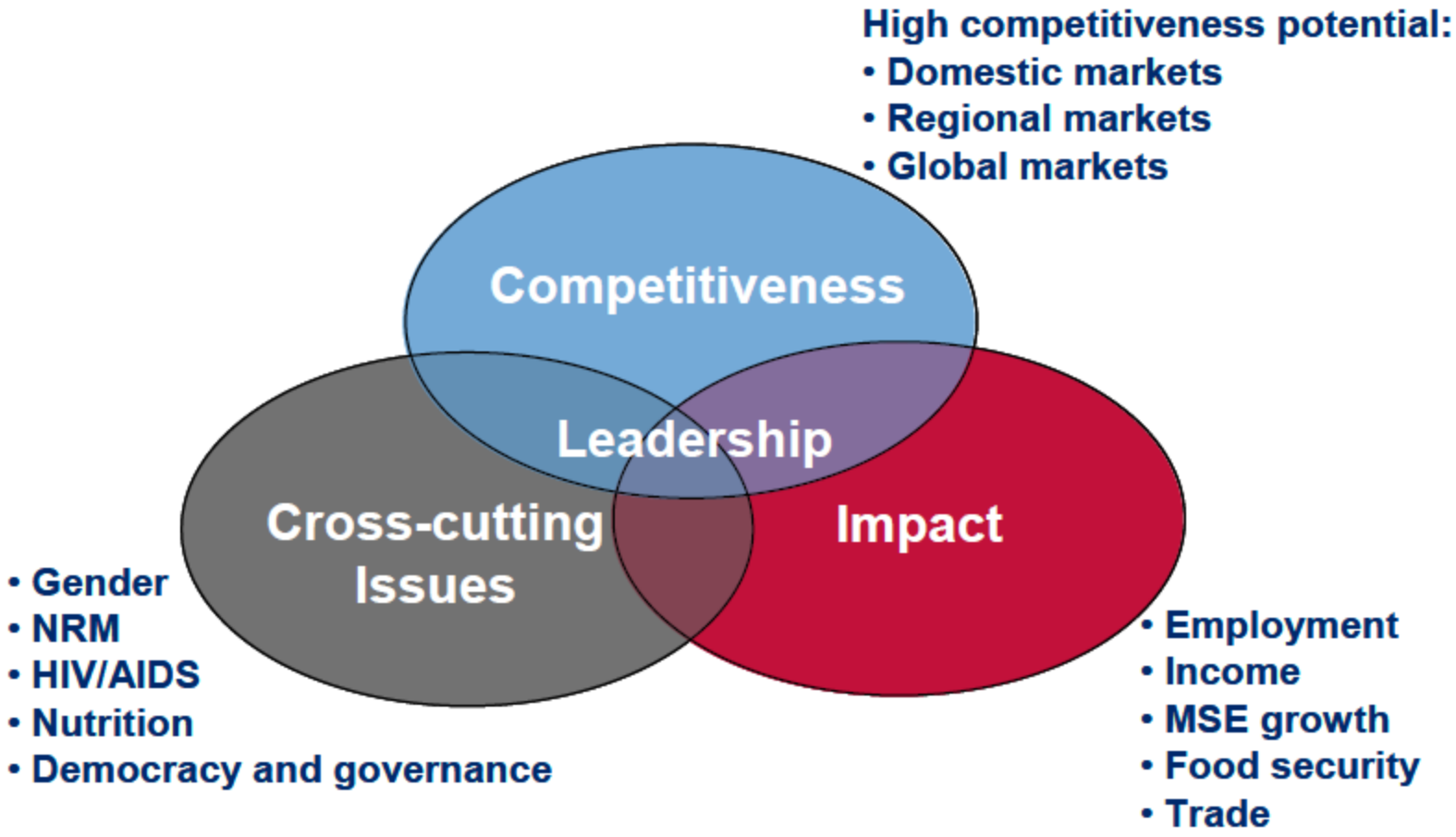


Figure 2: Value Chain Selection Criteria



Common Problems in Selecting Value Chains

- Selecting a “favorite” industry (politician, policy maker or donor)
- Selecting an industry with a temporarily favorable trade policy
- Poverty – not growth – focus
- High growth potential but low impact/reach

