Introduction to AGLINK-COSIMO Model

Medium Term Projections

FAO Headquarters

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Food and Agriculture Organization
of the United Nations

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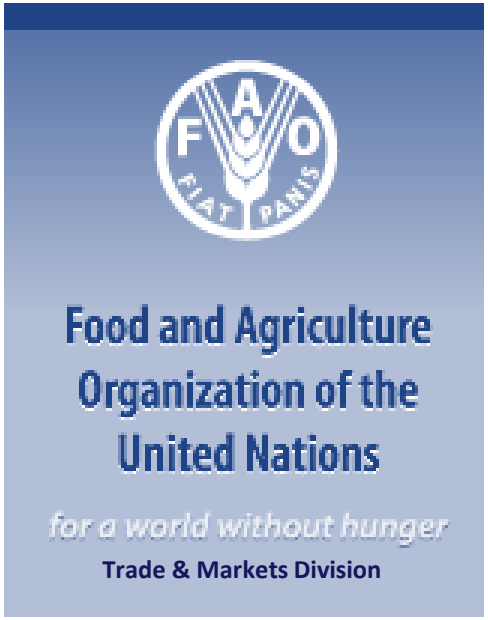

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1. Introduction

Overview of the Workshop

Monday

- General Introduction to OECD-FAO medium-term outlook methodology
- Highlights of the 2014 Agricultural Outlook
- General Introduction outlook process and model

Tuesday

- Introduction to country module – model, data, parameters
- Introduction of global projection model and process
- Applications and exercises using country and global models
- Discussion and future collaboration

WHY AGLINK-COSIMO?

Outlook tool	Analysis tool
• Medium-term outlook model to produce baseline projections • Provides guidelines for decision making • Control in scenario work	• Conduct studies on policy reform • Timely assessment of emerging market issues • Disaggregating of complex interactions

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2. Overview of AGLINK-COSIMO

Vision and main objectives

- Provide consensus analyses on the future evolution of international commodity markets.
- Develop increasingly integrated systems that link short, medium and long term projections.

- Publication of the annual "***OECD-FAO Agricultural Outlook***" in collaboration with the OECD.
- Construct scenarios analyzing emerging market and policy issues using the Aglink-Cosimo model.

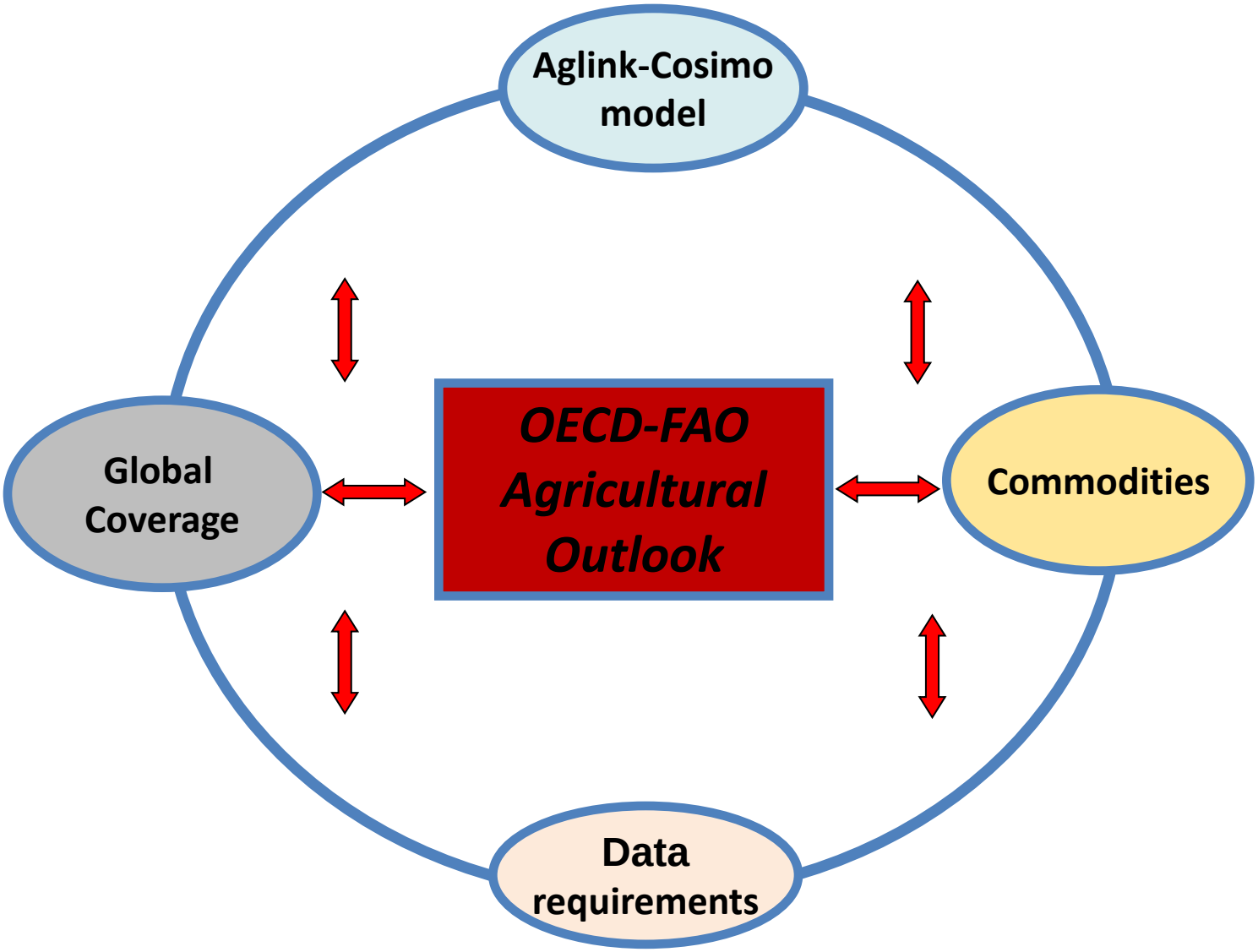
The Outlook: Forecast or Baseline?

- **Expectation for the future**
- **Based on clearly defined assumptions**
- **A prediction, as of coming events or conditions = Forecast**
- **A measurement, calculation, or location used as a basis for comparison = Baseline**

History of joint outlook preparation between OECD and FAO

- Medium term outlook work by FAO and OECD
- Joint work started in 2004
- Expansion of OECD Aglink model to developing countries
- Continuous development

OECD-FAO Agricultural Outlook



OECD-FAO Agricultural Outlook

- Produced annually from December to June.
- Ten-year projection of global supply, demand and trade
- Assessment of driving factors in commodity markets
- Theme Chapter – shared messages for FAO-OECD
- Growing scope – fish, cotton, land, fertilizers....
- Collaborative effort between various organizations
- Teamwork is critical to success

Aglink-Cosimo model

- Partial equilibrium model, driven by elasticities, technical parameters and policy variables,
- provides representations of national and global agricultural markets where all of the major agricultural sectors are assumed to be connected,
- outlook simulation tool that constructs projections over a **ten year period** so that all of the main characteristics of the crops and livestock sectors influence the final equilibrium.

Methodological Approach

Key assumptions of the model:

1. World markets for agricultural commodities are competitive.

2. Domestically produced and traded commodities are viewed to be perfect substitutes by buyers and sellers.

3. Aglink-Cosimo is a partial equilibrium model for the main agricultural commodities. Non-agricultural markets are not modelled and are treated exogenously to the model.

Data requirements

Annual time series for:

Historic (endogenous)

- prices
- supply (area, yield, animal numbers...)
- demand (food, feed, crush...)
- trade (exports, imports)

Projection (exogenous)

- macroeconomic data (GDP, ex. rate...)
- policy variables (tariffs, CAP...)

AGLINK Countries

Endogenous

Australia	Canada	EU-2	Japan	S.-Korea
Mexico	N-Zealand	USA		
Argentina	Brazil	China	Russia	

Exogenous

Norway	Switzerland

Countries and regions

Cosimo			
Countries			Regions
Algeria	Kazakhstan	Tanzania	LDC L. America
Bangladesh	Nigeria	Thailand	Other LDC Africa
Chile	Malaysia	Turkey	Other LDC Asia
Colombia	Mozambique	Ukraine	Other LDC Oceania
Egypt	Pakistan	Uruguay	Other W. Europe
Ethiopia	Paraguay	Vietnam	Other C. Asia
Ghana	Peru	Zambia	Other E. Europe
India	Philippines		Other M. East
Indonesia	Saudi Arabia		Other N. Africa
Iran	South Africa		Other Africa
Israel	Sudan		

Aglink – Cosimo Commodities

Wheat	**Beef**	**Skim Milk Powder**
Coarse Grains**	**Sheepmeat**	**Whole Milk Powder**
Rice	**Pigmeat**	**Cheese**
Oilseeds**	**Poultry**	**Butter**
Vegetable Oils**	**Eggs**	**Fresh Dairy Products**
Oilseed Meals**	**Sugar**	**Ethanol**
Roots and Tubers	**Cotton**	**Bio-diesel**
		Fish (Separate Model)

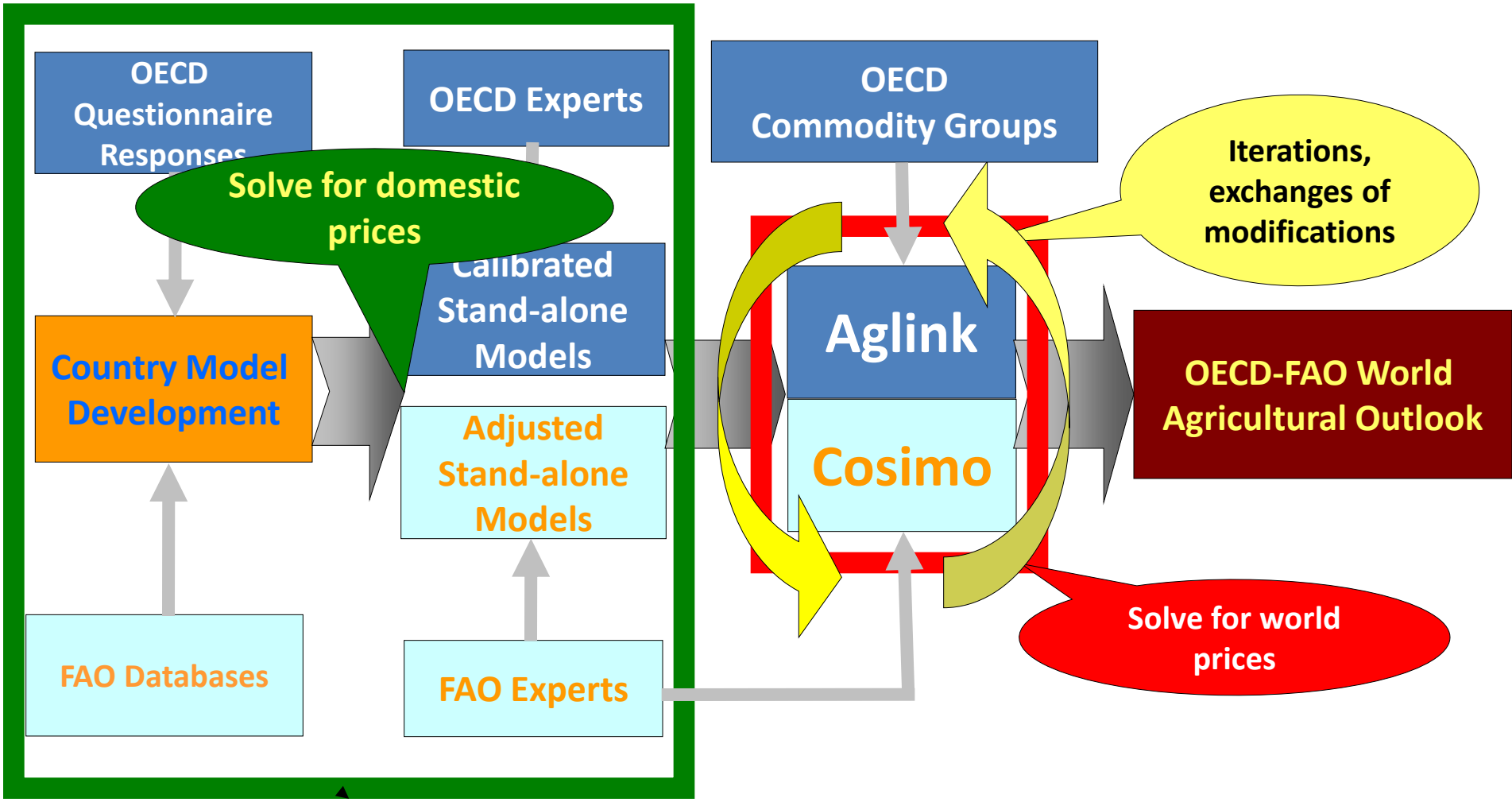
** Indicates sectors which may be disaggregated

Uncertainties and Limitations

Related to:

- macroeconomic developments
- technology advances (yields, biofuel)
- energy prices,
- weather-related production shocks,
- disease outbreaks,
- agricultural policy developments

Aglink – Cosimo Outlook Process



Questions?

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3. Highlights of the 2014 Agricultural Outlook

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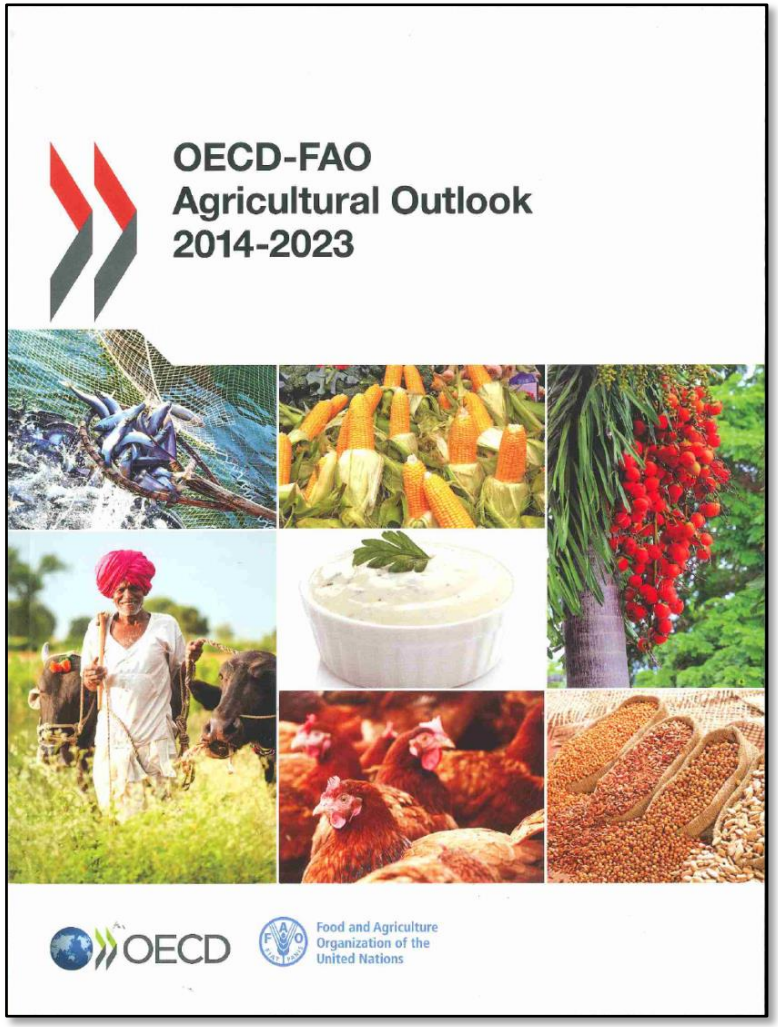
- **Global commodity trends and developments**
  - **Demand**
  - **Supply**
  - **Prices**
- **Feeding India: Prospects and challenges in the next decade**

OECD-FAO Agricultural Outlook

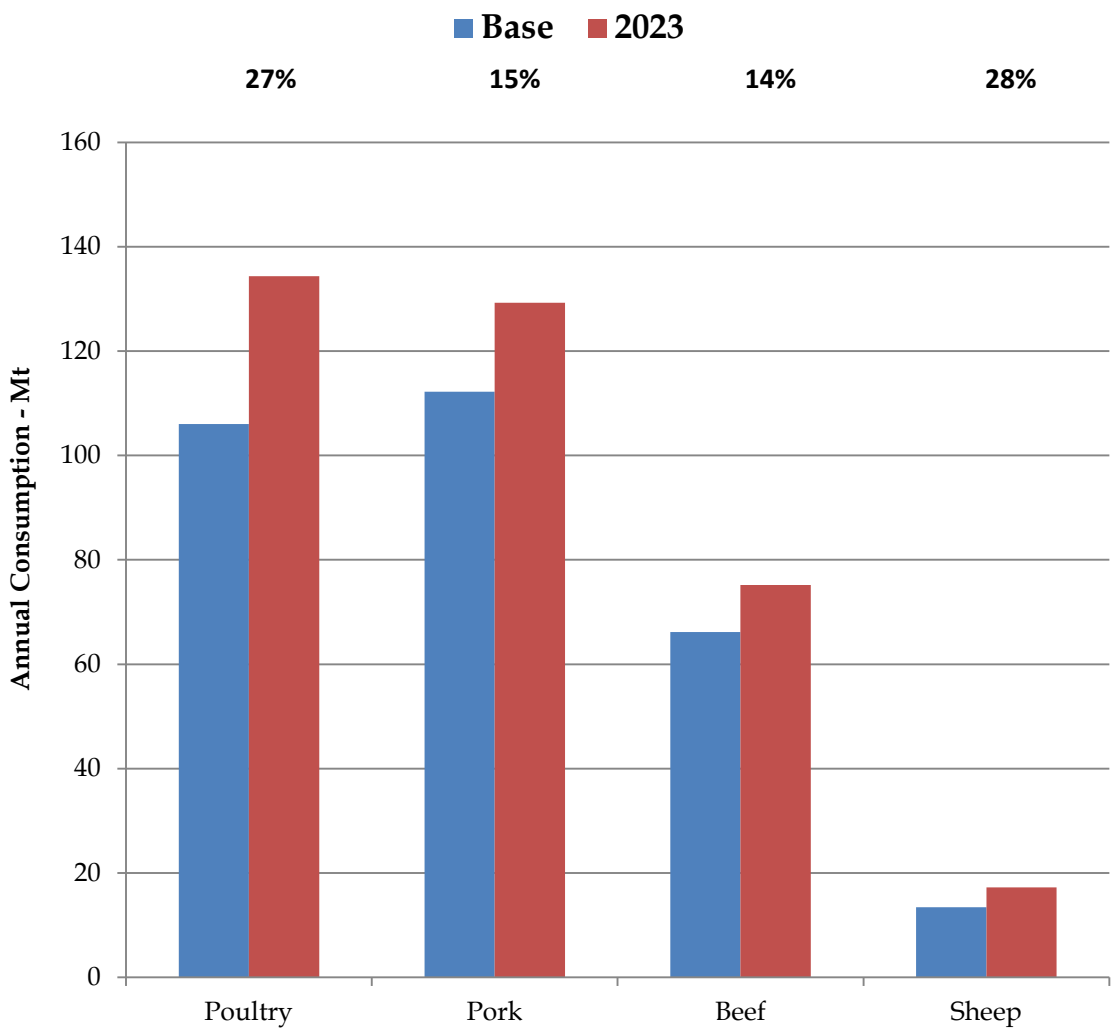
- Joint OECD-FAO report published annually in June
- 10 year horizon
- Model based projection validated through global expert consensus
- Major temperate commodities
- Global coverage
- Country Collaborators Program



