



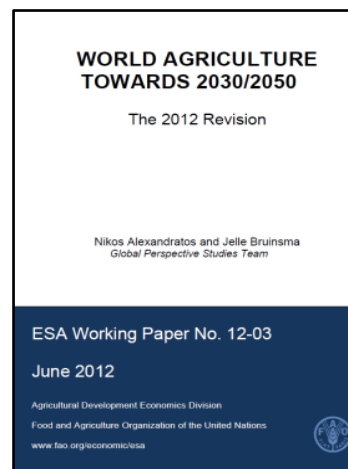
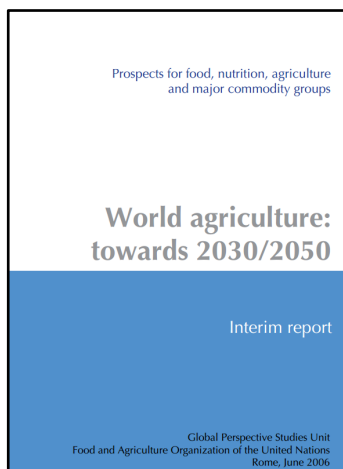
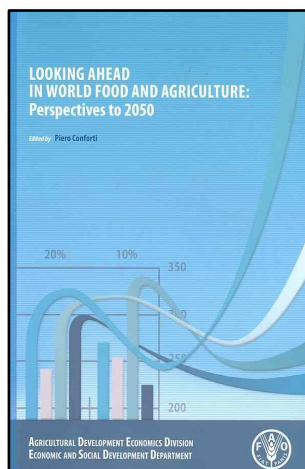
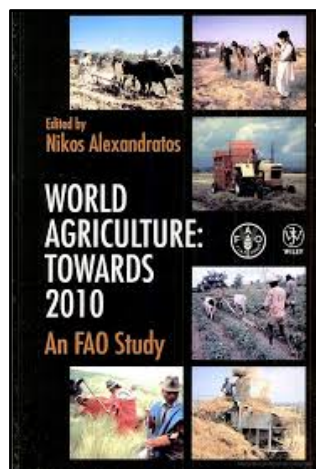
Food and Agriculture Organization
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FAO's long-term projections on the future of food and agriculture: from scenario to modelling

Dominik Wisser, Marc Müller, Aikaterini Kavallari, Lorenzo Giovanni Bellú,
FAO Global Perspectives Studies Team (GPS)

Africa Sustainable Livestock 2050 mid-term technical consultation
26 – 30 March 2018 | Nairobi, Kenya

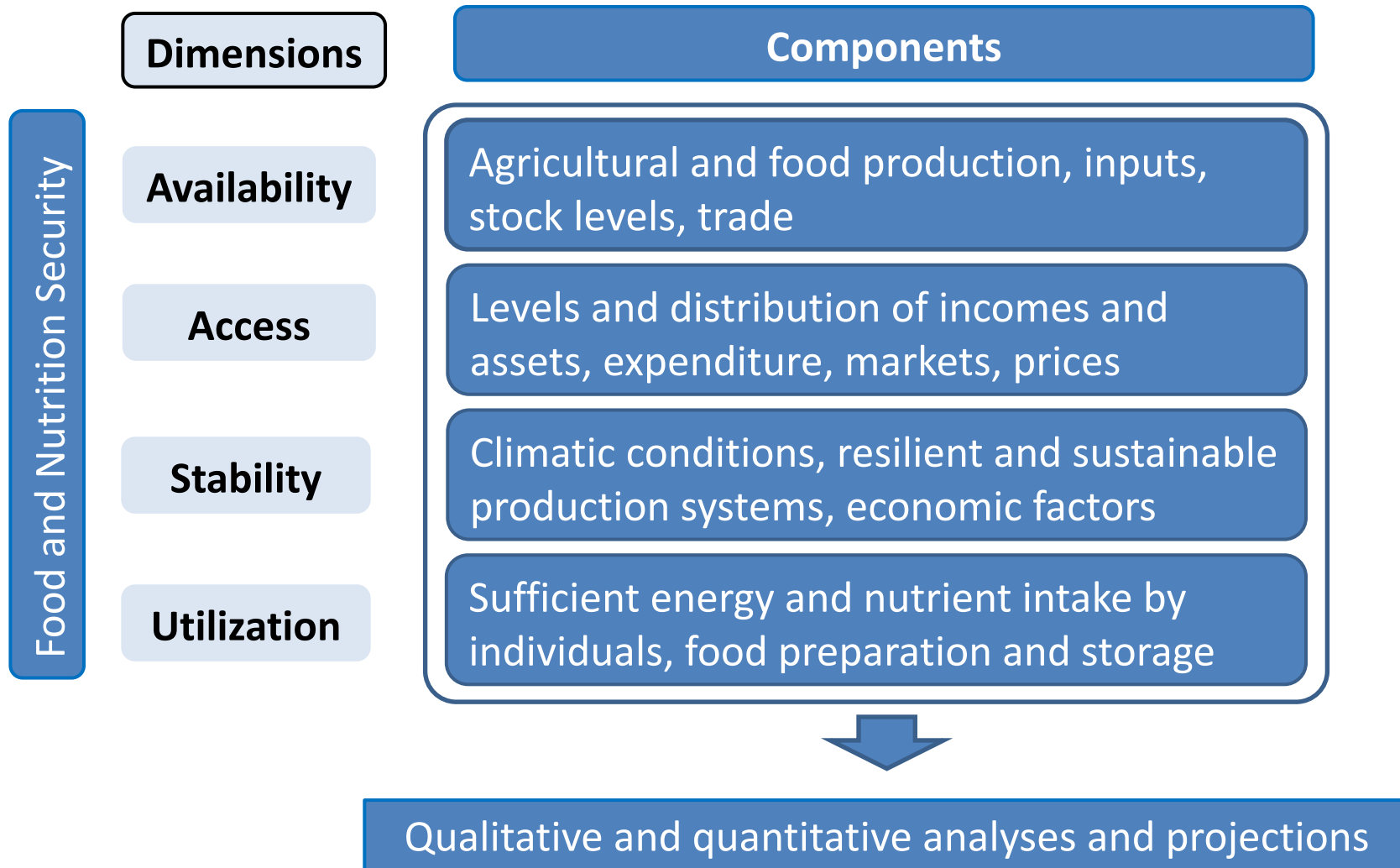
FAO's long-term projections



- Since the early 60s
- Indicative World Plan for Agricultural Development (1970)
- Series of publications “World Agriculture towards 20xx”
- Latest AT report, published in 2012: “AT 2050”



Food + Nutrition Security





AT 20XX: Approach

- Based on detailed accountancy system of FAOSTAT Food and Commodity Balance Sheets
 - Informed ideas about future evolution of variables of interest (productivity, inputs, etc.)
 - Real prices were assumed to stay constant over time -> no price path projections; base year prices used as weights to aggregate over commodities
 - Single scenario projections of food and commodity balances, often supplemented by further calculations (like food security indicators, investment)
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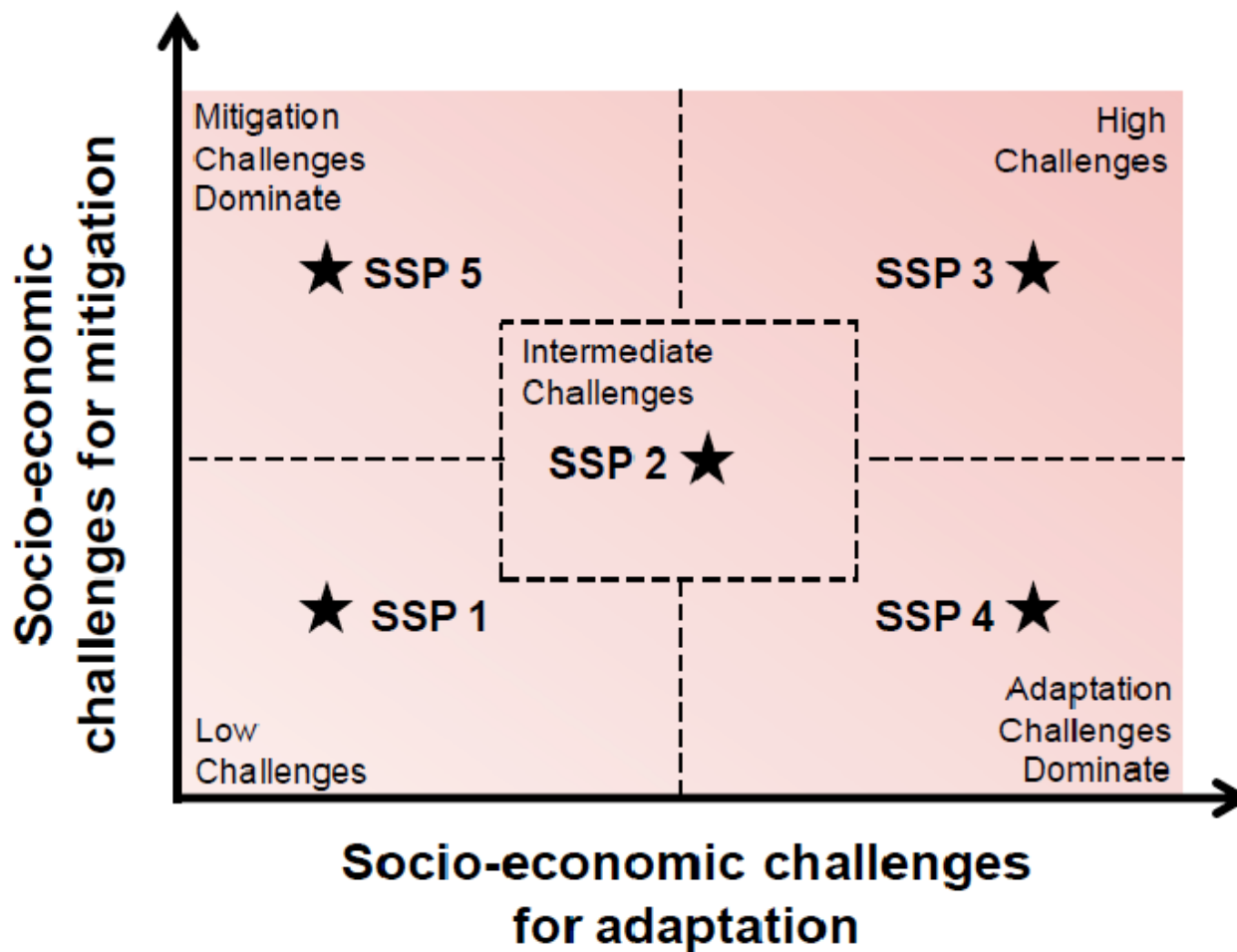