Key Principles of Value Chain Approach

- **Competitiveness** of firms
- **Economic growth** : must understand and identify sources of growth…pull factor to increase opportunities for farmers/producers
- **Leverage**: maximizing cost effectiveness of investments
  - Reach
  - Cost Effectiveness
  - Impact

Points of Leverage

There are three main forms of leverage in a Market System:

System Node – key actor in the value chain engaging with many other players (lead firm, association, supporting service)

Geographic Cluster – heavy concentration of production or marketing

Policy – reaches everyone at once

Value Chain Approach to Stimulate the Rural Economy of Colombia

- Has it been tried?
- Does it make sense?
- Which commodities would you prioritize?

Nourishing 9.5 to 13.3 billion people by 2100
Towards a Sustainable Global Food System

1. Improve Productivity
2. Improve Distribution and Access
3. Reduce Food Loss and Waste
4. Shift to Healthier Diets

Adapted from Foley *et al* (2011) & SDSN TG7 Report

1. Improve Productivity

Sustainable Agriculture means **Sustainable Intensification** *through*

- Transformative changes to *limit* conversion of forest, wetlands or grasslands to agriculture, and reduce environmental impact
- More efficient use of resources (land, labor, nutrients, water, and energy)
- Conservation and effective deployment of biodiversity & genetic resources
- Reducing the yield gap & raising the yield potential
- **Climate smart production systems & landscapes**

Godfray et al (2010), Tillman et al (2011), Foley et al (2011), FAO (2013), SDSN (2013)

Increasing productivity also **increases incomes** and **reduces the cost of food** to consumers (Engine of Growth). Timmer (1988, 2009), Tomich et al (1995), World Bank (2008)

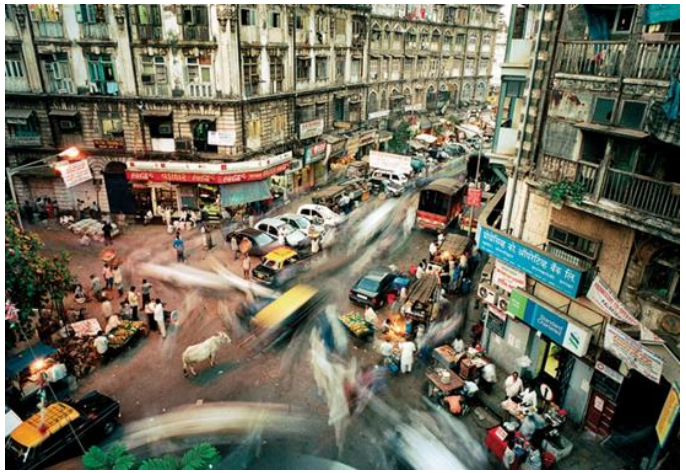
Sustainable Intensification principles should apply to all scales of farming, not only smallholders. **Different pathways; no "one size fits all" solution**. SDSN (2013)

2. Improve Distribution and Access

Ending Hunger and Improving Nutrition for All *means*

Improved Distribution and Access to Safe and Nutritious Food

- **Improving market infrastructure**: storage, transport & IT World Bank (2008)
- **Social safety nets** for the poor and disadvantaged Ruel et al (2013)
- **Empowerment of women** Ruel et al (2013)
- **Pro-poor trade policies** & **international cooperation** FAO (2006, 2011), OECD (2010)
- Complementary **urban** and **non-farm development** and **employment**
  Timmer (1988), Tomich et al (1995), Haggblade et al (2007)