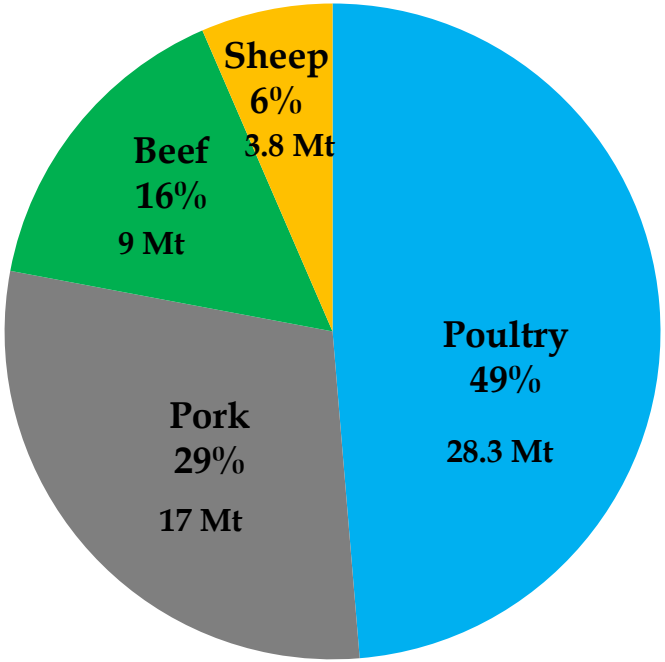
Macroeconomic Assumptions

- GDP growth 2.2% per year for OECD countries, higher in developing countries.
- World population expected to grow 1% per annum.
- Crude oil price to reach USD 147 per barrel by 2023.

Consumption growth: individual meats

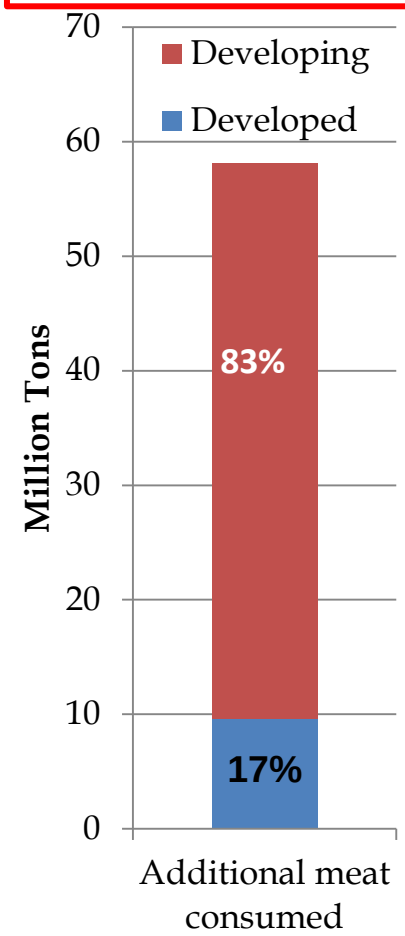


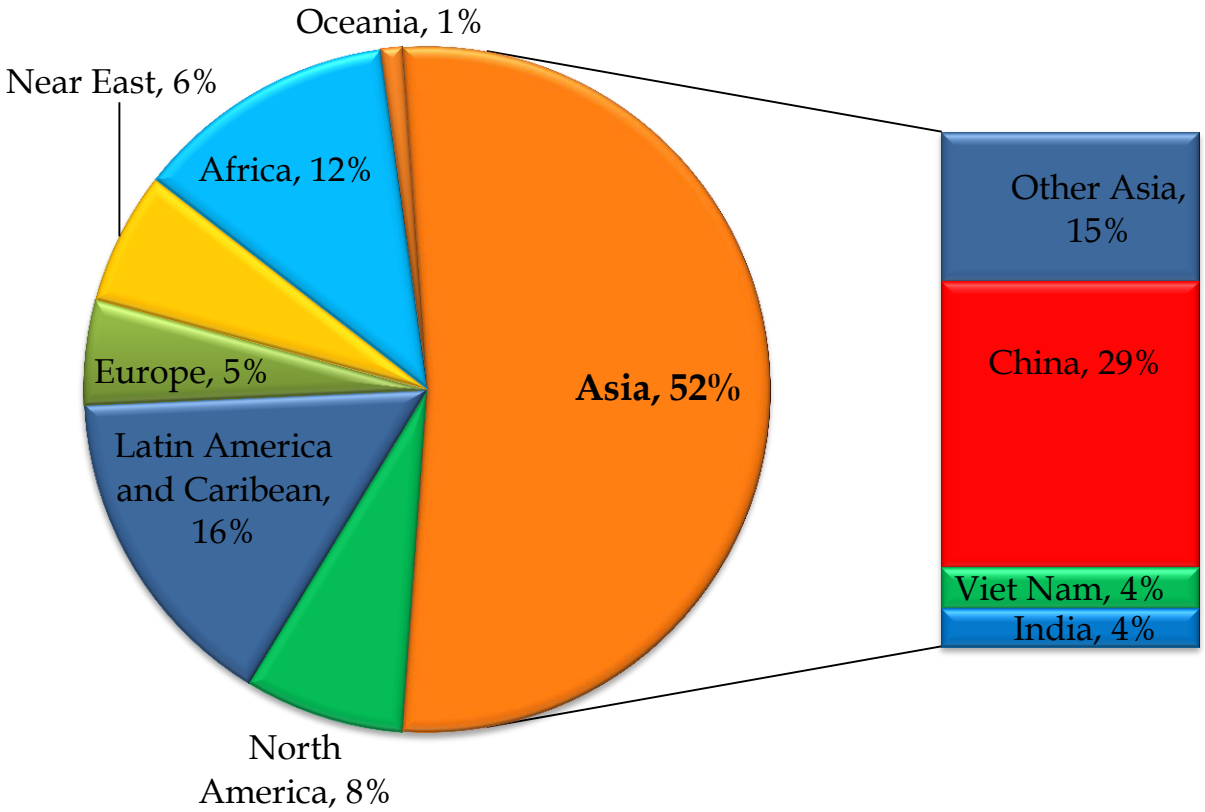
58 million tons additional meat consumed by 2023



Regional distribution of additional meat consumed

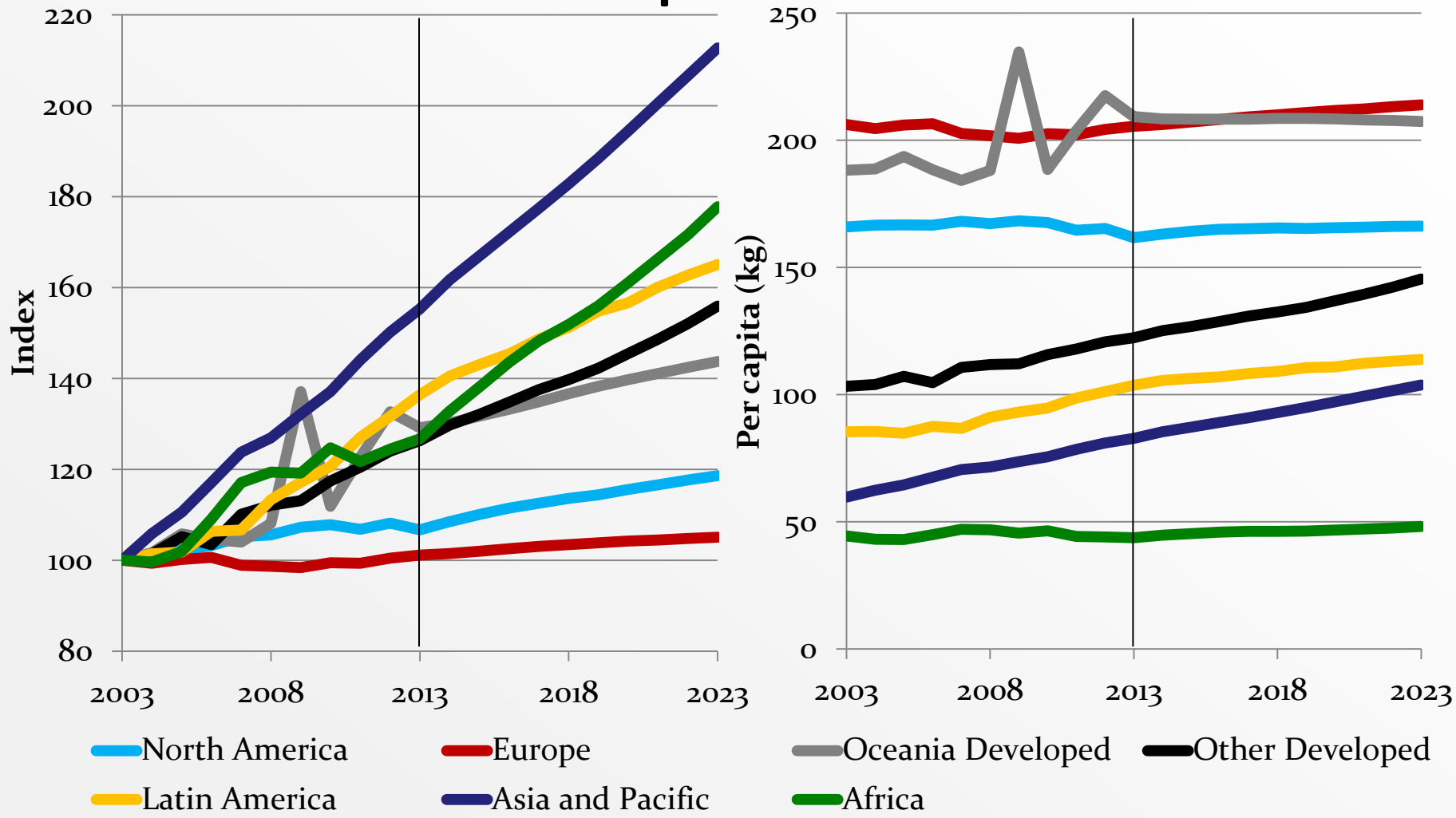
58 million tons additional meat consumed by 2023



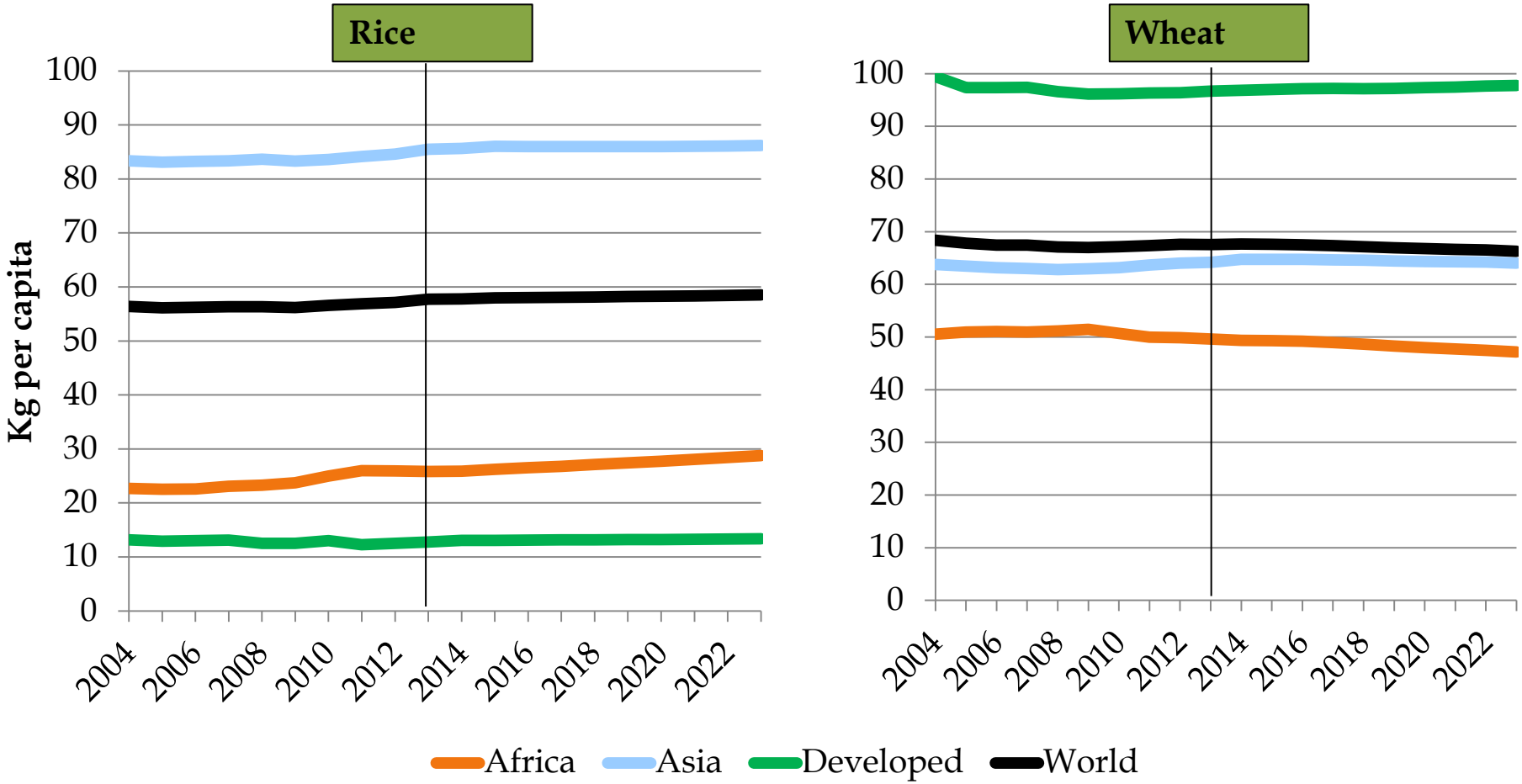


Dairy Demand

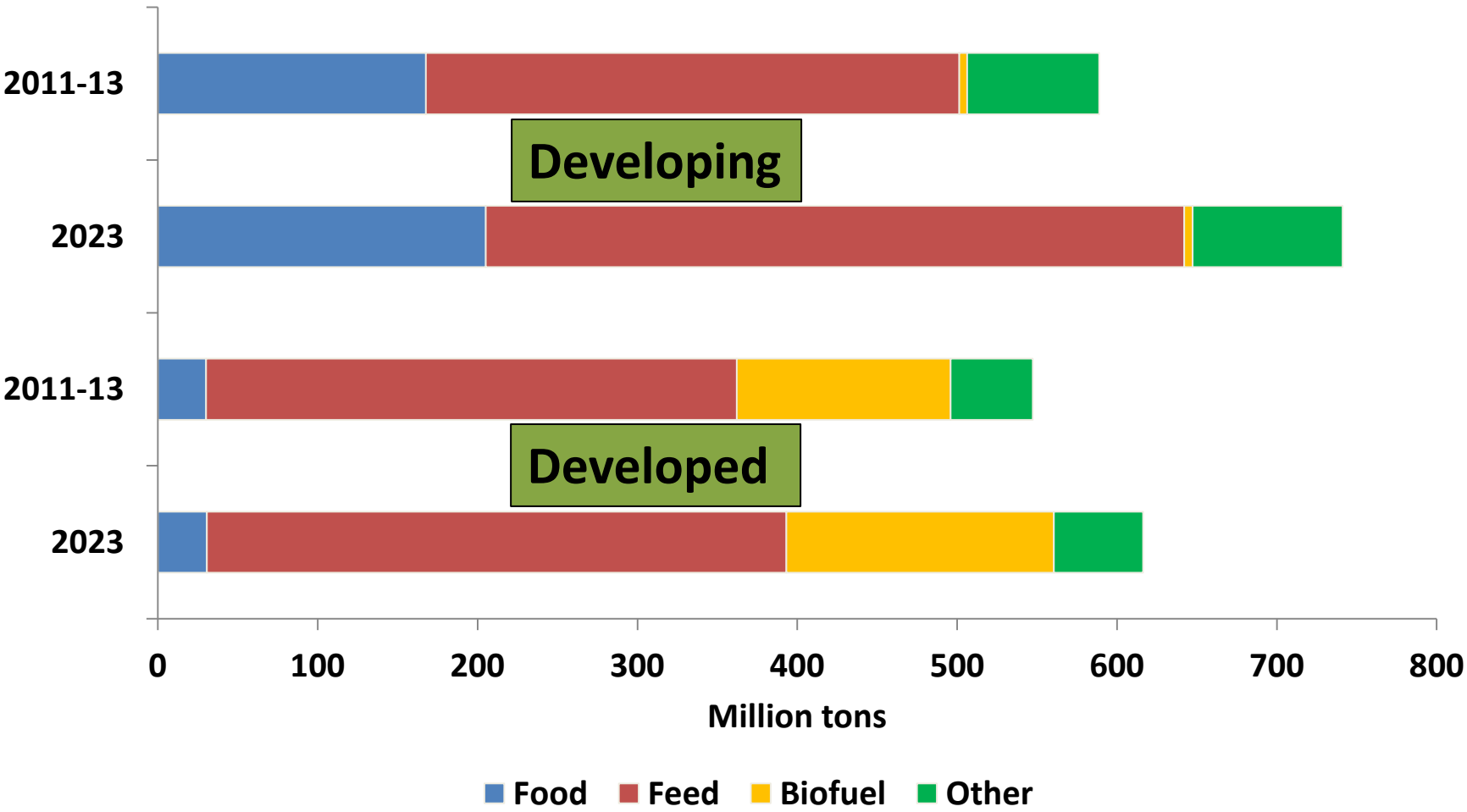
Total (index) and per capita consumption of milk and dairy products