FOFA 2050: Approach

Different methodology:

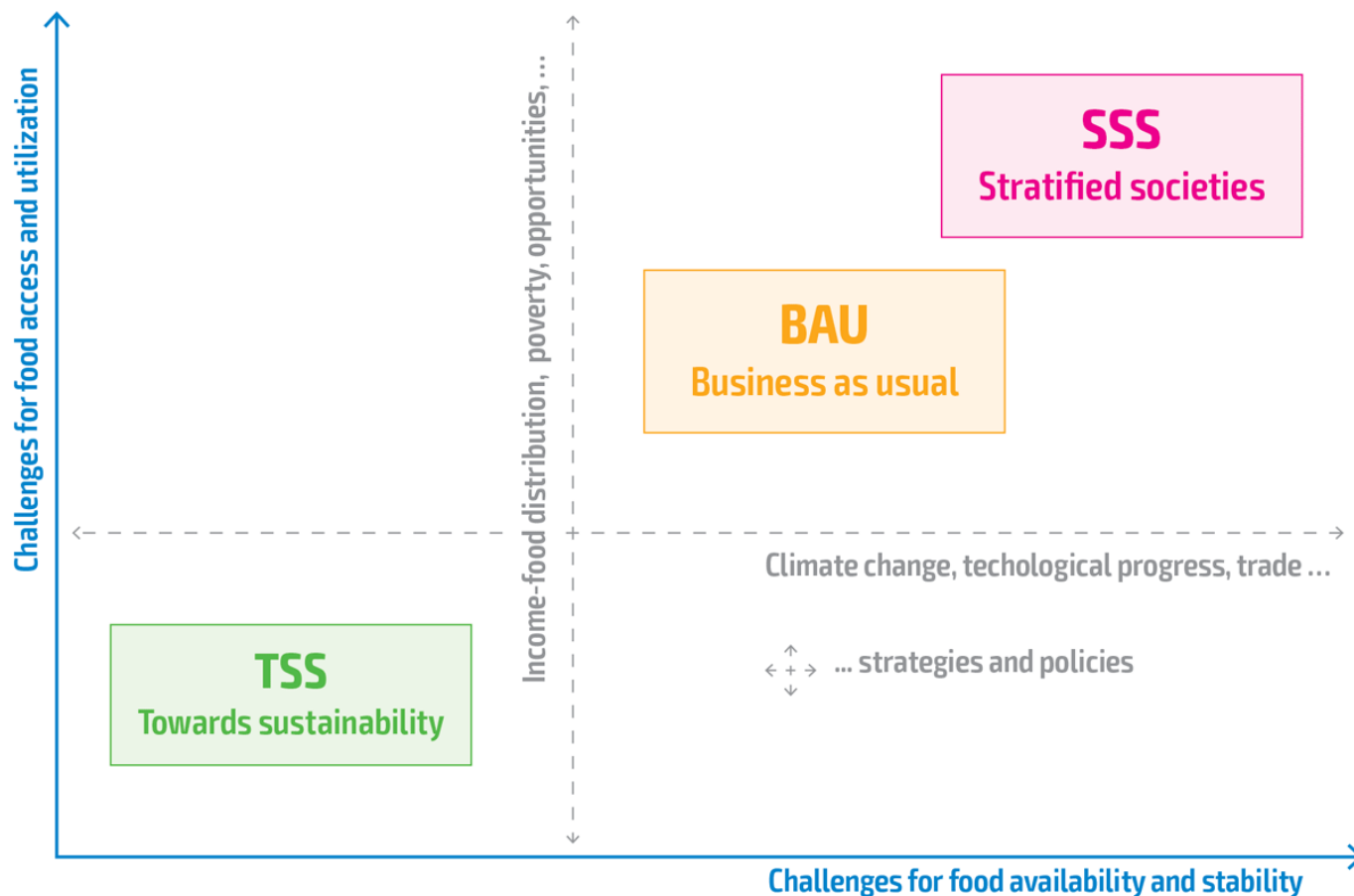
- Three scenarios (GDP, climate change, policies)
 - Time-varying impact of climate change on yields, water and land
 - Quantitate models for the agriculture sector (FAO GAPS) and the entire economy (ENVISAGE)
 - Impacts: Land use, water use, greenhouse gas emissions
 - Food security indicators
-

Shared Socioeconomic Pathways



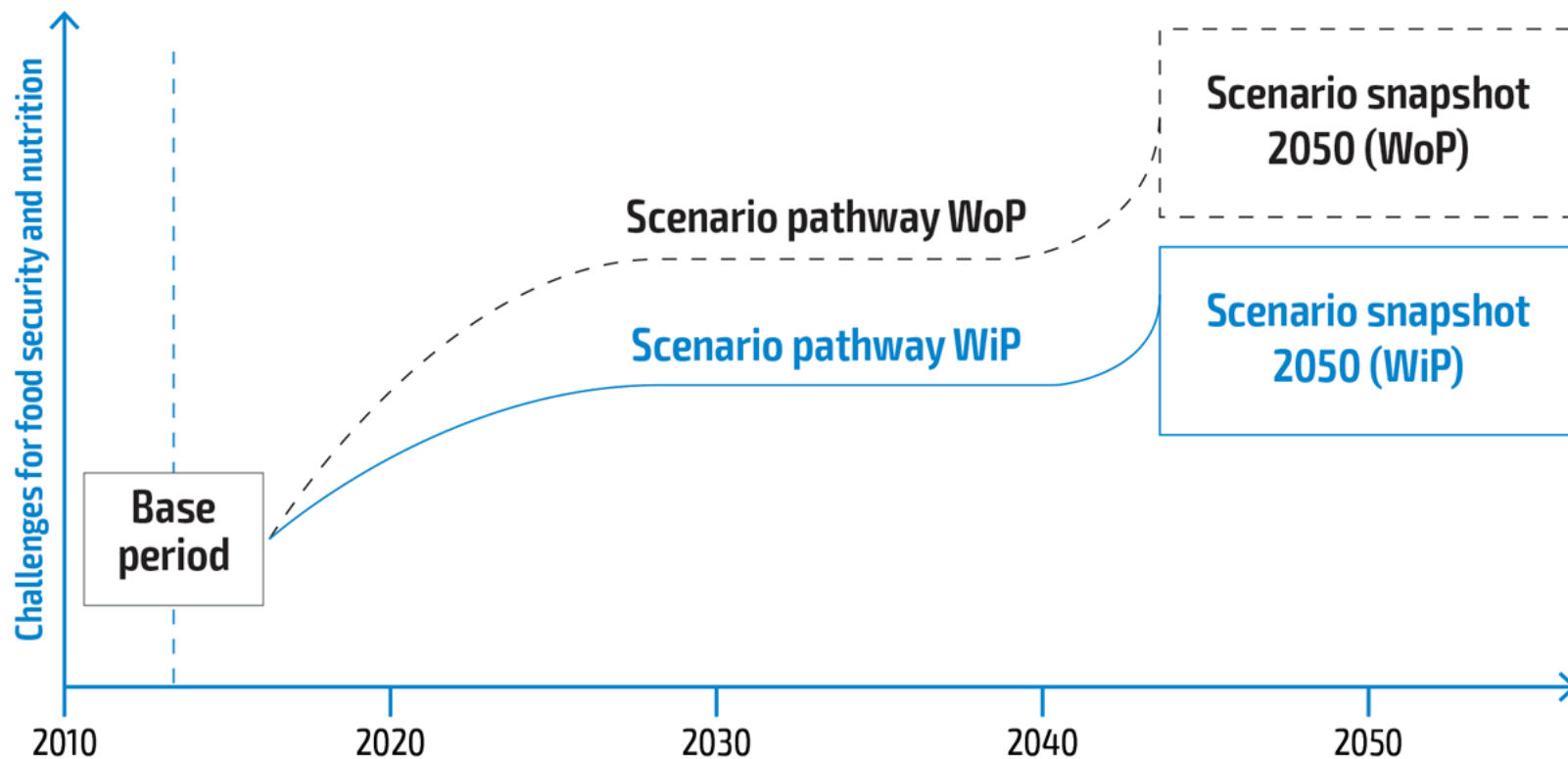


FOFA SAP Scenarios





Scenarios and policies





Towards Sustainability (TSS)

- The world increasingly develops following a sustainable path
 - A fairly generalized equity in terms of access to basic services, universal and sustainable access to sufficient, safe and nutritious food
 - No extreme poverty, reduced income inequality within and across countries
 - Sustainable use of natural resources and substantial climate change mitigation
 - Economic growth is moderate, but social welfare is increasing (social cohesion, inclusiveness, empowerment, security, etc.)
 - In the first decades, demand and production are investment-led
 - Yields show moderate but convergent increases across countries , increased agricultural productivity for smallholders
 - Widespread access to natural resources and distributed capital ownership
 - Fiscal systems work properly so social protection schemes ensure acceptable welfare levels of those permanently or temporarily unable to actively participate in production processes
 - **Low challenges both for equity and sustainable production occur**
-



Business as Usual (BAU)

Future develops according to socio-economic, technological and environmental trends similar to historical patterns; the world continues to do things as “usual”:

- Economic growth is medium and somehow uneven
 - Long-term cross-country convergence is doubtful
 - Diverse economic transformation, role of fiscal systems and social protection mechanisms
 - Technological progress in agriculture should take place but cross-country yield gap will still remain
 - Role of institutions (national, international) limited to solve conflicts and protracted crisis
 - **Moderate to high challenges to food availability/stability and access/utilization**
-



Stratified Societies (SSS)

Future develops in a way that historical patterns on inequality become more marked and pronounced:

- Unequal investment in human capital, know-how, physical and financial assets; disparities in savings potential
 - High inequalities both between and within countries regarding income availability
 - Widening gap between well-educated/internationally connected that concentrate power and low-income/unskilled population
 - High growth of the low-income population; low growth of the high-income population
 - Agriculture follows diverse paths; coexistence of subsistence agriculture, low quality commercial agriculture for bulk of low-income population and production of high quality niche food
 - **High challenges to food availability/stability and access/utilization**
-