3. Reduce Food Loss and Waste

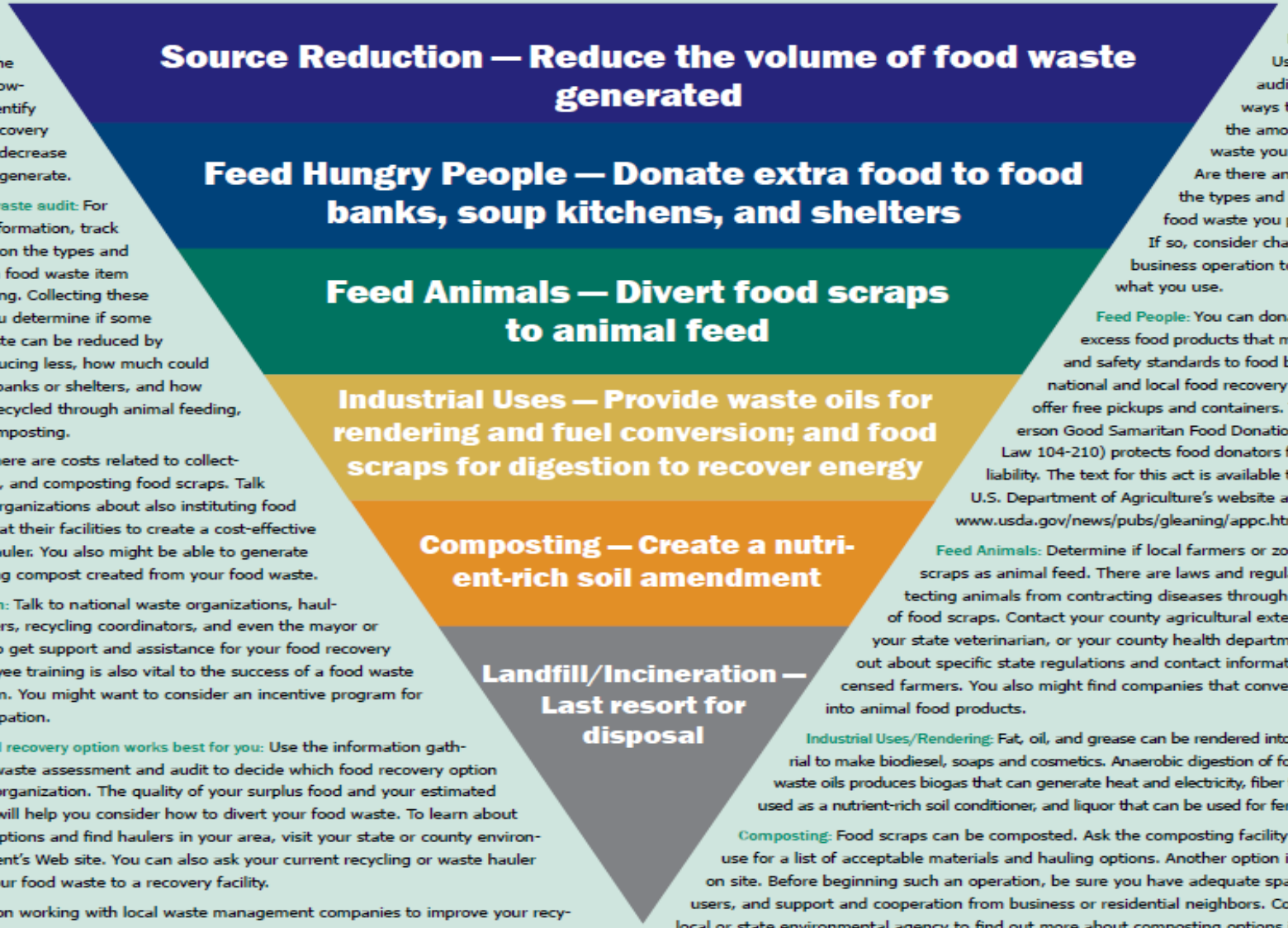
Reducing losses and waste along the Food Value Chain is highly contextual

- Reduce post-harvest and processing losses through technology, infrastructure, information, and policies
- Reduce retail and consumer waste through education, advocacy, and policies

IME-UK (2013), FAO (2013), USDA-ERS (2014)

Reducing and Recovering Surplus Food

Surplus food can be beneficially used in a variety of ways. The food recovery hierarchy prioritizes methods of reducing food waste.