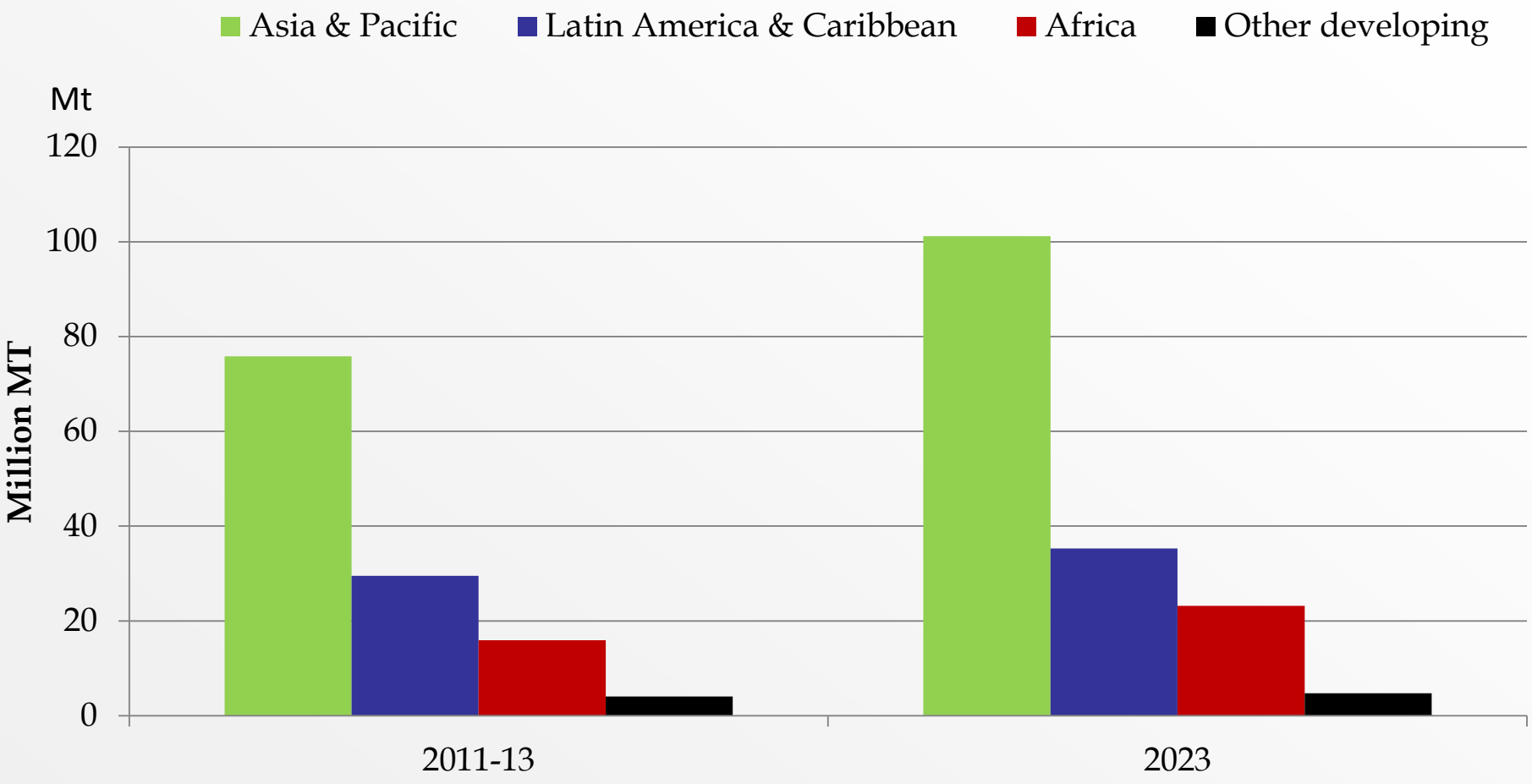
Trends in per capita consumption of primary food grains: rice and wheat



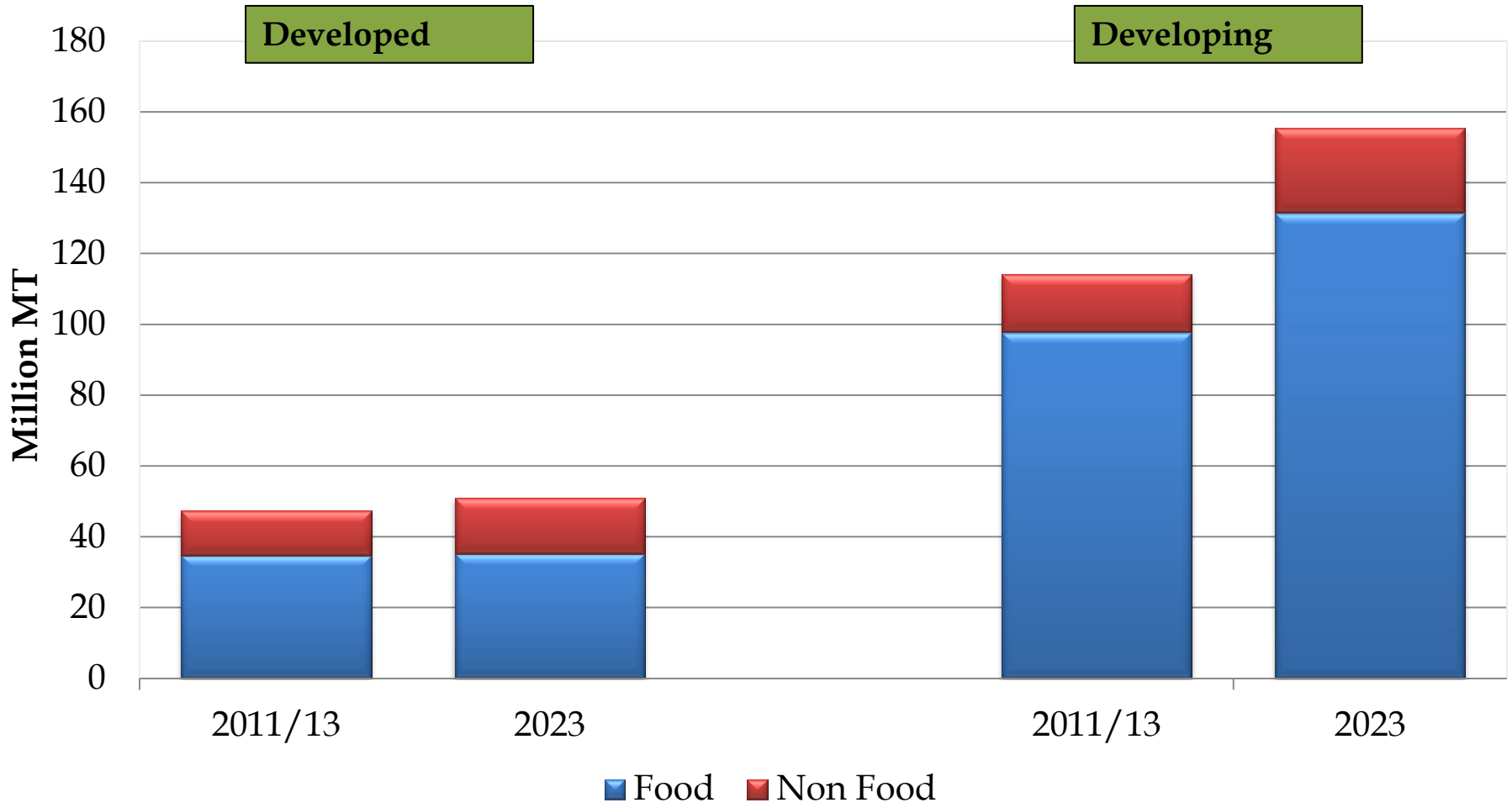
Coarse grains demand food, feed and biofuel



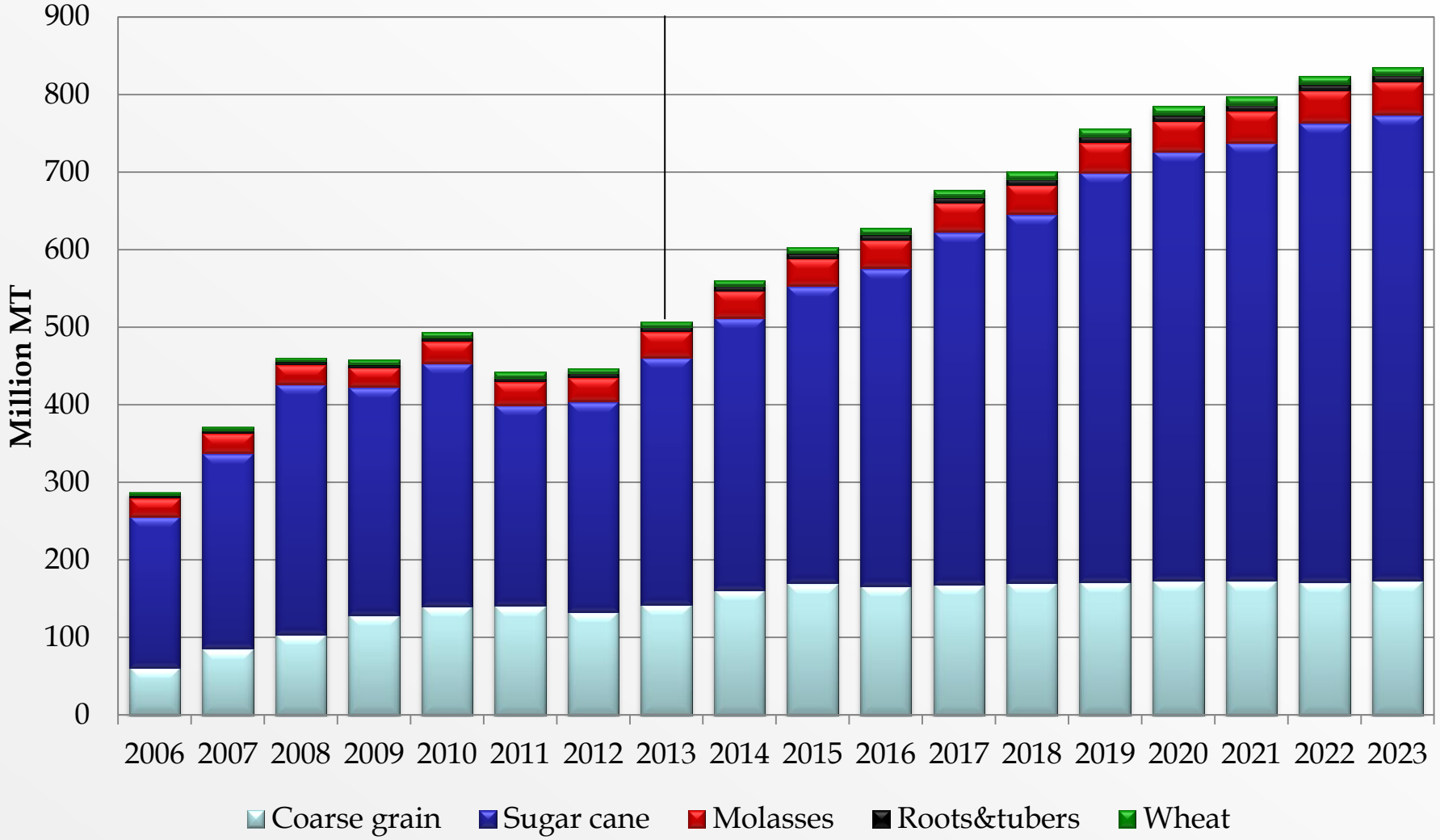
Sugar consumption in the developing countries to underpin the market



Vegetable Oil
Food vs. Non-food Uses



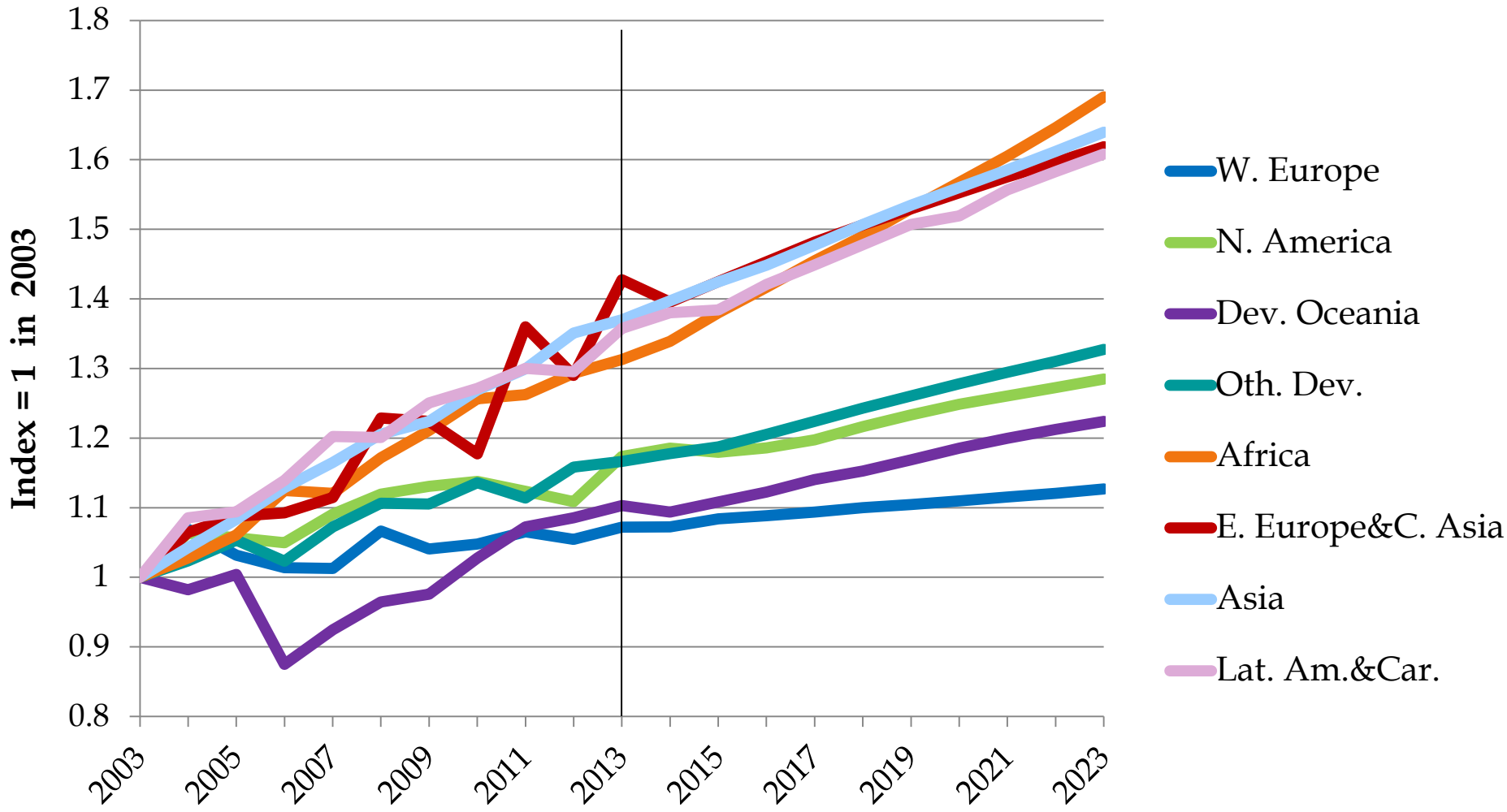
Ethanol use of main feedstocks



Mention to your friends that…

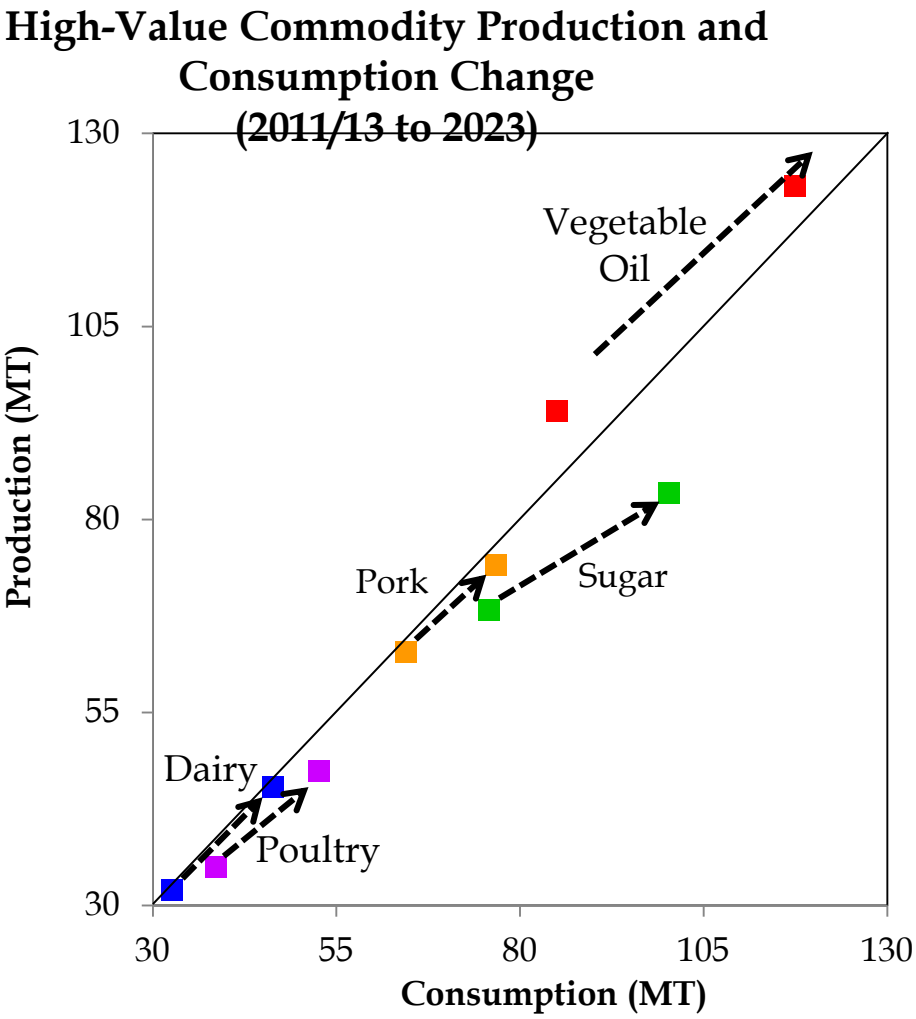
- Cereals are still at the core of human nutrition, but growing incomes, urbanisation and a certain globalisation of eating habits contribute to the ongoing transition of diets that are higher in protein, fats and sugar.
- Annual increase in global consumption is projected for cereals at 1.2%, meat 1.6% and dairy 1.9%.
- Demand is growing at slower rates compared to the past decade, due to: population, saturation, recuperation.