Scenario Assumptions I

| | BAU | TSS | SSS |
|---|--|---|---|
| Economic growth | Moderate (SSP3). | Same total gross world Product as in BAU, but more distributed across countries as in SSP1. | High (SSP4), but “immiserising growth” mechanisms are at work. |
| Income inequality within countries | Current trends of modest convergence are maintained. SDG10 is barely achieved through fiscal policies and public spending. | Inequality reduction achievements exceed SDG10 targets. | SDG10 targets are not achieved, as within-country income distribution follows diverging patterns. |
| Income inequality across countries | Current trends of modest convergence (based on SSP3). | Inequality reduction achievements exceed SDG10 targets (proportions of per capita income as in SSP1). | Higher than BAU from 2050 onward (based on SSP4). SDG10 targets are not achieved, even by 2080. |
| Public investment | Modest, along current trends. | Focused on R&D that stimulates technical progress on sustainable and pro-poor practises. | Limited, flowing rather on non-sustainable practices, like fossil fuels and favouring elites. |
| International trade | More bilateral trade agreements in place; tariff barriers are modest; non-tariff barriers gain some importance. | Both tariff and non-tariff barriers are lower than in BAU. | Both tariff and non-tariff barriers are higher than in BAU, creating more fragmentation. |



Scenario Assumptions II

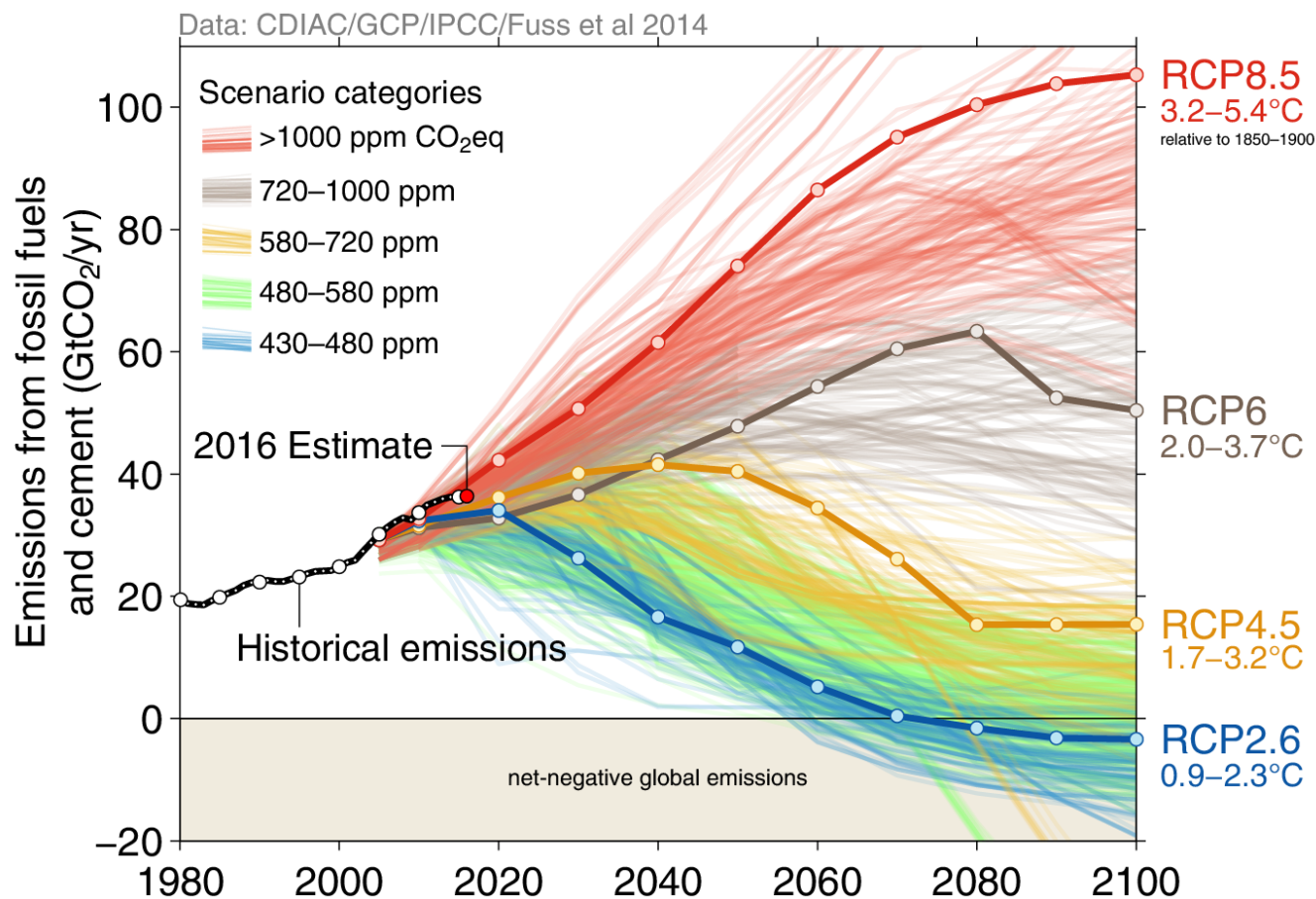
| | BAU | TSS | SSS |
|---------------------------|---|--|---|
| Water | Water efficiency improves but no major technical changes occur. More water-stressed countries emerge. | Water efficiency significantly improves thanks to investment. Limited CC reduces extreme droughts. | Water is unsustainably used. Little investment in water efficiency. CC exacerbates constraints. |
| Forests | Deforestation continues at current rates. | No additional deforestation. Investment in reforestation. | Further deforestation. |
| Biodiversity | Current loss rates prevail, also in the future. | Conservation practices (e.g. eco-agriculture, agroforestry) reduce the loss of biodiversity. | Current loss rates prevail, also in the future. |
| Foreign investment | Medium and along the north-south axis. | Higher than BAU in low-income countries, with positive impacts on local incomes. | Higher than BAU in low-income countries with little impact on local incomes. |
| Evolution of diets | Current trends of moderate convergence towards the consumption of more nutritious food maintained. | Balanced, healthy and environmentally sustainable diets are mostly universally adopted. | Diets worsen for most people due to lower purchasing power and lessened consumer awareness. Elites consume high-quality luxury foods. |



Scenario Assumptions III

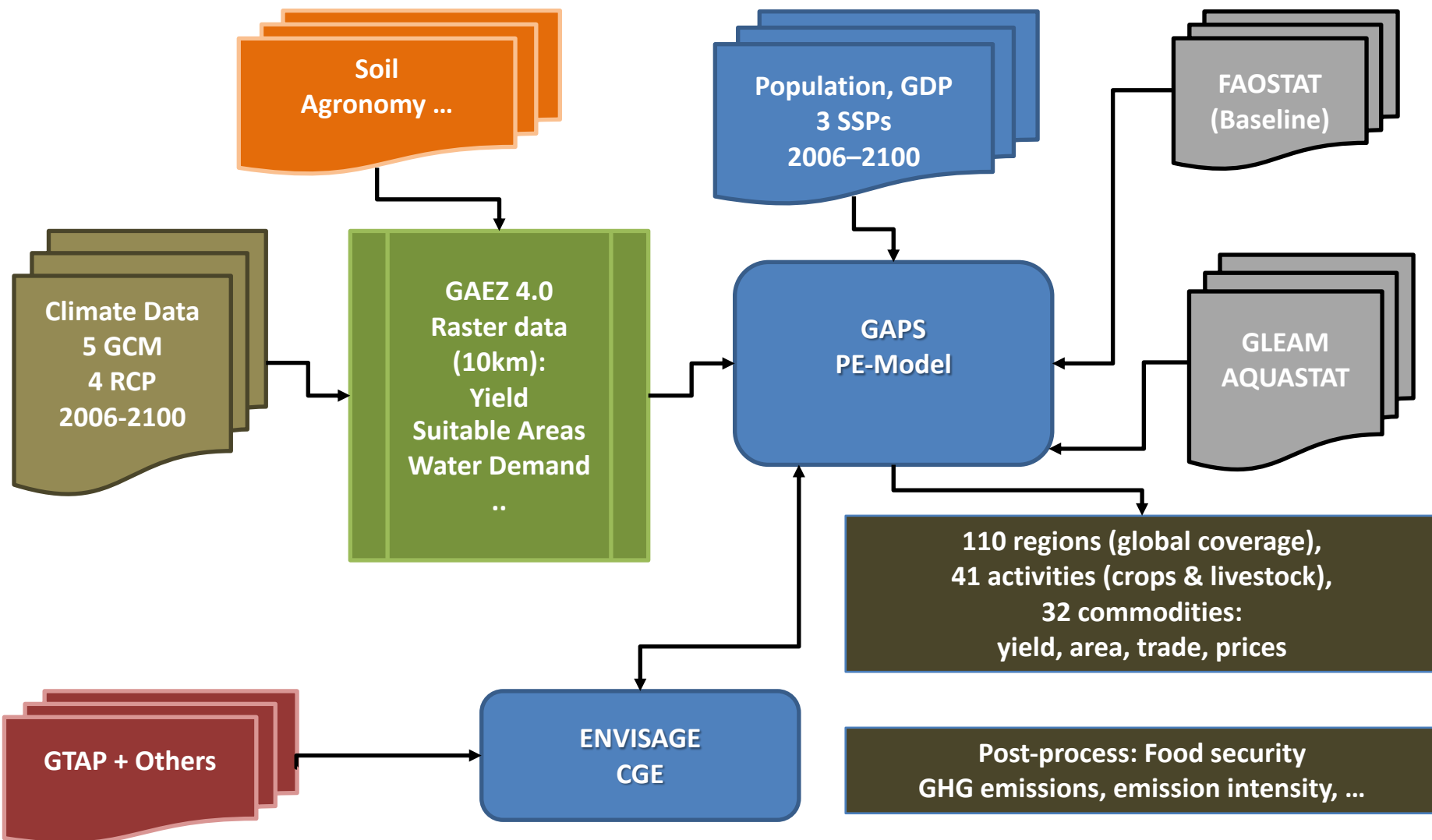
| | BAU | TSS | SSS |
|---|---|---|---|
| Pests and diseases | Continuation of current trends of increasing spread and AMR resistance. Average long-term yields are negatively affected by occurrence. | R&D to focus on fighting against them. | Boosted by climate change, international trade and AMR. Increased use of drugs, particularly against them, and so more pests and diseases that threaten yields. |
| Prevailing production systems | Mixed. High value-added small farms and processors for high-quality food co-exist with large scale, high-input agriculture. Irrigation and intensive livestock increase to the extent possible. | Low-input precision agriculture, agroforestry intercropping, conservation, climate-smart ecological agriculture fit in “circular” economies. Animal welfare and biodiversity is promoted. | Segmented agriculture and food systems: a) many marginal producers for subsistence in LICs; b) big corporations for mass, low-quality food; c) small-medium farms both in HICs and LICs for luxury food for elites. |
| Land intensity (quantity of land per unit of output) | Along current trends: The quantity of land per unit of output decreases as long as crop and animal yields increase. | The quantity of land per unit of output is stable at base-year levels to preserve soil quality and restore degraded/eroded land. | The quantity of land per unit of output decreases for commercial agriculture and remains stable for smallholder/ marginal farmers. |