Assess your food waste: Take a quick look at the food you are throwing away and identify potential food recovery opportunities to decrease the amount you generate.

Conduct a food waste audit: For more detailed information, track and collect data on the types and amounts of each food waste item you are generating. Collecting these data will help you determine if some of your food waste can be reduced by ordering or producing less, how much could be sent to food banks or shelters, and how much could be recycled through animal feeding, rendering, or composting.

Plan for costs: There are costs related to collecting, transporting, and composting food scraps. Talk to neighboring organizations about also instituting food waste collection at their facilities to create a cost-effective route for your hauler. You also might be able to generate revenue by selling compost created from your food waste.

Start the program: Talk to national waste organizations, haulers, town planners, recycling coordinators, and even the mayor or town manager to get support and assistance for your food recovery program. Employee training is also vital to the success of a food waste recovery program. You might want to consider an incentive program for employee participation.

Decide what food recovery option works best for you: Use the information gathered from your waste assessment and audit to decide which food recovery option is best for your organization. The quality of your surplus food and your estimated generation rate will help you consider how to divert your food waste. To learn about waste disposal options and find haulers in your area, visit your state or county environmental department's Web site. You can also ask your current recycling or waste hauler about hauling your food waste to a recovery facility.

For information on working with local waste management companies to improve your recycling rates and cost savings, visit http://www.epa.gov/waste/conserve/materials/organics/food/tools/.

Source Reduction: Use your waste audit to identify ways to decrease the amount of food waste you generate. Are there any trends in the types and amounts of food waste you produce? If so, consider changing your business operation to buy only what you use.

Feed People: You can donate unsold or excess food products that meet quality and safety standards to food banks. Many national and local food recovery programs offer free pickups and containers. The Bill Emerson Good Samaritan Food Donation Act (Public Law 104-210) protects food donators from legal liability. The text for this act is available through the U.S. Department of Agriculture's website at: www.usda.gov/news/pubs/gleaning/appc.htm.

Feed Animals: Determine if local farmers or zoos use food scraps as animal feed. There are laws and regulations protecting animals from contracting diseases through consumption of food scraps. Contact your county agricultural extension office, your state veterinarian, or your county health department to find out about specific state regulations and contact information for licensed farmers. You also might find companies that convert food scraps into animal food products.

Industrial Uses/Rendering: Fat, oil, and grease can be rendered into a raw material to make biodiesel, soaps and cosmetics. Anaerobic digestion of food scraps and waste oils produces biogas that can generate heat and electricity, fiber that can be used as a nutrient-rich soil conditioner, and liquor that can be used for fertilizer.

Composting: Food scraps can be composted. Ask the composting facility you plan to use for a list of acceptable materials and hauling options. Another option is to compost on site. Before beginning such an operation, be sure you have adequate space, staff, end users, and support and cooperation from business or residential neighbors. Contact your local or state environmental agency to find out more about composting options in your area and more information on special issues that apply. Learn more about the science and technology of composting—including various methods—at http://www.epa.gov/waste/conserve/rr/composting/science.htm.

Economically Recoverable Waste

4. Shift to Healthier Diets

Also highly contextual…

The Double Burden of Under- and Over-Nutrition Black et al (2013)

For producers, promote diversification and nutrition-sensitive agriculture

For consumers, promote dietary diversification and balanced nutrition; discourage overconsumption; improve food safety

through **education, advocacy, policies and research**

Ruel et al (2013), Meeker and Haddad (2013), SDSN (2013)

Nine-year-old children in Guatemala are significantly shorter than the World Health Organization's global average height for their age. Chronic malnourishment, which causes stunted growth, is an epidemic in Guatemala. In rural villages, more than 80 percent of the population is stunted. (ABCNews)

Nourishing 9.5 to 13.3 billion people by 2100
Towards a Sustainable Global Food System

1. Improve Productivity
2. Improve Distribution and Access
3. Reduce Food Loss and Waste
4. Shift to Healthier Diets

Adapted from Foley *et al* (2011) & SDSN TG7 Report


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

“Solemn Commitments are Not Enough.”