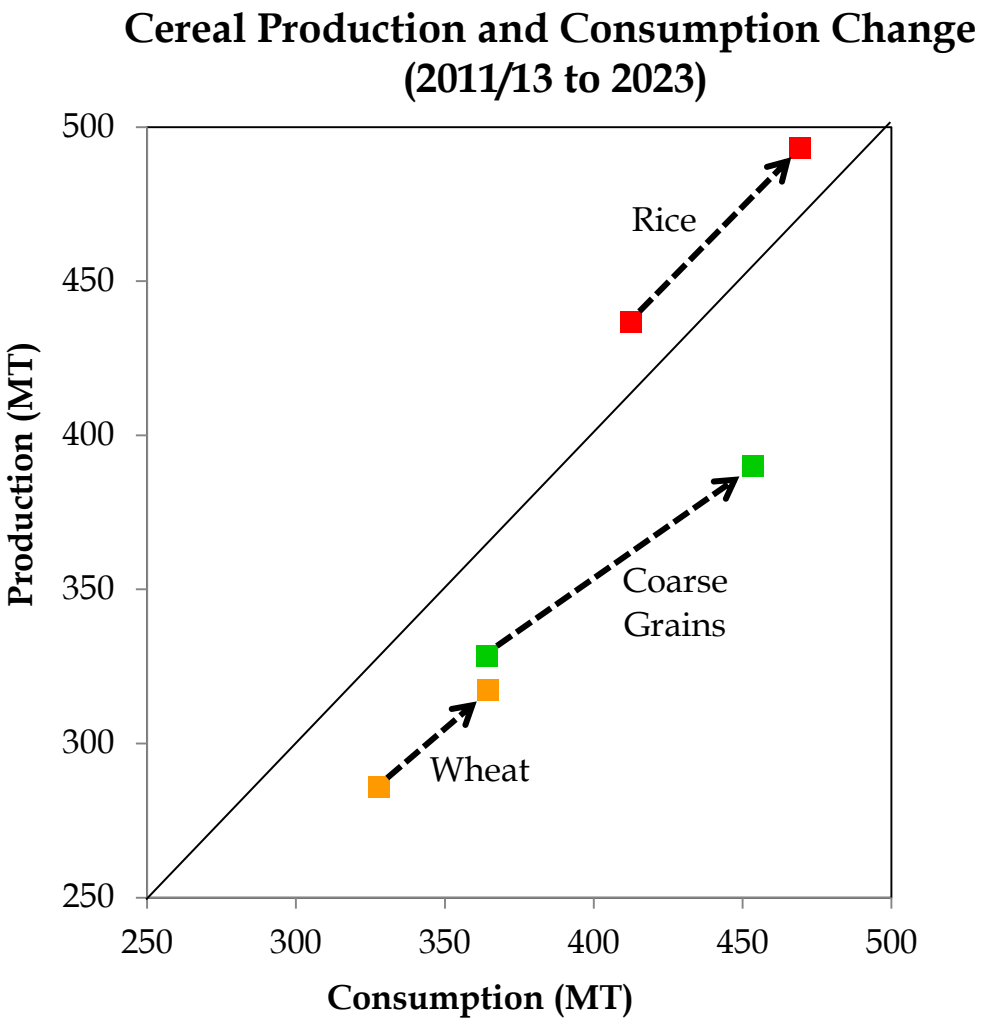
Net agricultural production index



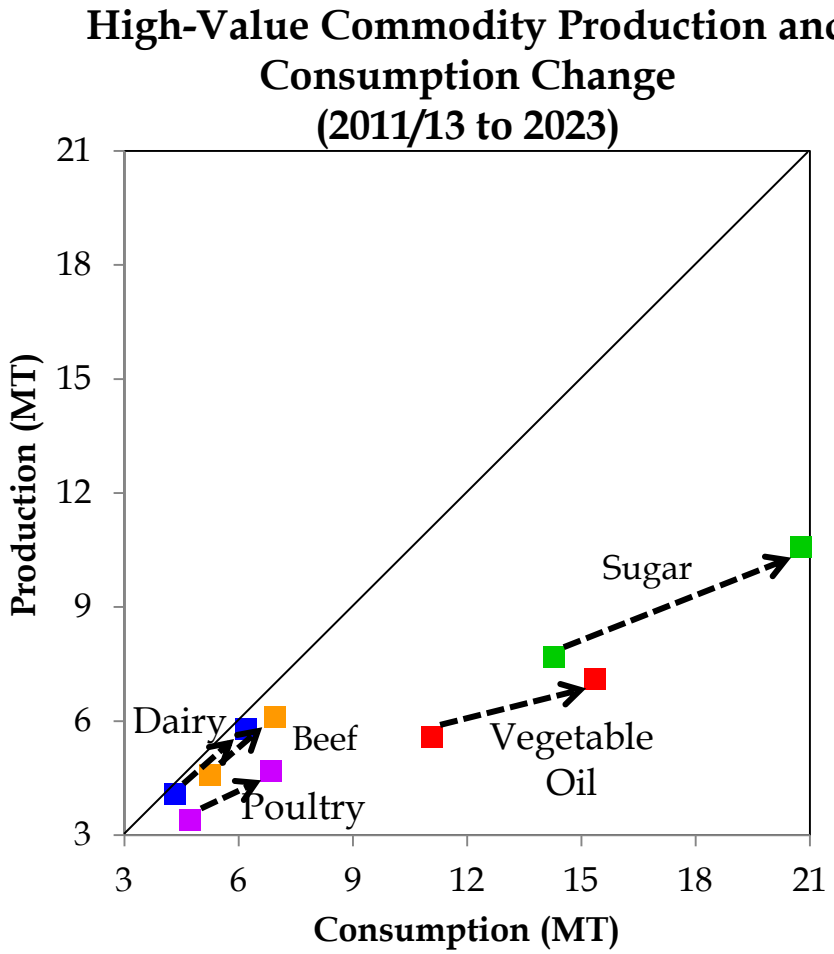
Index based on constant 2004-06 dollars

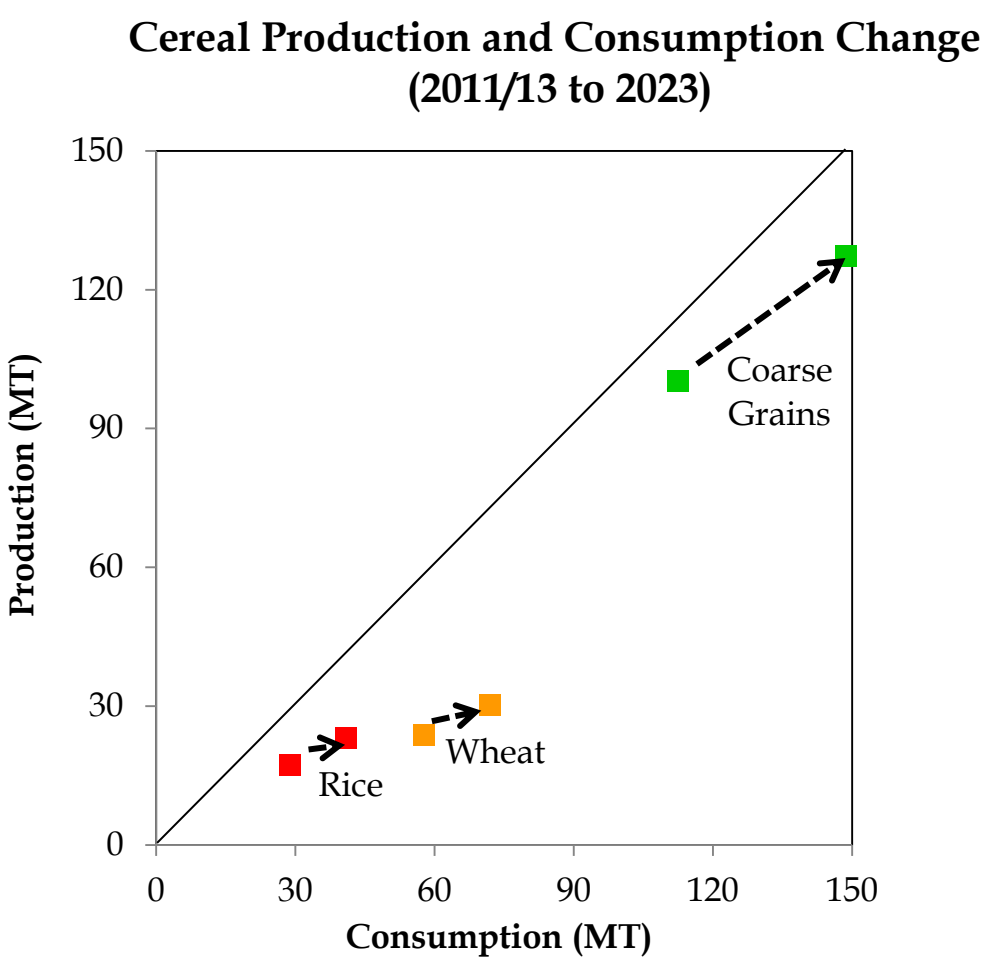
Production in Asia



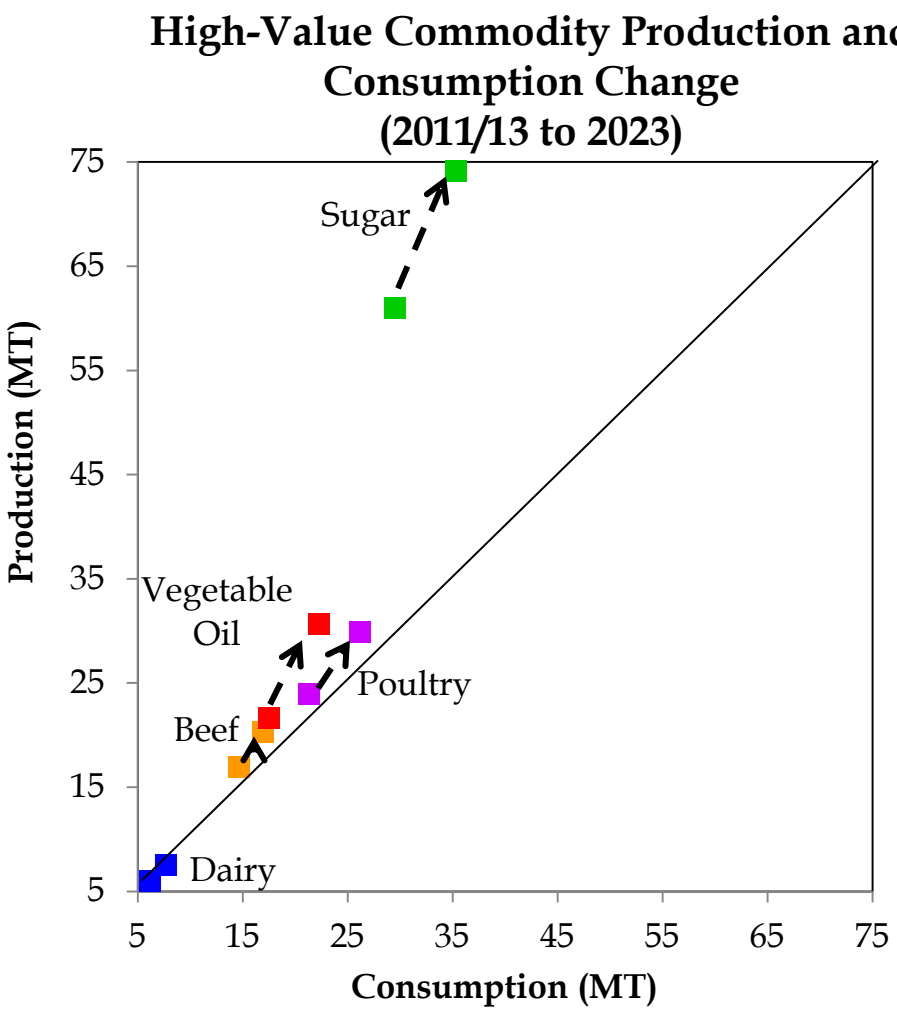


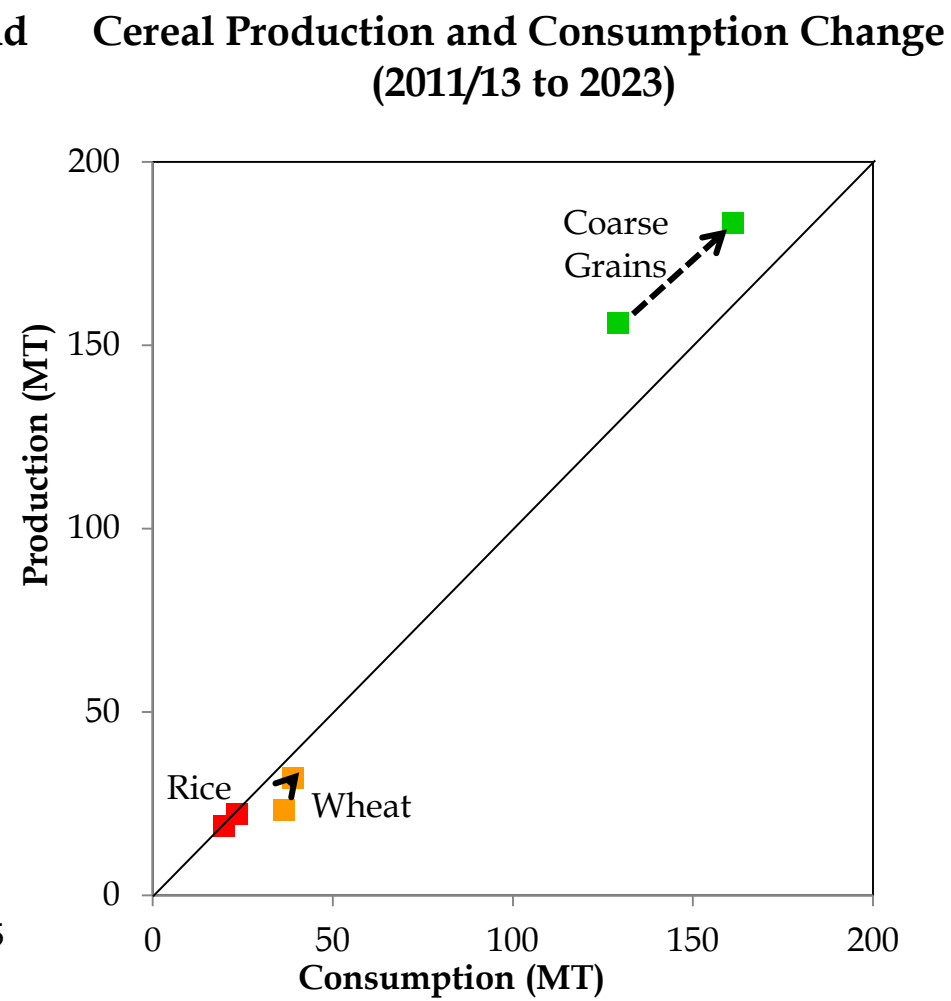
Production in Africa



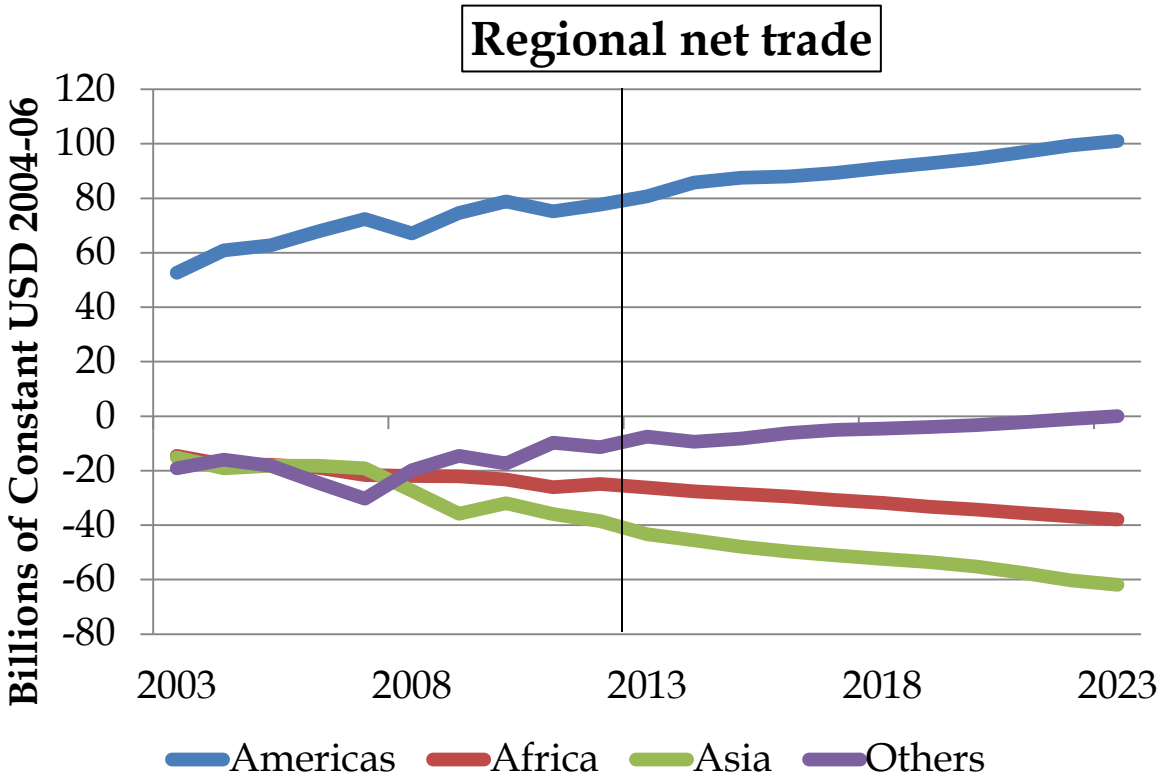


Production in Latin America





The Americas are the surplus region of the world



Americas: dominant export region for most products

Africa: increasingly import dependent for basic food needs

Asia: larger imports despite strong production growth

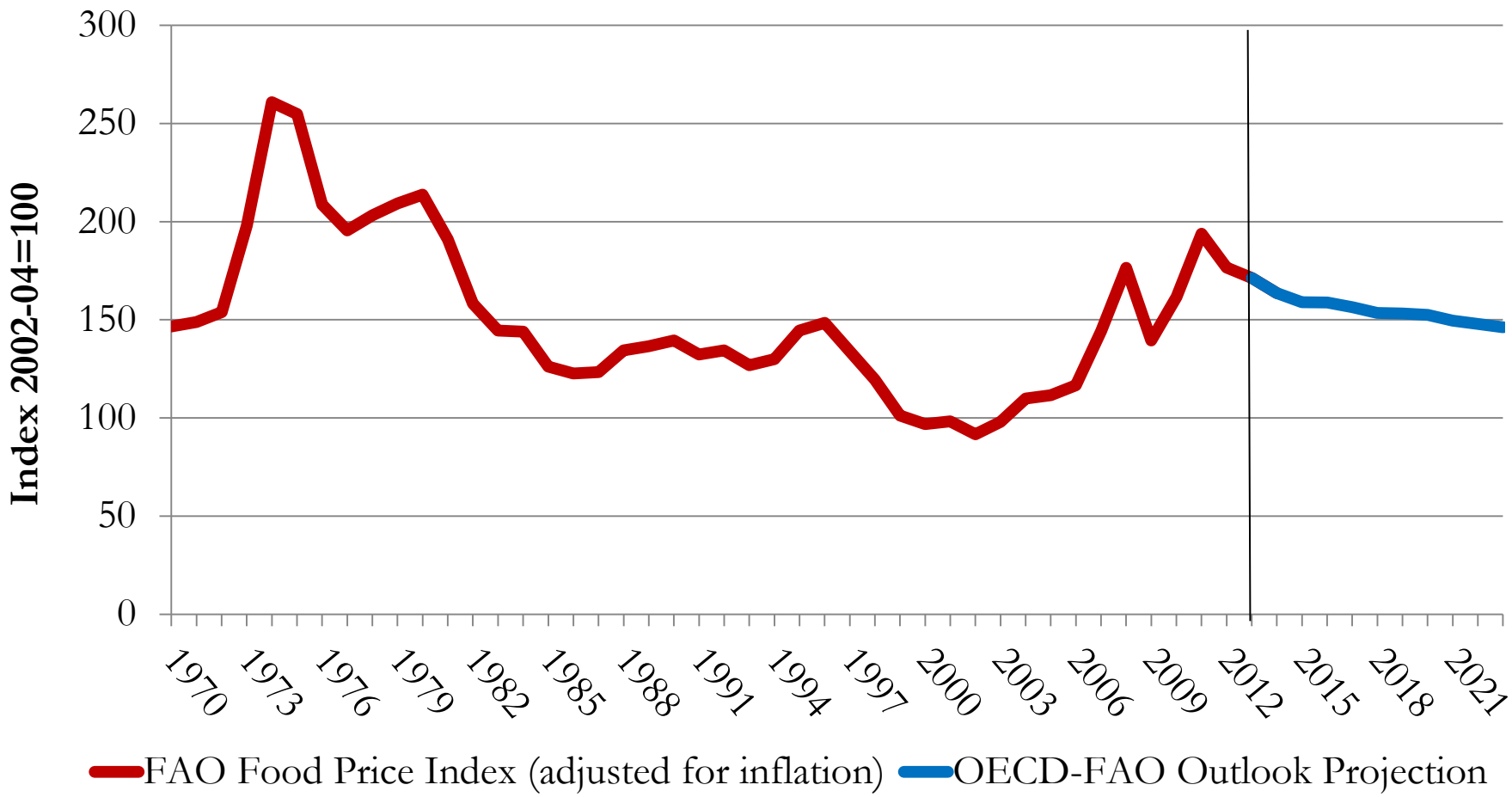
Other: Eastern Europe and Central Asia emerge

Note: Agriculture and fisheries products included in the Outlook

…will they agree that…

- Growth in livestock production is expected to outpace crop production in the next decade.
- The structure of global agricultural production is expected to respond to the increased need for coarse grains and oilseeds compared to wheat or rice.
- The limited availability of additional arable land will impact the expansion and concentration of additional crop production.
- The Americas will strengthen their position as the dominant export region, both in value and volume terms.

FAO's Food Price Index: Real prices on downward trend but high level



Special focus: India

- Strong growth in agriculture will continue, but at a slower pace.
- Food consumption will rise, particularly for value added commodities.
- The new National Food Security Act expects to deliver further significant gains in terms of food security.
- India stays among the leading exporters of agricultural products.

OECD

Food and Agriculture Organization of the United Nations

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4. Introduction to Partial Equilibrium Outlook Modeling

Definition of Partial Equilibrium Model

"A partial equilibrium is one which is based on only a restricted range of data, a standard example is price of a single product, the prices of all other products being held fixed during the analysis."

Source: Definition by George Stigler in

Jain, T.R. (2006-07). Microeconomics and Basic Mathematics. New Delhi: VK Publications. p. 28.

Assumptions of a Partial Equilibrium Model

- The analysis only considers the effects of a given policy action on the market that is directly affected;