RCPs





FOFA 2050 Data



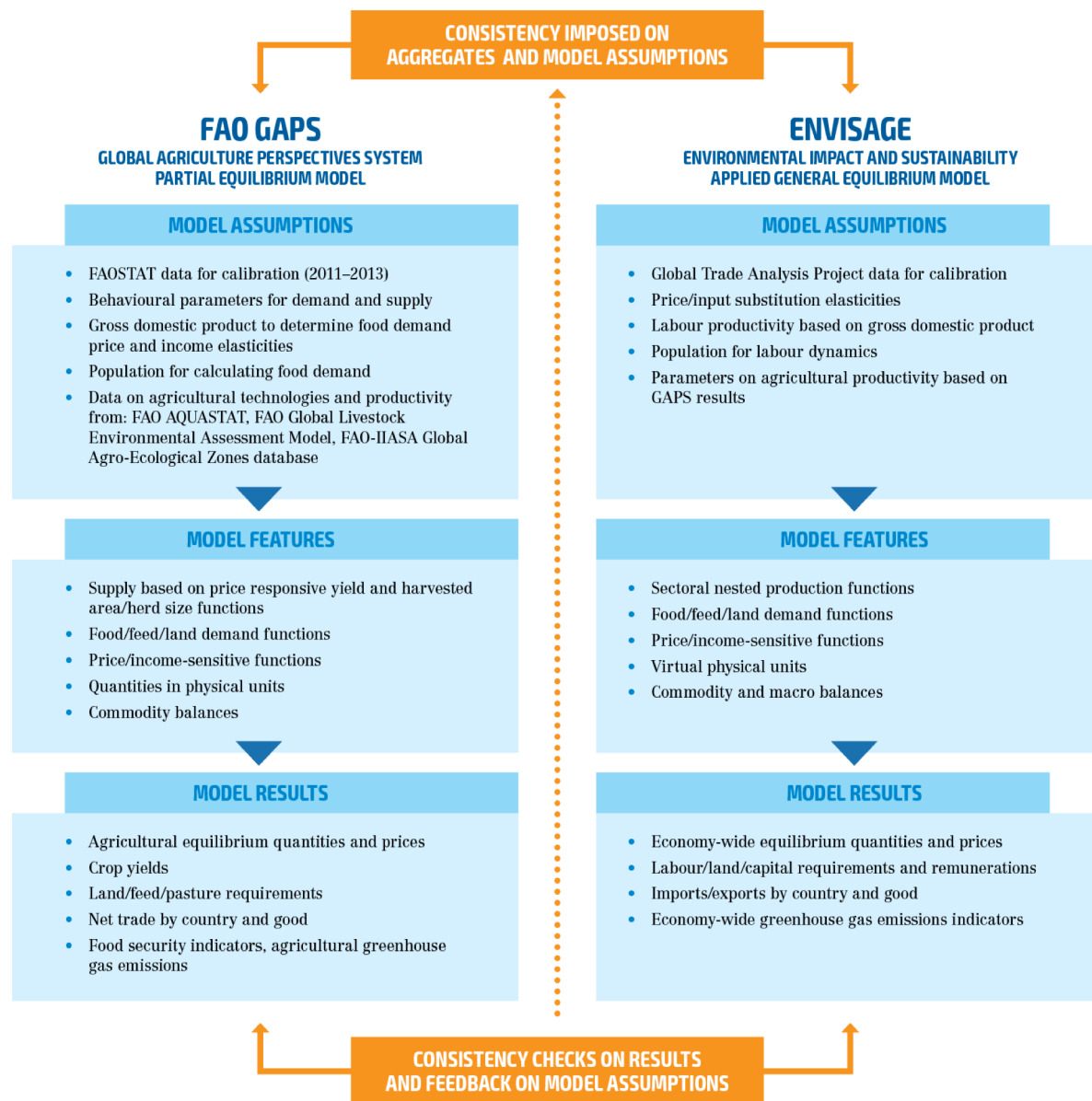


FAO GAPS

- 36 crop activities in 2 production systems (irrigated and rainfed)
 - 1 activity for fish (2 production systems)
 - 13 processing activities (oil milling, sugar extraction, paddy milling, cotton...)
 - GAPS represents the supply and demand of 68 agro-food commodities out of which 21 processed) in 182 countries (out of 233 countries covered in UN DESA 2015 population projection) and of 194 countries of FAOSTAT's commodity balance sheets.
 - GAPS is calibrated for 2012 FAOSTAT data
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The modelling framework





Livestock in GAPS

6 animal species in 6 production:

- Cattle, buffalo, goats, sheep, pigs, poultry, others

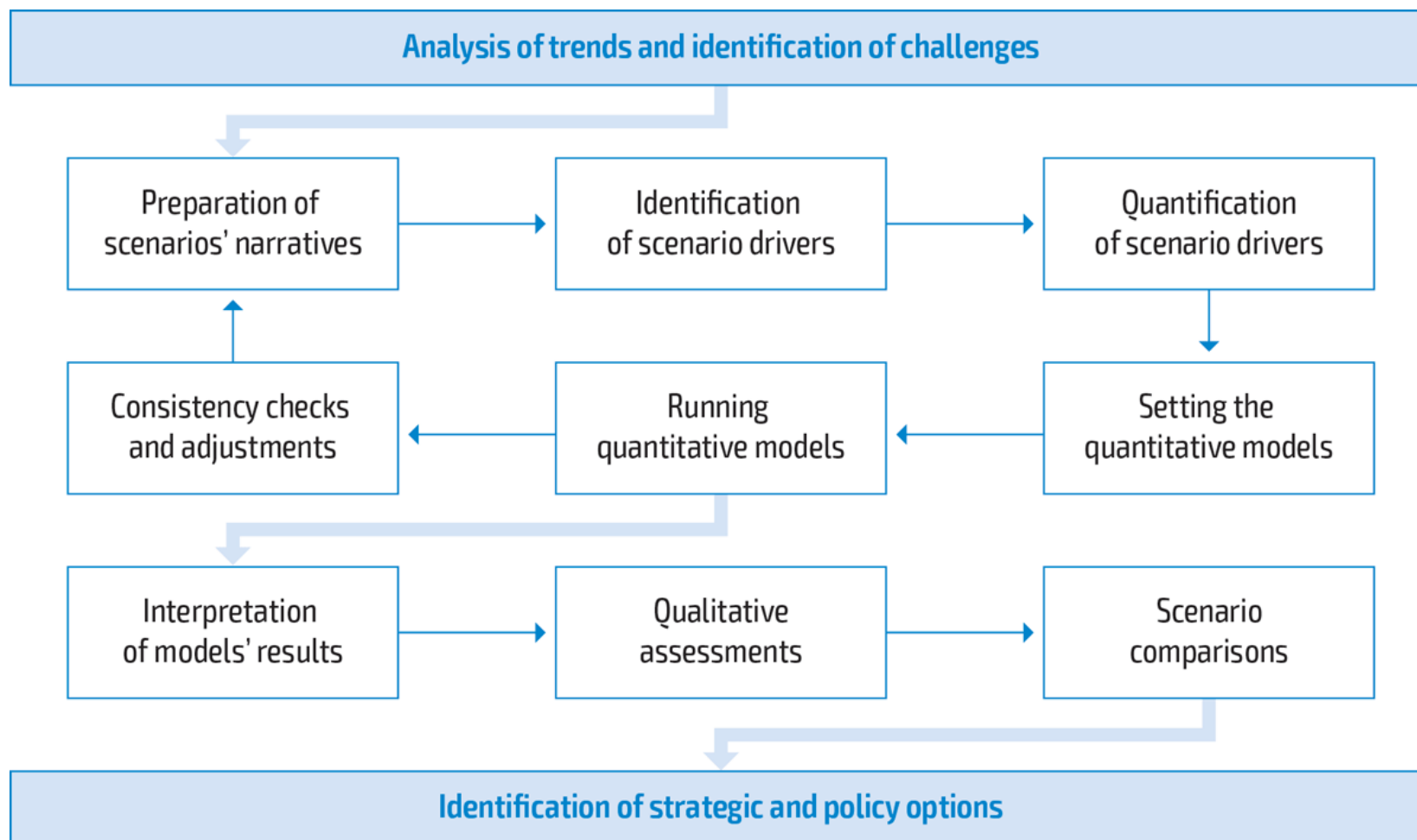
9 production systems:

- Dairy herd grassland based
- Dairy herd mixed farming systems
- Dairy herd feedlots
- Meat herd grassland based
- Meat herd mixed farming systems
- Meat herd feedlots
- Monogastrics backyard
- Monogastrics intermediate or layers
- Monogastrics industrial or broilers