- Price and Quantity of a given commodity are taken as endogenous (determined) and all other goods are constant and exogenous to the analysis;
- Markets are perfectly competitive

Assumptions of PE Model 2.

- Cost minimization or profit maximization on the production side;
- Utility maximization (given budget constraint) on the consumption side

Advantages of PE Modeling

1. Disaggregated-level analysis

2. Flexible structure

3. Minimal data requirement

Limitations of PE Modeling

…Obviously….the analysis being only

Partial!!!

Questions?

Tuesday

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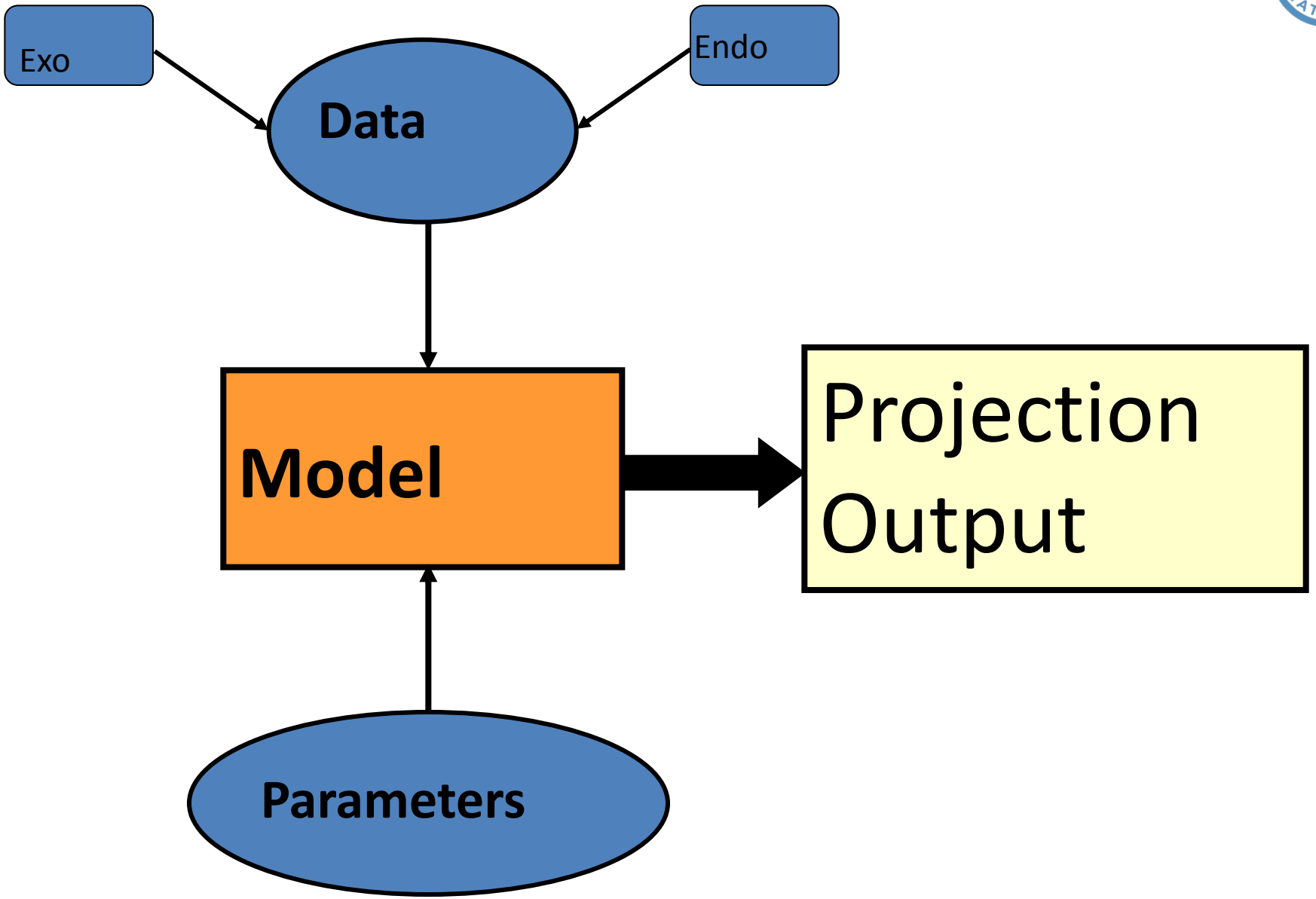
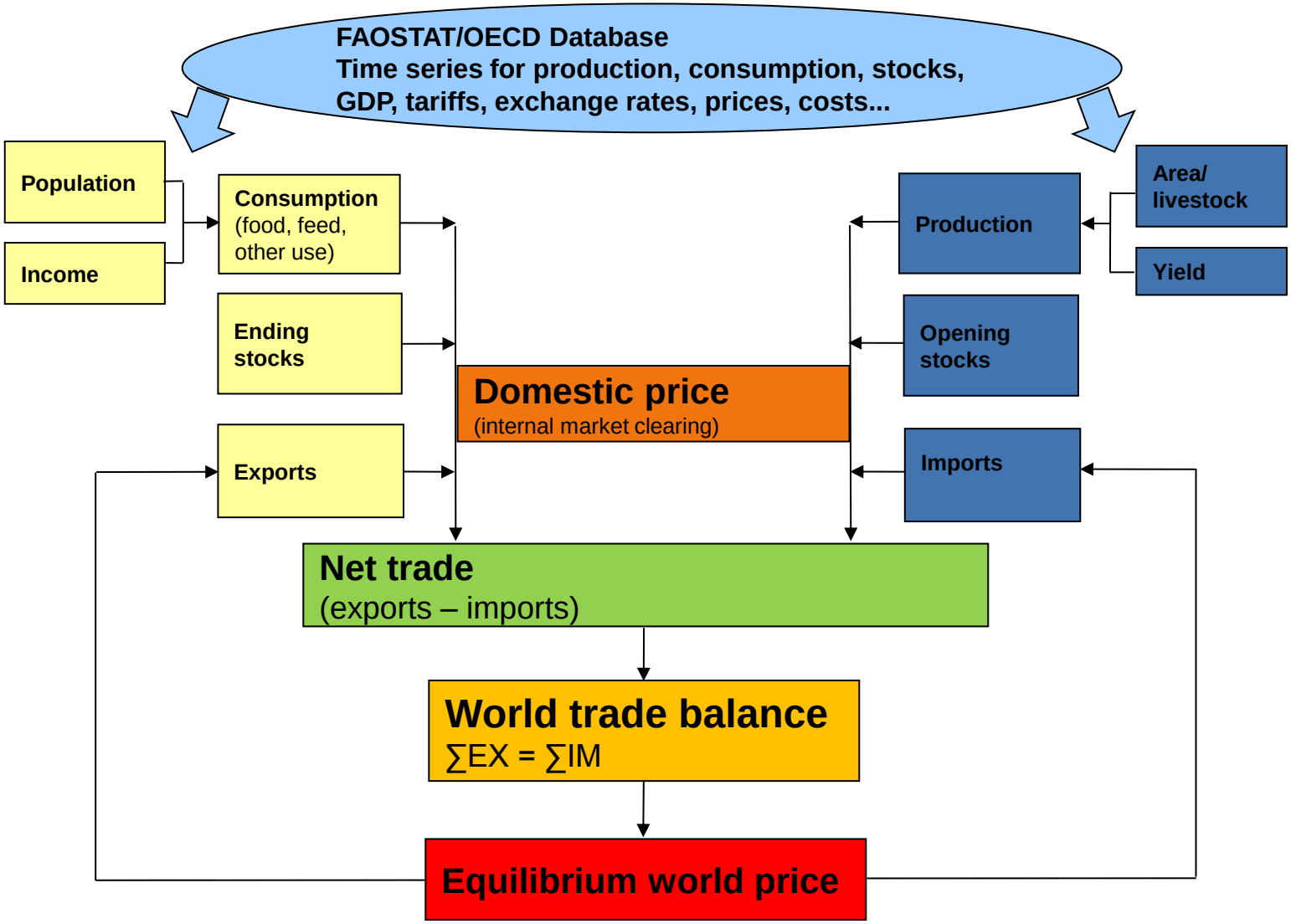
6. Country Model Structure


Exo
Endo
Data
Model
Projection Output
Parameters

Aglink-Cosimo model



Supply

- **Crop production:**

  Area=f(Return/ha, Paymt/ha, Costindex,Area(-1),Rfactor)

  Yield=f(Return/t,Paymt/t,Costindex,trend,Rfactor)

  Production=Area*Yield

- **Oilseed products**

  OilseedMeal production=mealyield*oilseed crush

  Protein meal production=oilseed meal + others…

  Oilseedoil production=oilyield*oilseed crush

  Veg oil production=oilseed oil + palm oil + others…

Supply

- **Meat production**:

  Livestock Inventory=f(Meatprice,Paymt/hd, Feedpriceindex,Costindex,Inventory(-1),trend,Rfactor)

  Indigenous meat production=f(Meatprice,Paymt/tn, feedprice index,costindex,Inventory(-1), production(-1),trend,Rfactor)

- **Milk production:**

  Cow Inventory=f(Milkprice,Paymt/hd, Feedpriceindex,Costindex,Inventory(-1),trend,Rfactor)

  Cow yield=f(Milkprice,Paymt/tn, feedprice index,costindex, trend,Rfactor)

  Milk production= Inventory*yield

  Milk products=f(fatprice,proteinprice)

Demand

- **Food demand**

  Food demand= f(Ownprice, other prices, pricedeflator, Income/person,trnd,Rfactor)

  » Demand constraints apply in log linear relationship

- **Crop Feed demand**

  Feed demand=f(Ownprice, otherprices, nonruminant prod, ruminant prod,trnd, Rfactor)

  » Fish meal, DDGs are deducted

- **Bio-fuel crop feedstock demand**

  Feedstock demand=f(Pricebiofuel, feedstock price, mandate,subsidy, Rfactor)

- **Crop Other use**

  – Other use=f(Price, income,trnd,Rfactor)

Stocks

- **Crops**

  Stocks= f(Ownprice/(average(ownprice), production, Rfactor)

- **Meat and dairy products**

  Stocks=f(Ownprice, production, Rfactor)

Trade

- **Exports**

  Exports= f(producerprice/exportprice, Rfactor)

- **Imports**

  Imports=f(producerprice/importprice, Rfactor)

Prices

- Export price

  Exportprice= worldprice*(1+exportwedge)*exchangerate

- Import price

  Importprice=worldprice*(1+tariff+importwedge)*exchangerate

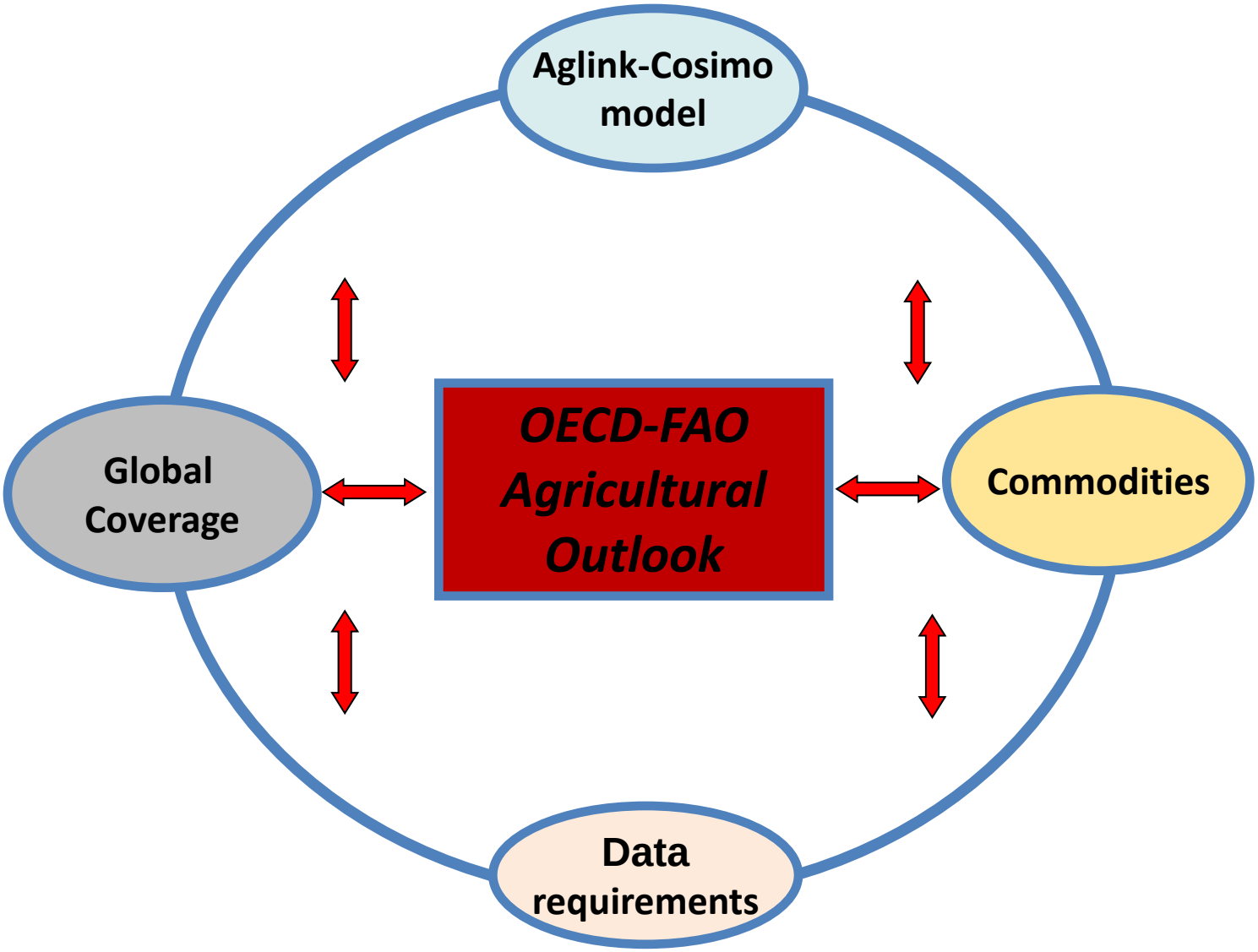
- Producer price: domestic market clearing

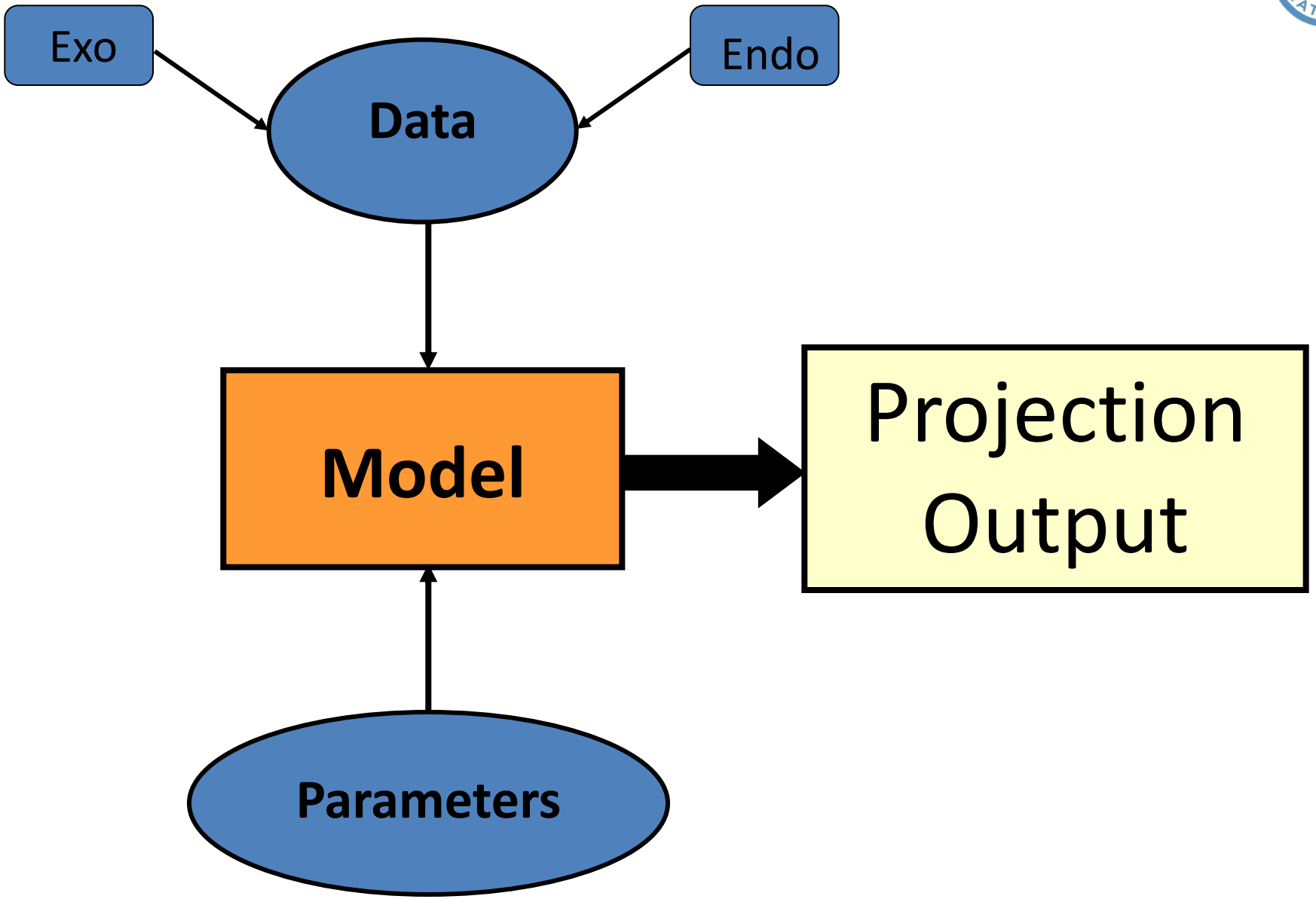
  Production+stocks(-1)+imports=consumption+exports+stocks

- Consumer price

  consumerprice=f(producerprice,deflator)

OECD-FAO Agricultural Outlook

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Questions?

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7. Bioenergy and Food Security

Country model

- **Biofuels**
  - Ethanol
  - Biodiesel

Biofuels

Objectives:

- Produce an annual medium-term outlook for the biofuel sector.
- Carry out in-depth analyses of the fundamentals shaping the biofuel market and their impact on agricultural markets and food security.
- Assess the impact of stated biofuel policy targets on commodities markets.
- Evaluate the impact of second generation biofuels.

Biofuels

Feedstocks:

Ethanol:

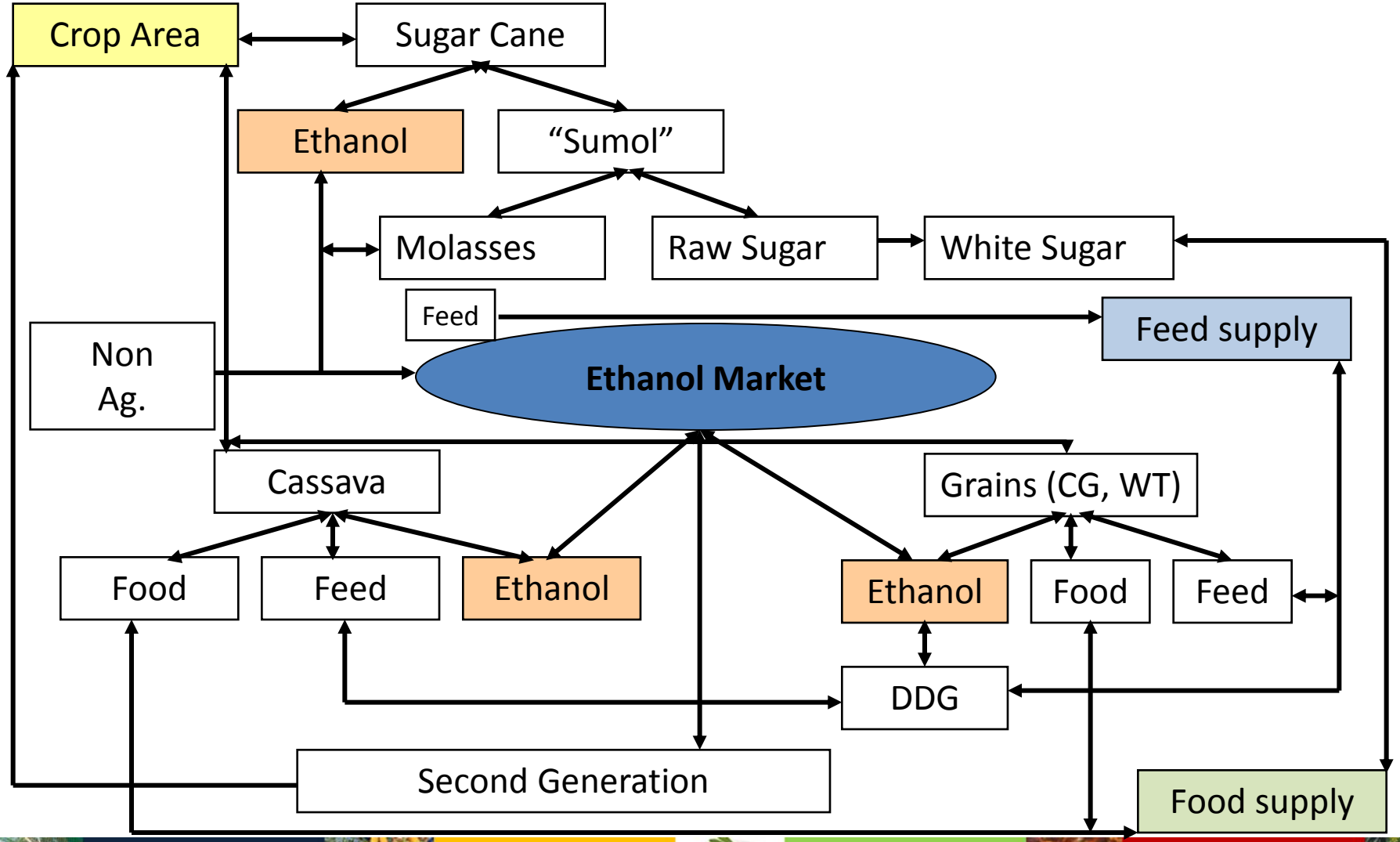
- Molasses
- Sugar cane
- Sugar beet
- Wheat
- Coarse grains
- Roots and Tubers (Cassava)
- Non Agricultural

- Energy crops and residues (second generation)

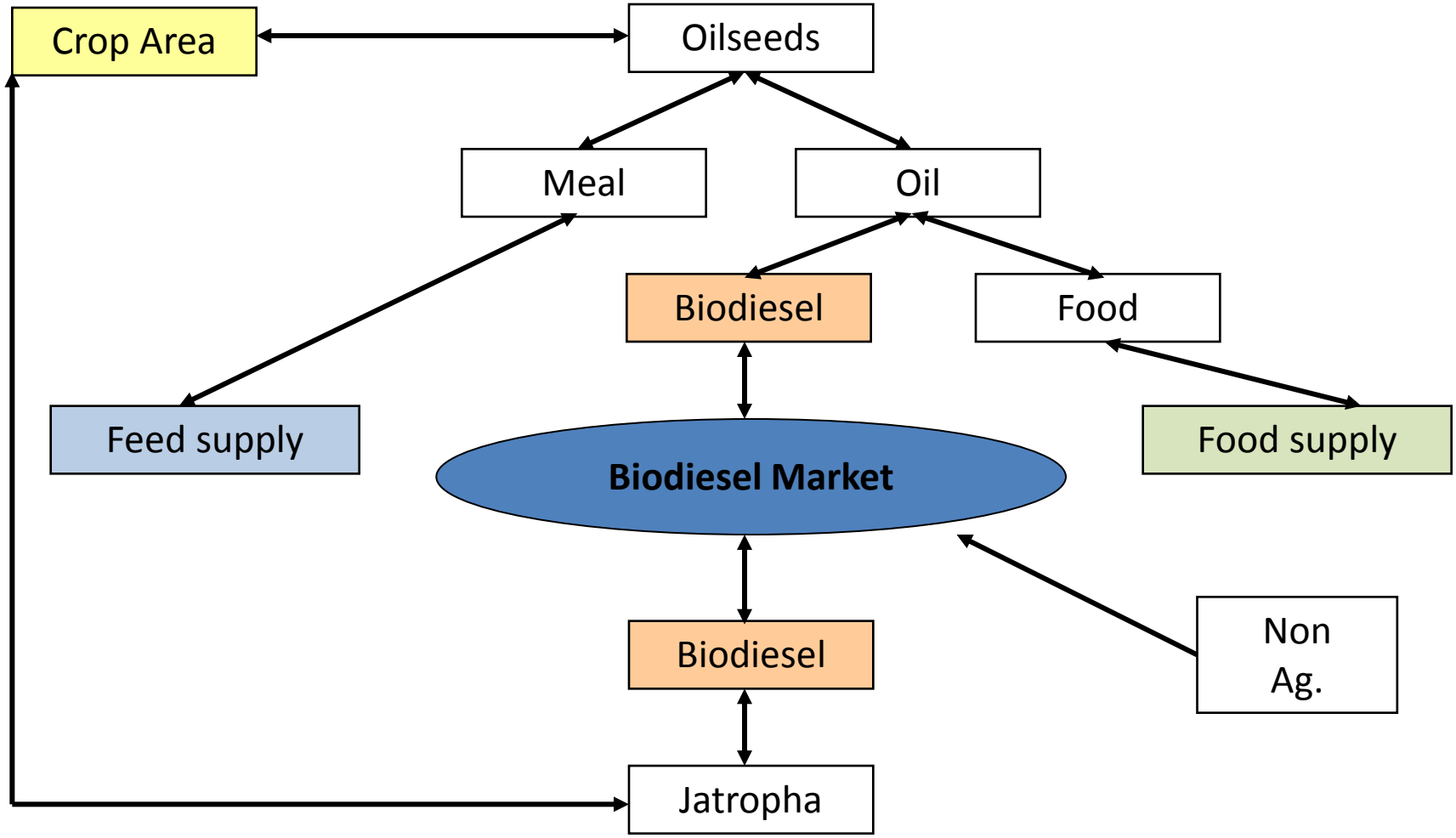
Biodiesel:

- Vegetable oils
- Jatropha
- Non Agricultural

Integration of ethanol into the model



Integration of biodiesel into the model



Biofuels

Exogenous data:

- Transportation fuel use and retail prices (gazoline, diesel)
- Technical conversion factors
- Taxes, tariffs, payments
- Blending requirements

Biofuels

Endogenous data:

- Ethanol and biodiesel domestic production
- Feedstock use
- Ethanol and biodiesel consumption (fuel and other)
- Biofuel trade
- Ethanol and biodiesel domestic and world market prices

Biofuel Production

Total Production = f(price of ethanol/average feedstock price, policy variables)

Production by feedstock = f(average feedstock price/feedstock price)

Feedstock demand = f(production by feedstock, conversion factor)

Byproducts production = f(production by feedstock, conversion factor)

Biofuel Use

Ethanol/Biodiesel use in low blends (price driven) = f(ethanol price/gasoline price, per-capita income, population)

Ethanol other use (non fuel) = f(ethanol price, income)

Mandated Ethanol/Biodiesel use = f(mandated blending, gasoline/diesel use)

Total Ethanol/Biodiesel use = max (mandated, price driven uses)

+ other use (ethanol)

Trade and domestic prices equations are same as other commodities

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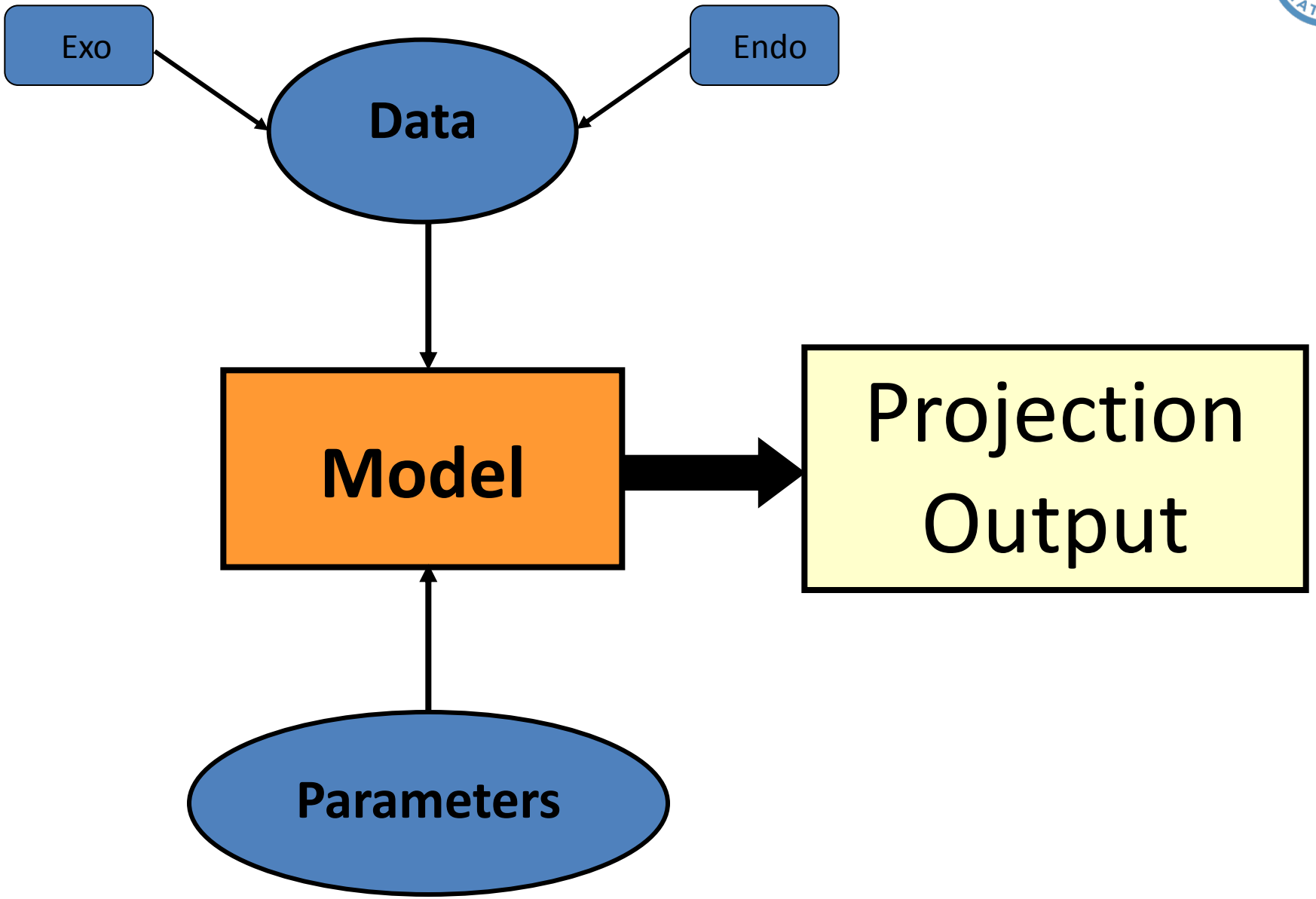
5. Required Data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Annual time series for:

- supply (area, yield, animal numbers, ...)
- demand (food, feed, crush, ...)
- trade (exports, imports)
- prices
- macroeconomic data (GDP, ex. rate, ...)
- policy variables (tariffs, CAP, ...)