Production systems for monogastrics shift as function of income



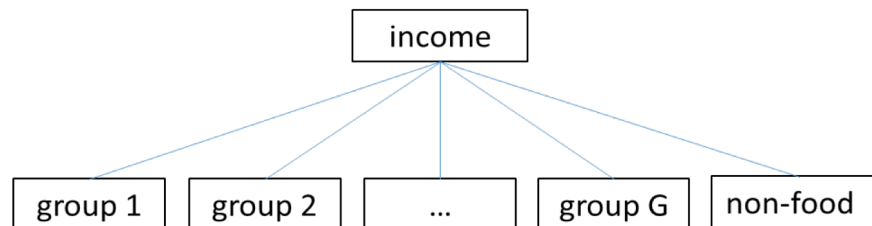
FOFA SAP workflow





FAO GAPS food demand

1. Allocation of income to food bundle
2. Allocation of calories to food items within the bundle



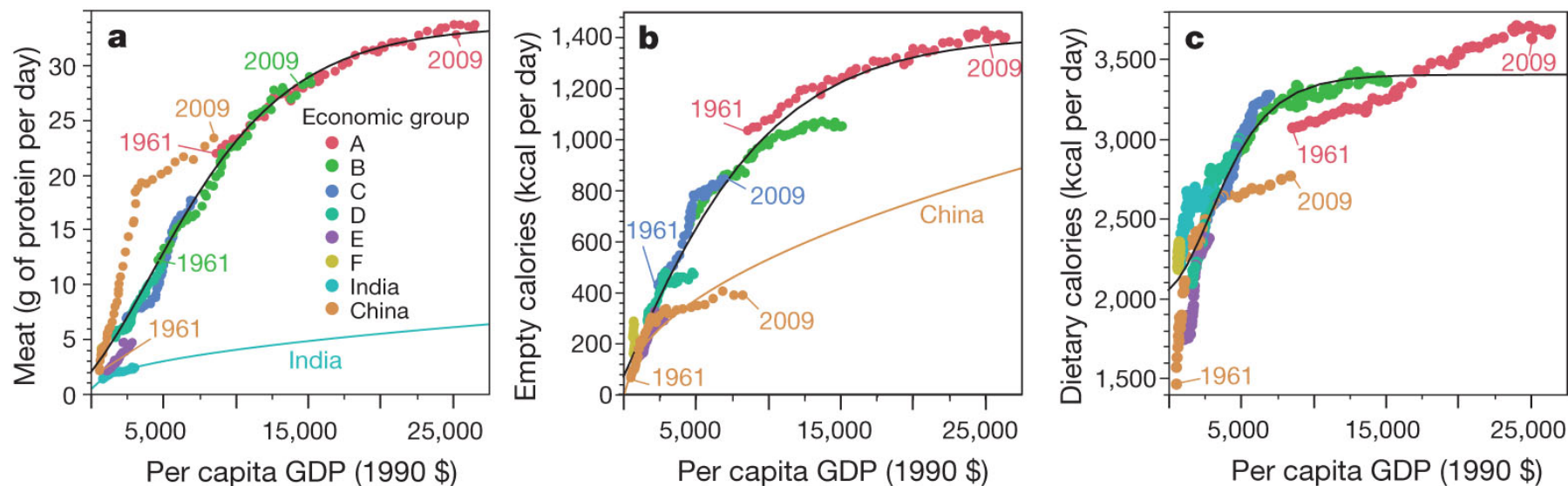
Food bundles:

- ☐ Cereals
- ☐ Domestically consumed cereals
- ☐ Starchy crops
- ☐ Protein crops
- ☐ Fruit und vegetables
- ☐ Other crops
- ☐ Vegetable oils
- ☐ Meat and fish
- ☐ Dairy and eggs
- ☐ Other food

Assumptions:

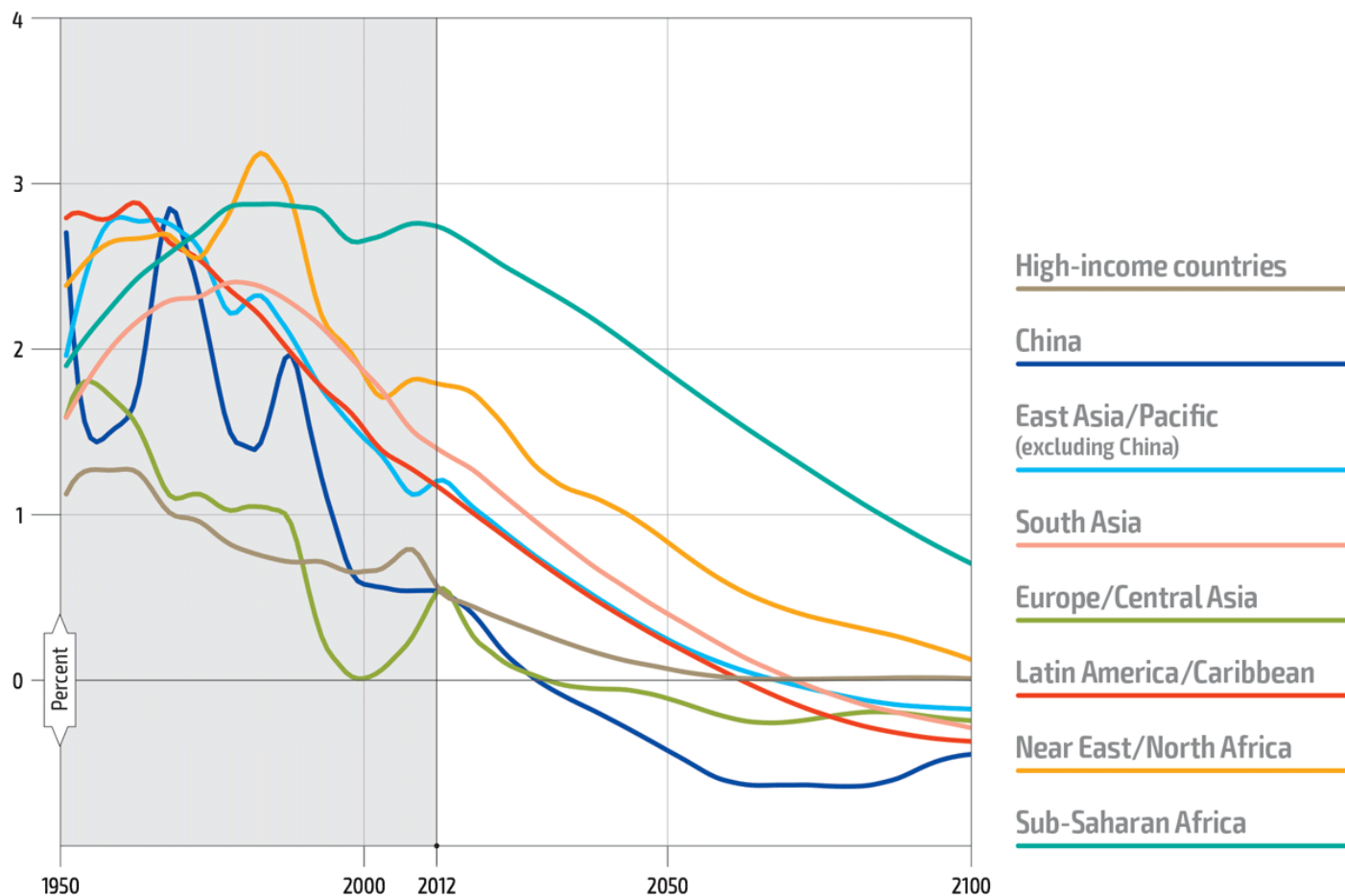
- the share of expenditure on food consumption declines as income increases
- an income increase stimulates substitution away from carbohydrates (e.g. staple foods) towards higher value items such as vegetables and animal-based proteins