Data sources for endogenous data

- national statistics
- international databases
- surveys, questionnaires
- literature
- calculations

Exogenous data

- Population
- GDP deflator
- Consumer price index
- Exchange rate
- GDP
- World prices

- Technical Parameters (time variable)

Data sources for exogenous data

Sources (historic series and projections):

- national statistics
- international databases
- surveys, questionnaires
- literature
- calculations

Exogenous projections may have to be done by you!

Methods:

- trend
- time series methods
- regression
- expert opinion

Questions?

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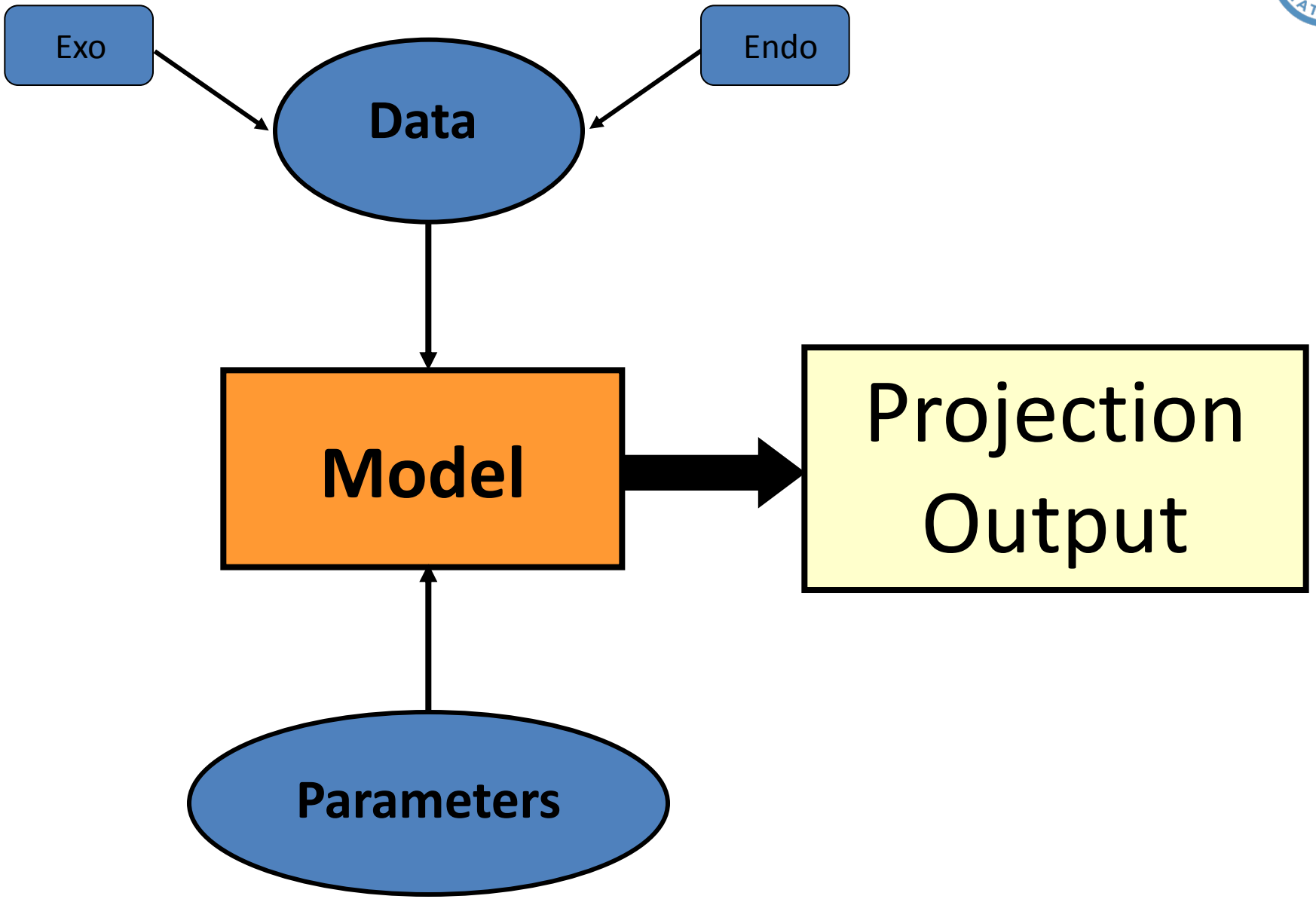
8. PARAMETERS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Parameters

- are the link between variables
- determine the properties of the model

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Parameters

Strategy for parameter choices

1. Use available estimates.
2. Use systems / appropriate constraints
3. Estimate: research estimation agenda

Model validation by country / by commodity

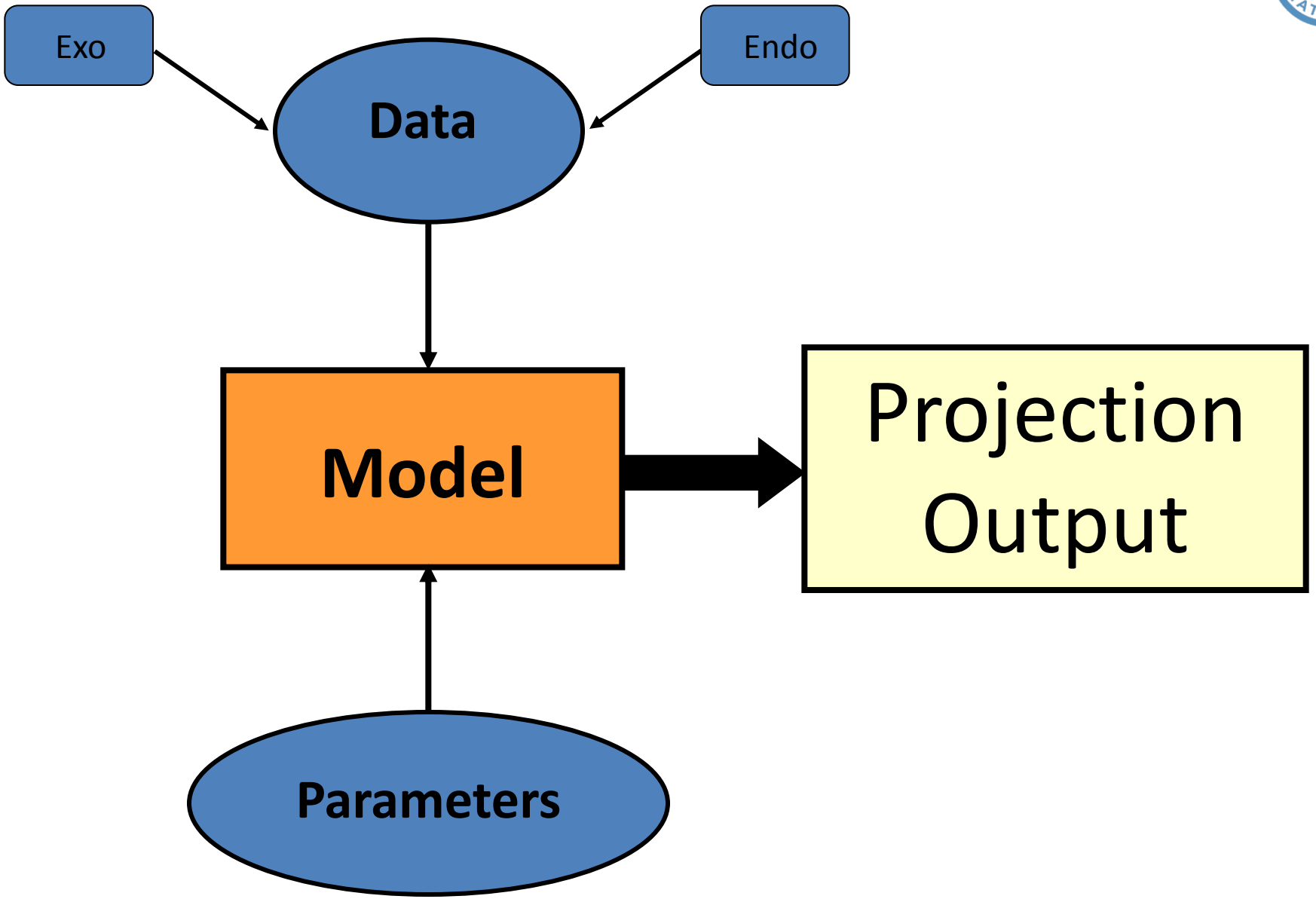
Emphasis on consultation with experts

Parameters

Steps to develop and modify the parameter set

- example of non-estimation method
- based on available estimates

IDNparm2014.xlsm

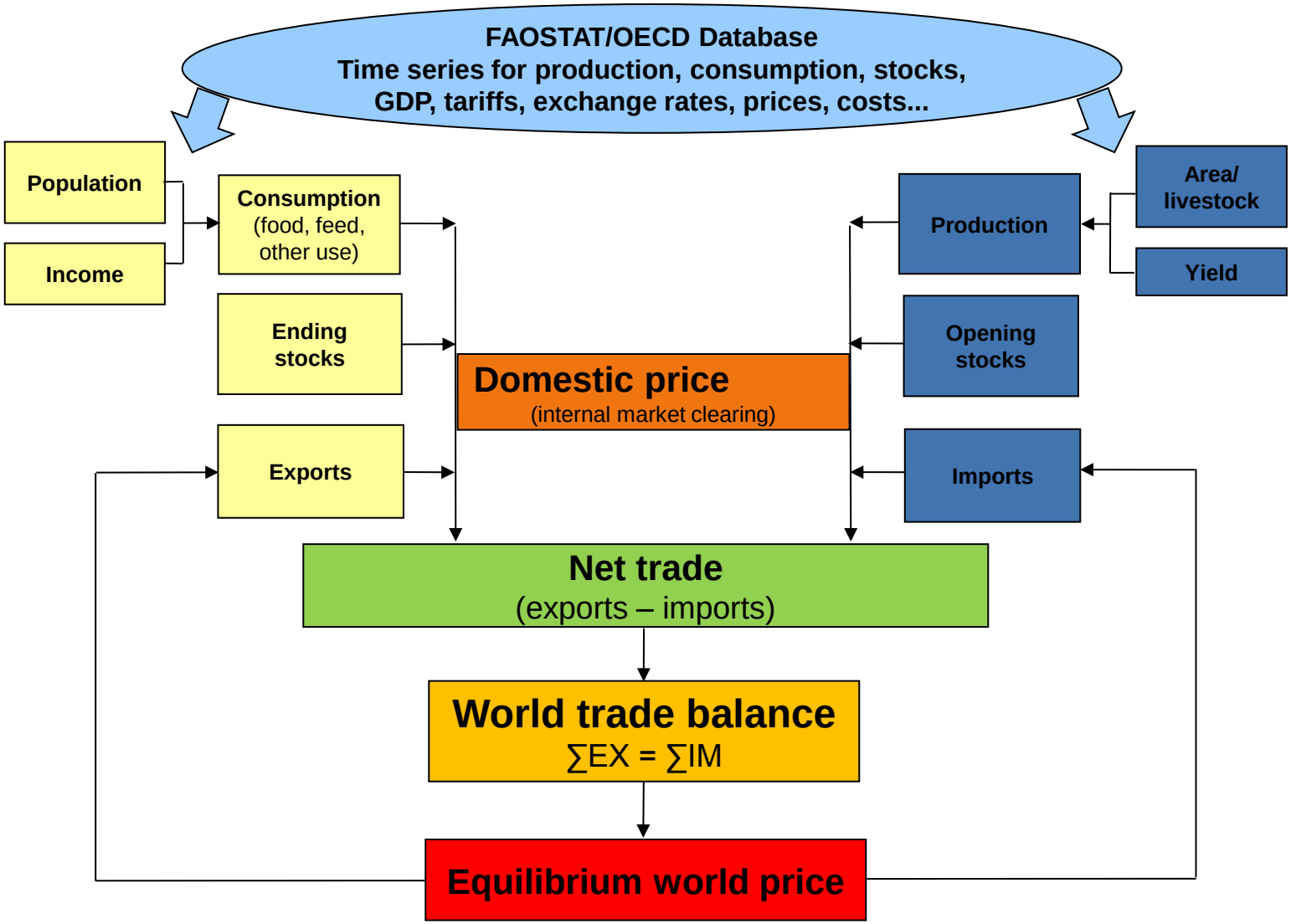

Exo
Endo
Data
Model
Projection Output
Parameters

Questions?

OUTLINE

9. GLOBAL AGLINK-COSIMO MODEL

Aglink-Cosimo Model



Introduction to the global "all linked" model concept

- All country modules are merged
  - Models
  - Data files
  - Parameter files
- World price endogenized
- Equilibrium solution for all countries and all commodities

Model Closure

World Prices Market Clearing

- Wheat, Coarse grain, rice, oilseeds, raw sugar, poultry, sheep meat, butter, cheese, skim powder, whole powder, ethanol, biodiesel:
  - Global exports = Global imports

- Bovine and pig meats:
  - Pacific market: exports=imports
  - Atlantic market: exports = imports
  - Rest of world: exports=imports

OUTLINE

11. Introduction to Troll-based Modeling

Introduction of the Troll Simulation Software

- Integrated software for econometric, modeling and statistical analysis
- State-of–the-art model simulation engine designed for large systems
- Complete integration of various tasks (calculation, model editing, estimation, simulation...)
- Hundreds of built-in functions and sophisticated modeling language
- Efficient interface to MS-EXCEL
- Available for any platform, MS-WINDOWS or UNIX

OUTLINE

10. Applications

Scenarios

Aglink-Cosimo is capable of simulating scenarios involving:

Policies

- production
- consumption
- trade

Socio economic factors

- macro economic drivers
- population

Technology

- yields
- costs

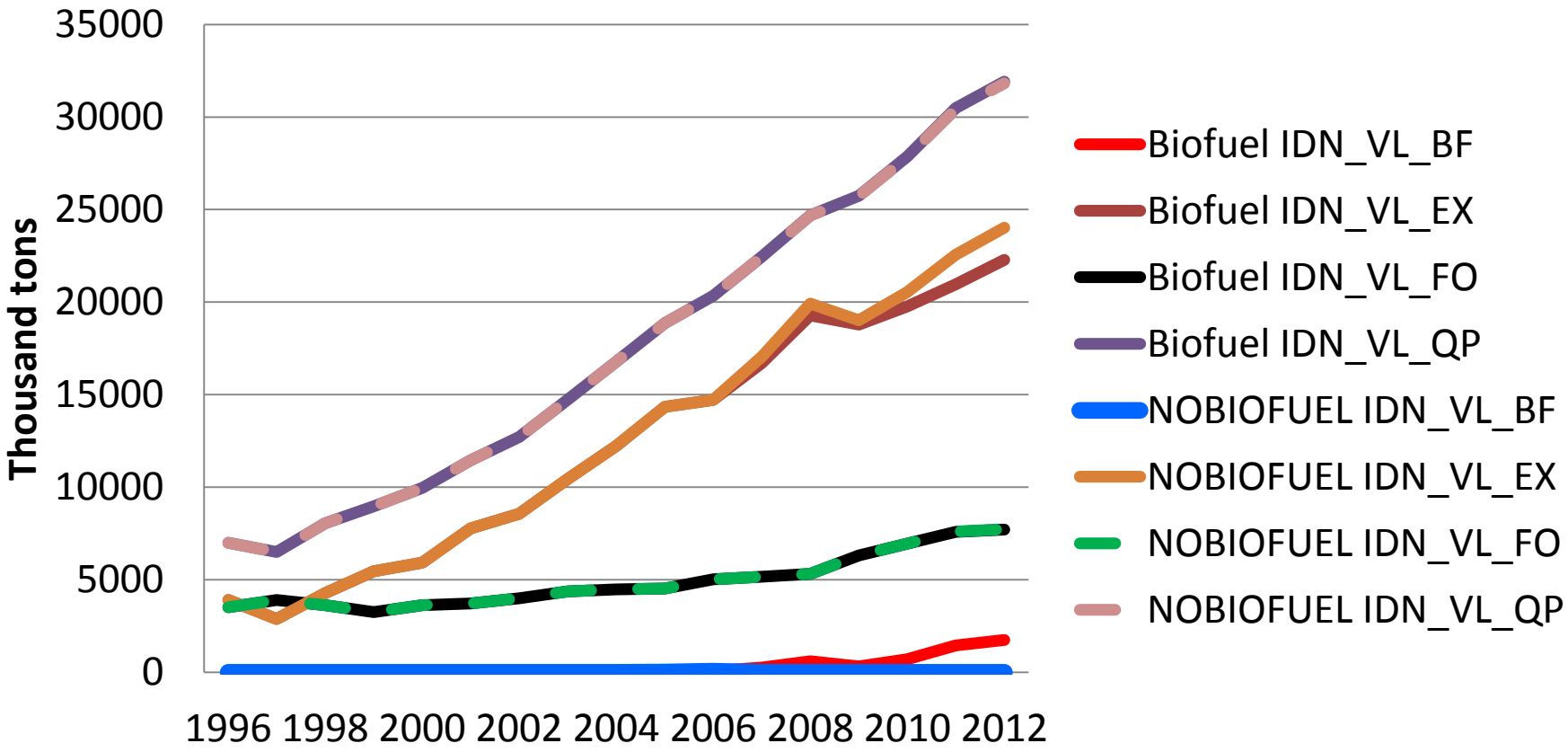
Counterfactual Scenario Setup 1.

Impact of biodiesel production on domestic prices of the main agricultural commodities from 2007 to 2012

- Ex- post **2007-2012**
- Analyses deviation from hypothetical baseline caused by using vegetable oil instead of biodiesel

Scenario 1. biodiesel

Indonesia Vegetable oil production, exports, food and biofuel use



Scenario 1: Results

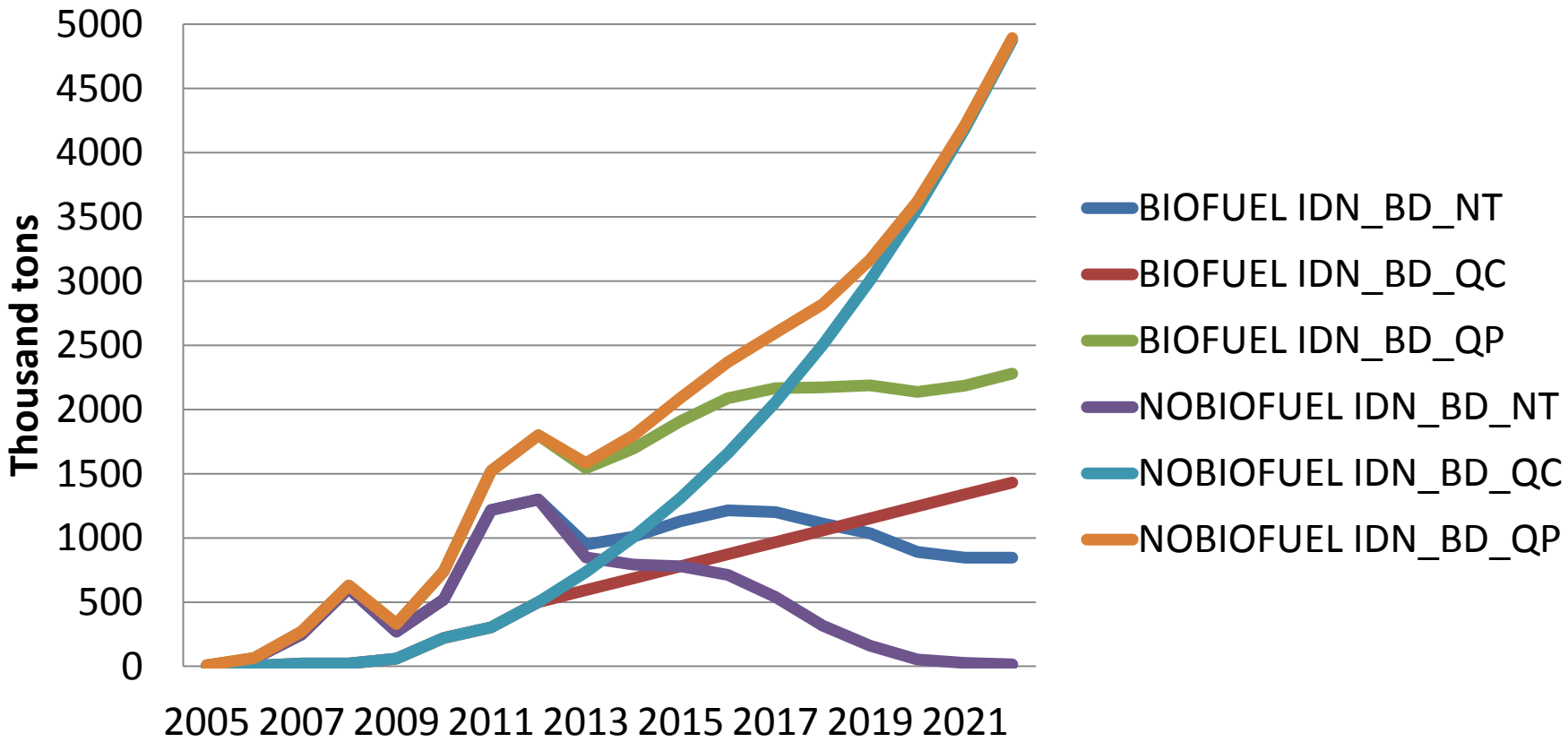
Results indicate that there would be no major changes affecting food markets: domestic prices for rice, wheat and coarse grains remained relatively unchanged compared to the baseline.

Forward-looking Scenario Setup 2.

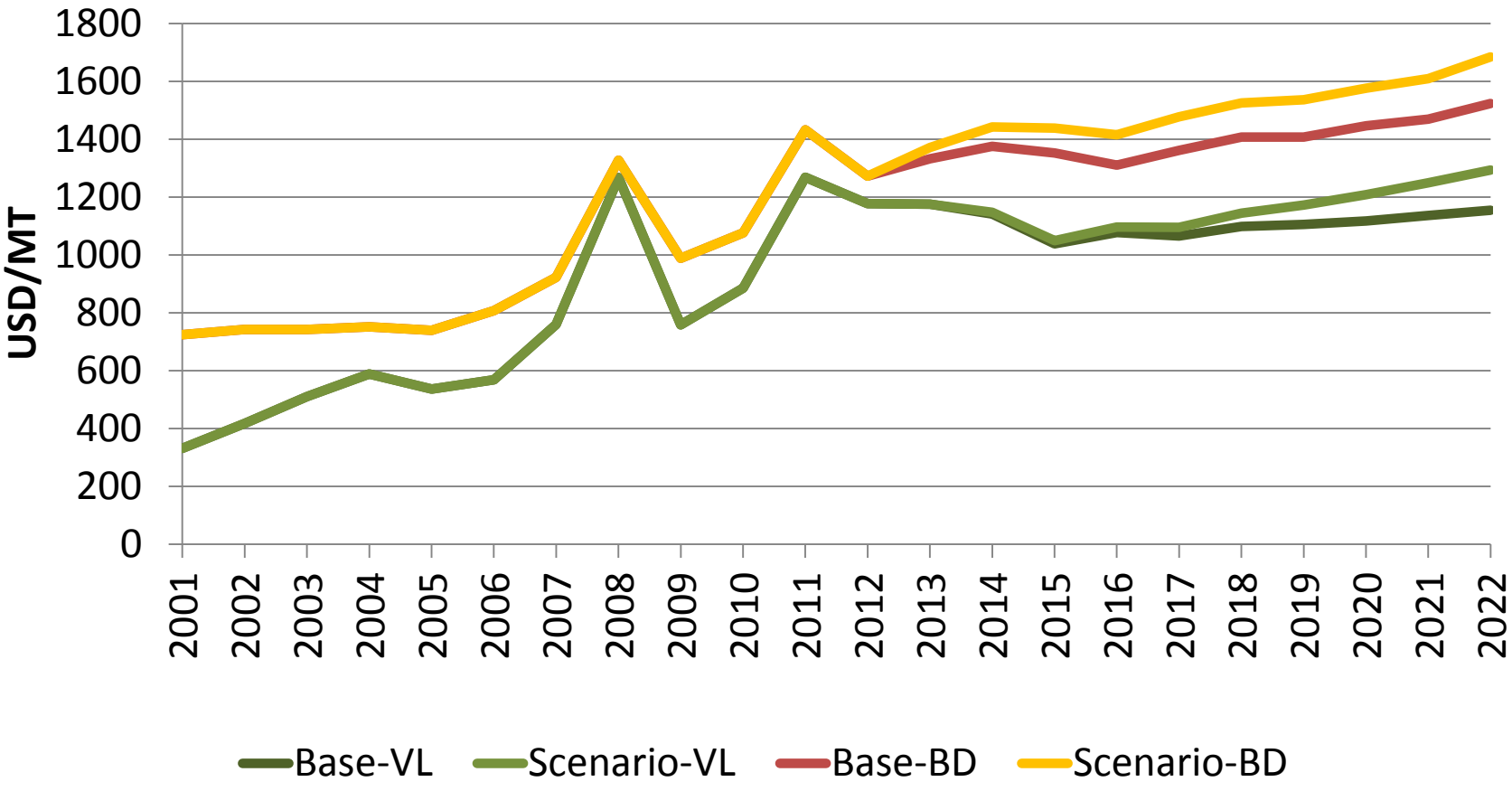
Raising the biodiesel blending ratio* to 25 percent, impact on world markets

Scenario 2: raising blending ratio 25%- impact on domestic biodiesel markets

Indonesia biodiesel: production, consumption and net trade



Scenario 2: raising blending ratio 25%- impact on world vegetable oil and biodiesel markets



Scenario 2. Results

- Domestic vegetable oil production increases by 6%;
- World vegetable prices increase by 12%;
- World biodiesel prices rise by 11%;
- Vegetable oil and biodiesel exports decrease;
- Global food consumption of vegetable oil decreases by 2%
- Global production of vegetable oil increases by 3%

Scenario 2. Results

Global consequences of vegetable oil price increase:

- A **decrease in global consumption** of vegetable oils **(2%)**
- **Increased production (3 Mt)** mainly from Malaysia, Canada China, the European Union and Brazil.

Compensation effects:

The reduced export of Indonesian CPO would be compensated by:

- **Increased exports of Argentinian vegetable oil;**
- **Reduced imports of vegetable oils into the European Union.**

Uncertainties concerning Scenarios

Scenarios are based on assumptions related to:

- Market developments;
- Domestic policies;
- Trade policies;
- Weather conditions

Questions?

OUTLINE

12. Future work

Discussion for future co-operation

- Data review
- Country module development
- Scenario work

OECD

Food and Agriculture Organization of the United Nations

Thank you

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OUTLINE

11. COUNTRY MODULE

Creating the standalone projections

Introduction of the Aglink–Cosimo Standalones

- **Standalone model construction and baseline generation**
  - how modules are put together, solution process
- **Analysis and scenario exercises**
  - demonstration exercises running these scenarios, compare, discuss one example chosen by the group

IDNsys.inp

IDNstep2-2014.inp

Country_Viewer

Introduction to the Sys file

1. Functions of the Sys file
    - data-generation
    - calibration
    - simulation

IDNsys.inp

2. Overview over **model**

IDNmod_2014.inp

3. Overview over **viewer**

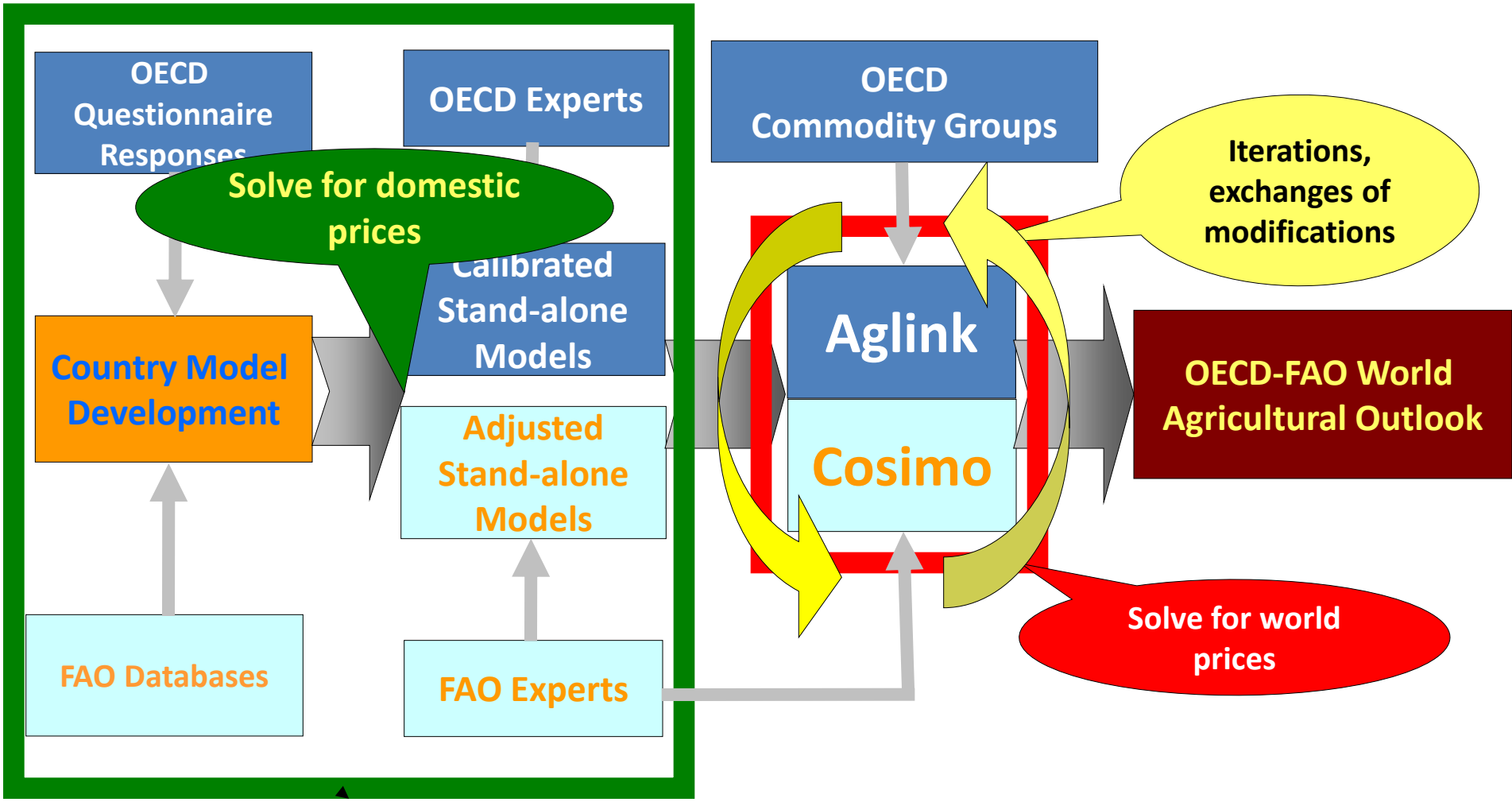
IDNview2014

Practical exercises using the country module

- Simulation exercises with stand alone model
  - Baseline generation
  - create a projection with model, put output in viewer
- Adjustments of endogenous and exogenous variables
  - read in new r-factors,
  - modify the macro variables
- Parameter modifications
  - modify parameters run model,
- Structural changes
  - exercises to change equation structure (diff average in RH)
- Model improvement discussion

IDNparm.inp **IDNmod2014.inp** **Country_Viewer**

Aglink – Cosimo Outlook Process



How do we carry out the Outlook?

1/ Country expertise is taken into account as a starting point

A questionnaire is sent to each collaborator country

2/ The AGLINK-COSIMO model is used to get a consistent and coherent picture

Collaboration between FAO and OECD Secretariats

3/ Model Outcomes are adjusted through expert opinions

Collaboration between FAO and OECD Secretariats

4/ Final review of projections in OECD commodity groups

Projections (not forecast) are discussed with member/observer countries

Main steps to obtain the baseline

Step 1 : Country standalones
Calibrate country models on questionnaire replies

Step 2 : Merge of country standalone and of COSIMO
Get the AGLINK – COSIMO model

Step 3: Computation of the baseline
Work on the global model on a commodity base

Introduction to the global "all linked" model

- **Merged model construction and baseline generation**
  - how modules are merged, solution process.
- **Analysis and scenario exercises with complete Aglink-Cosimo**
  - demonstration exercises running these scenarios, compare, discuss one example chosen by the group.

driver **aglink** **os_3_viewer**

Practical exercises using the global model

- Simulation exercises with global model
  - Baseline generation
  - create a projection with model, put output in viewer
- Adjustments of other countries
  - read in new r-factors,
  - modify the macro variables
- Parameter modifications
  - modify parameters run model,
- Structural changes
  - exercises to change equation structure (diff average in RH)
- Model improvement discussion

coefs.txt **Scenario_Viewer**

Questions?

OUTLINE

12. Future work

Discussion for future co-operation

- Data review
- Country module development
- Scenario work

Co-operators Program

- **Benefits**
  - Participate in annual world commodity projection
  - Access to data, models, FAO staff
  - Participate in analysis projects
  - Access to capacity building – training
  - Tap global expertise

- **Country involvement**
  - Depends on commitment– 2-6 staff months
  - Provide data on markets and policies
  - Advice as to policy issues etc.
  - Input into projection– country questionnaire

Levels of cooperation

- A Level (1 month staff time)
  - Fill out historical data questionnaire
  - Provide judgments on projections
- B Level (2 months staff time)
  - Participate in projection process
  - Attend meetings in Rome
- C Level (6 months qualified staff time)
  - All of above
  - Create new country specific module
  - Training on modules – Cosimo provided by FAO
  - Use module/model for projection work

Time requirements

- Annual Cycle – from November to April/May
- Questionnaire on historical data and projection judgements
- Participation in baseline process
- Meetings – OECD/FAO
- Model maintenance - research

Steps to formalize co-operation

- Set up Task Force (identify members)
- Sign agreement on what is required/offered by both FAO and collaborator
  - Identify initial funding sources to build capacity
  - Identify process of collaboration
  - Identify technical support requirements
- Prepare work plan for new country model development and maintenance
- Identify policy questions to be addressed
- Undertake country report: Medium term prospects for agriculture and food security

Questions?

OECD

Food and Agriculture Organization of the United Nations

Thank you

Contact :

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