Diet trends and income





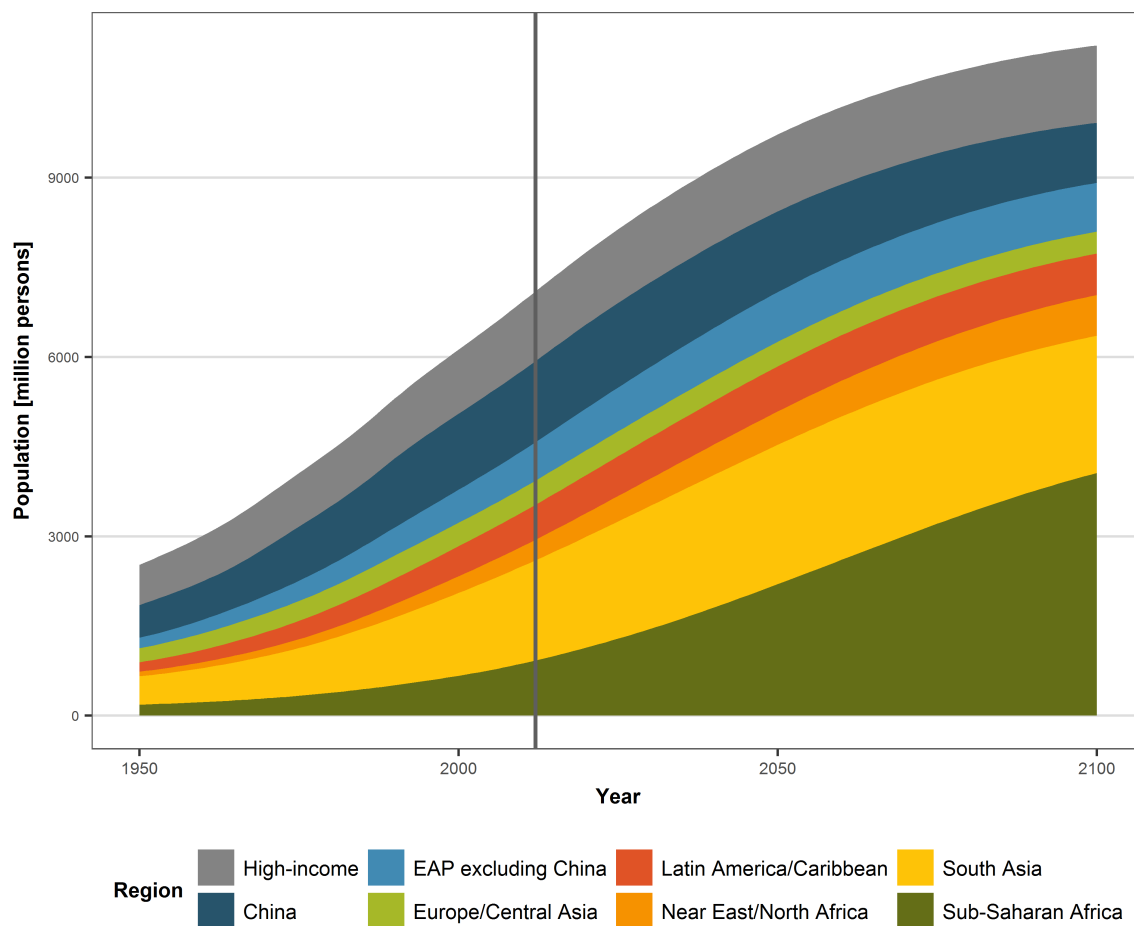
Population growth rates



Source: UN World Population Prospects 2015, medium variant

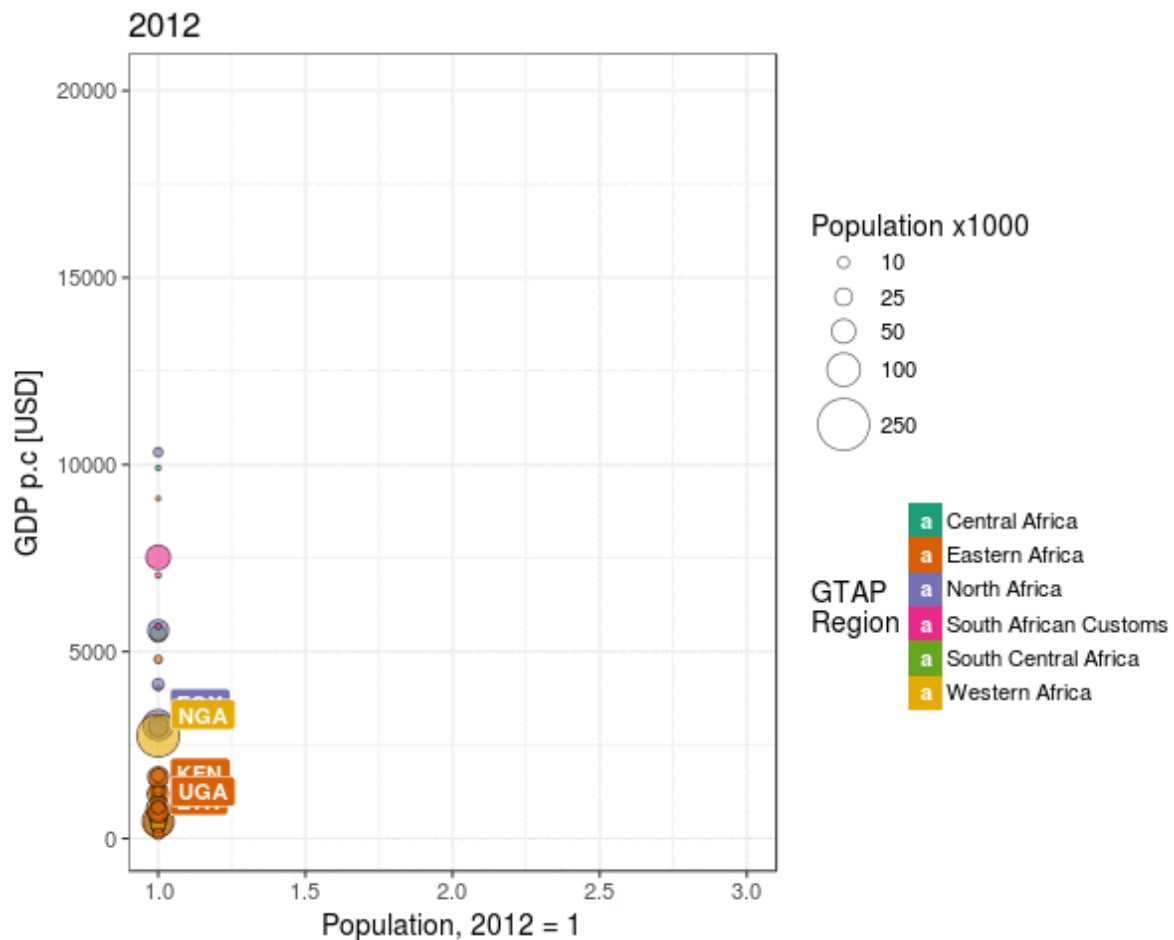


Population projections



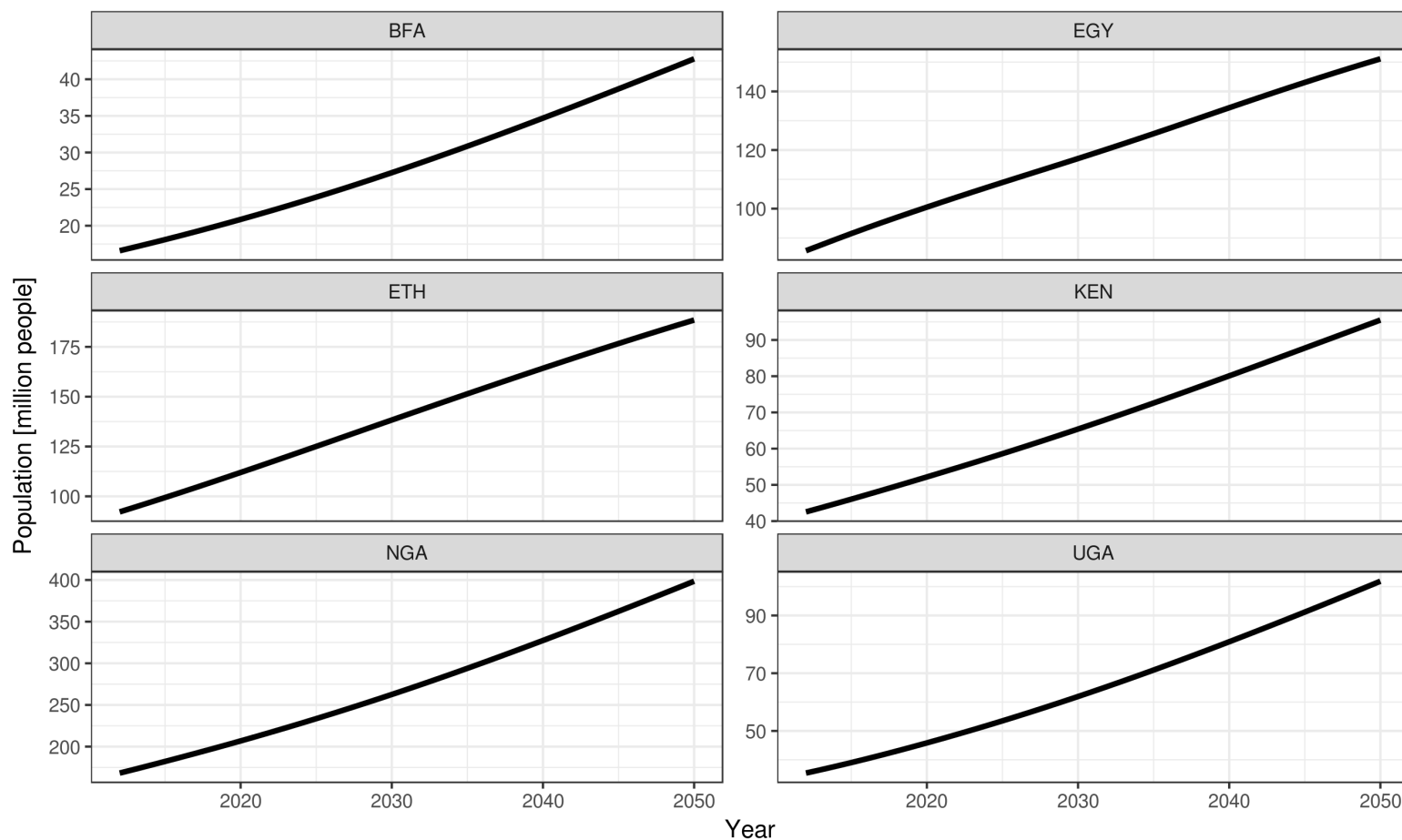
Source: UN World Population Prospects 2015, medium variant

Drivers of demand



Source: UN World Population Prospects 2015, medium variant, SSP3 GDP Data

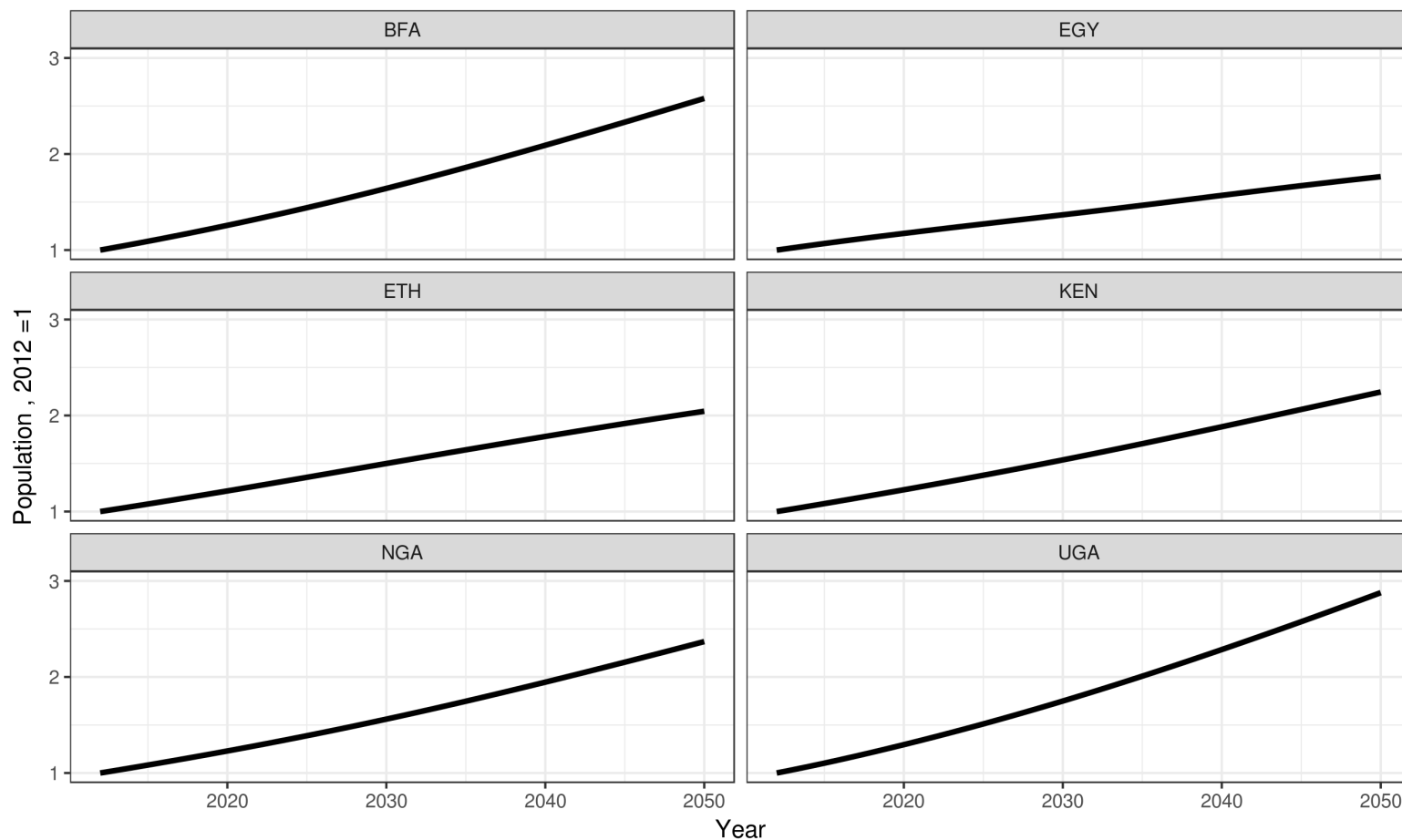
Population projections



Source: UN World Population Prospects 2015, medium variant



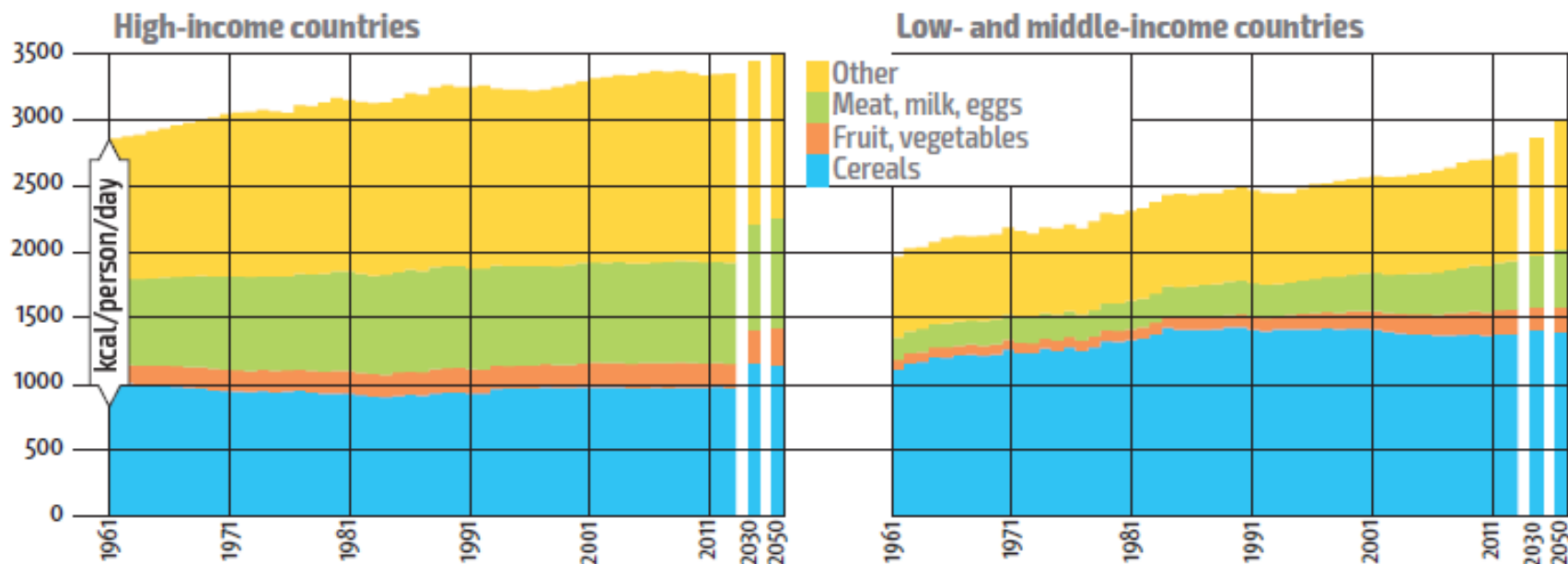
Population projections



Source: UN World Population Prospects 2015, medium variant

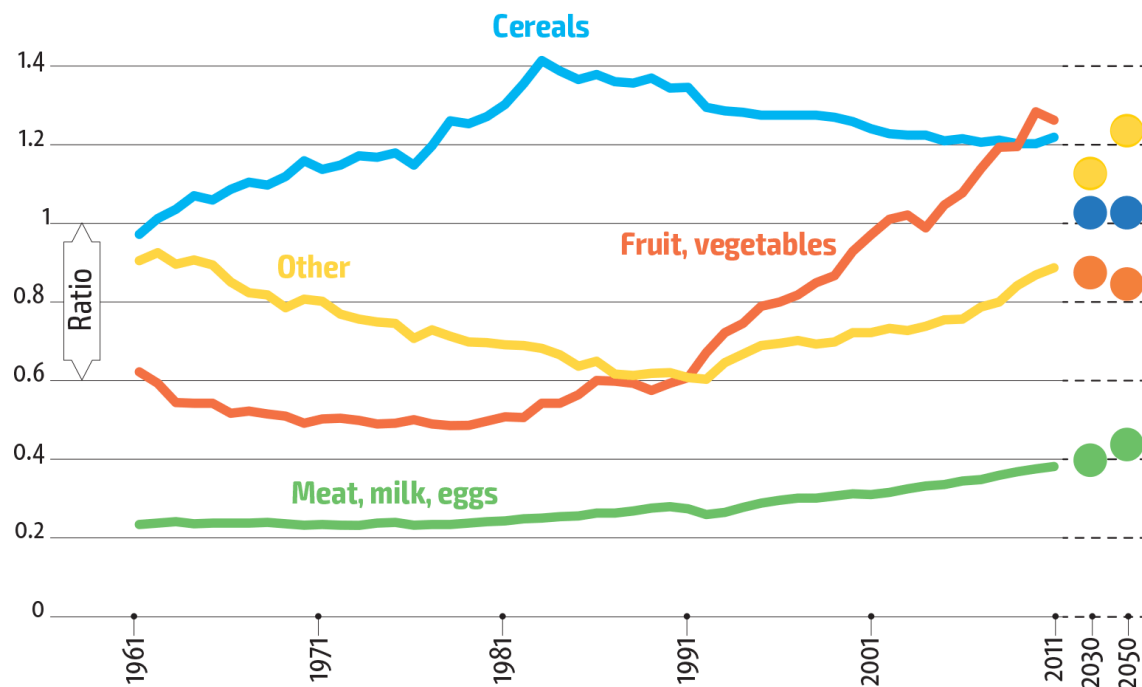
Food demand (AT 2050)

Per person calorie intake 1961–2050



Dietary convergence

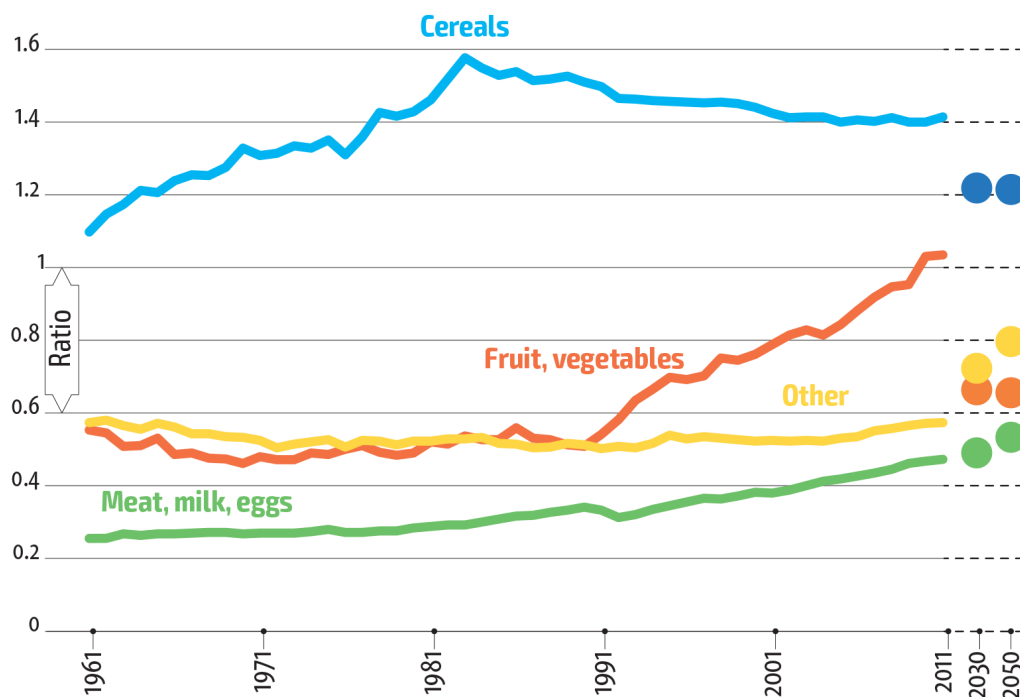
Per capita protein intake in low- and middle-income countries compared to high-income countries



Source: FAO. 2017. *The future of food and agriculture – Trends and challenges.*

Dietary convergence

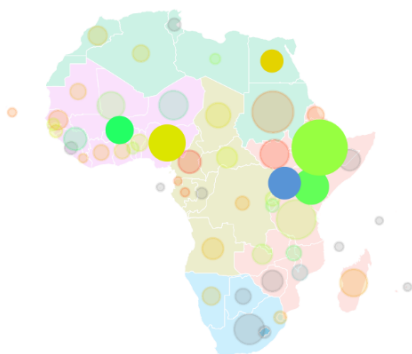
Per capita calorie intake in low- and middle-income countries compared to high-income countries



Source: FAO. 2017. *The future of food and agriculture – Trends and challenges*.

Hist. livestock growth rates

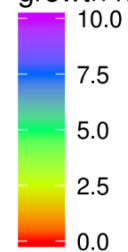
Cattle



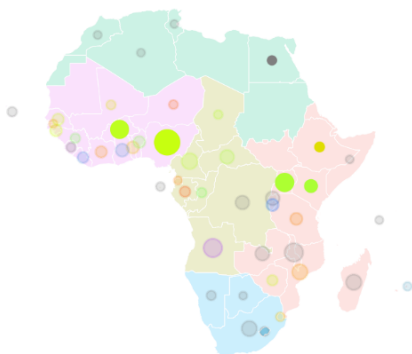
Goats



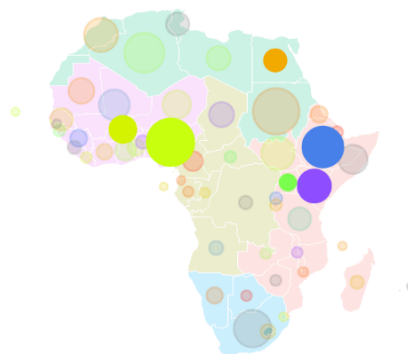
Mean annual
growth rate (2000/2015)



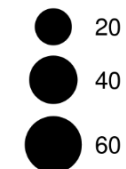
Pigs



Sheep

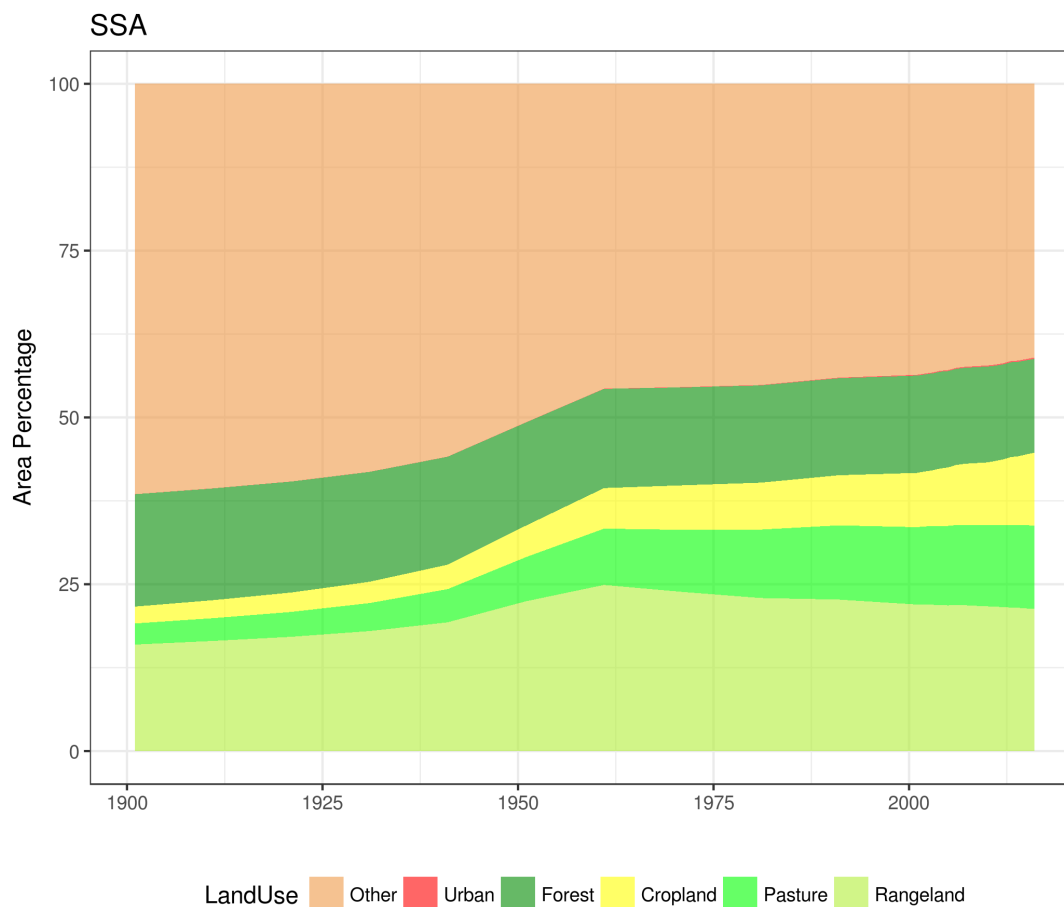


Animal heads 2012 (million)





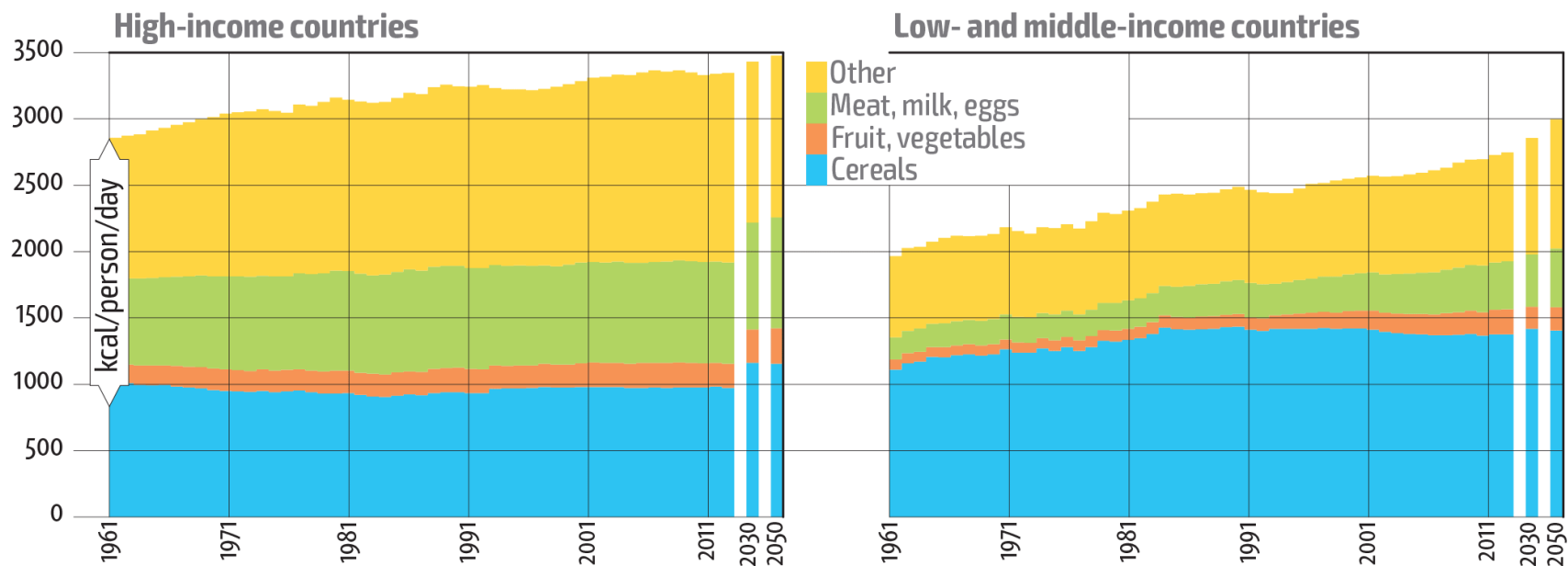
Land use competition



Source: FAO Global Perspectives Studies Team, based on Hurtt et al.

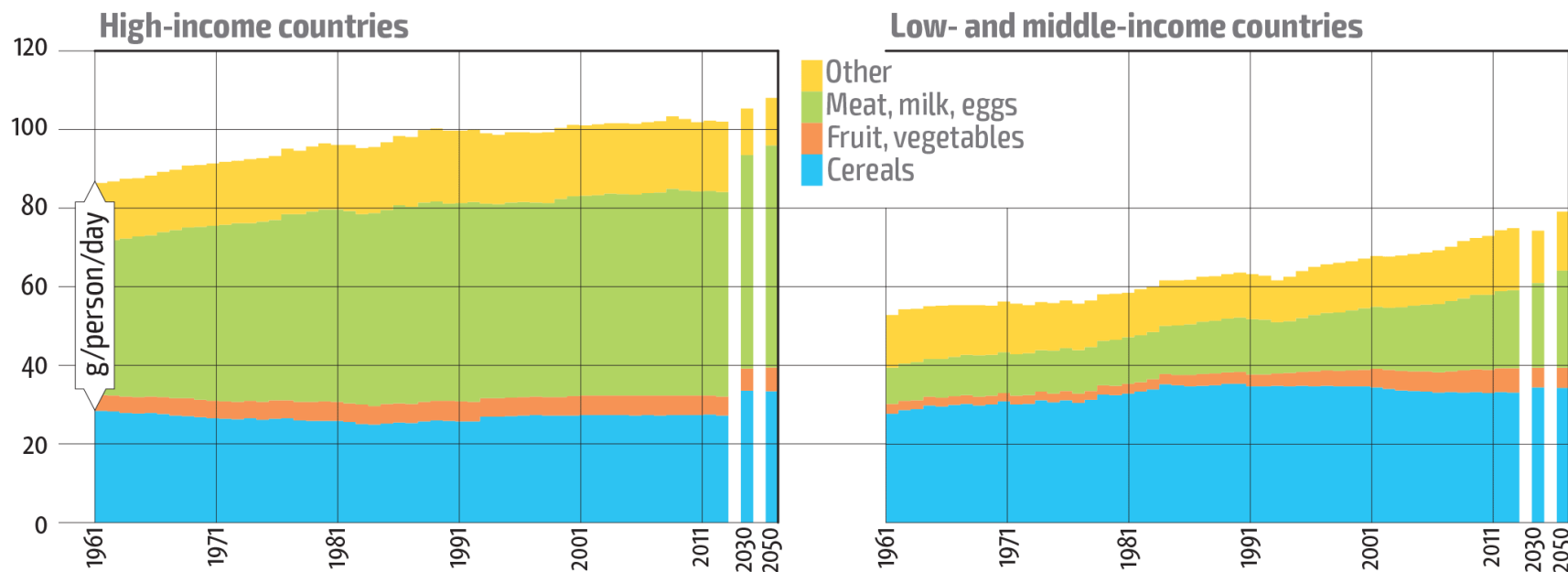
Dietary convergence

Per person calorie intake 1961–2050



Dietary convergence

Per person protein intake 1961–2050





Potential scenarios

Tier 1: Three FOFA 2050 scenarios

Tier 2: FOFA 2050 scenarios with adjustments on feed and land

Tier 3: Simulated changes for specific scenarios, e.g.:

- Changes in productivity (yield per head) by production system
 - Changes in crop productivity
 - Shifts in production systems (herd composition)
 - Changes in demand for food (and meat mix) items
 - Change in herd
 - Selected changes in feed mix (only for traded feed items)
 - Selected macro-economic shocks (per capita GDP, labour productivity in the livestock sector...)
 - Changes in trade
 - Constraints on water resources
 - Further shocks (e.g. non-traded feed) after model adjustments
-



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Thank you



www.fao.org/global-perspectives-studies