# Progress on CGE Modeling and Role in CGIAR Impact Assessment

## Impact of Agricultural Productivity Growth for Poverty Reduction in Ethiopia and Ghana and Nutrition in Yemen

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**New approaches to assessing the impact of agricultural research on poverty and undernutrition**

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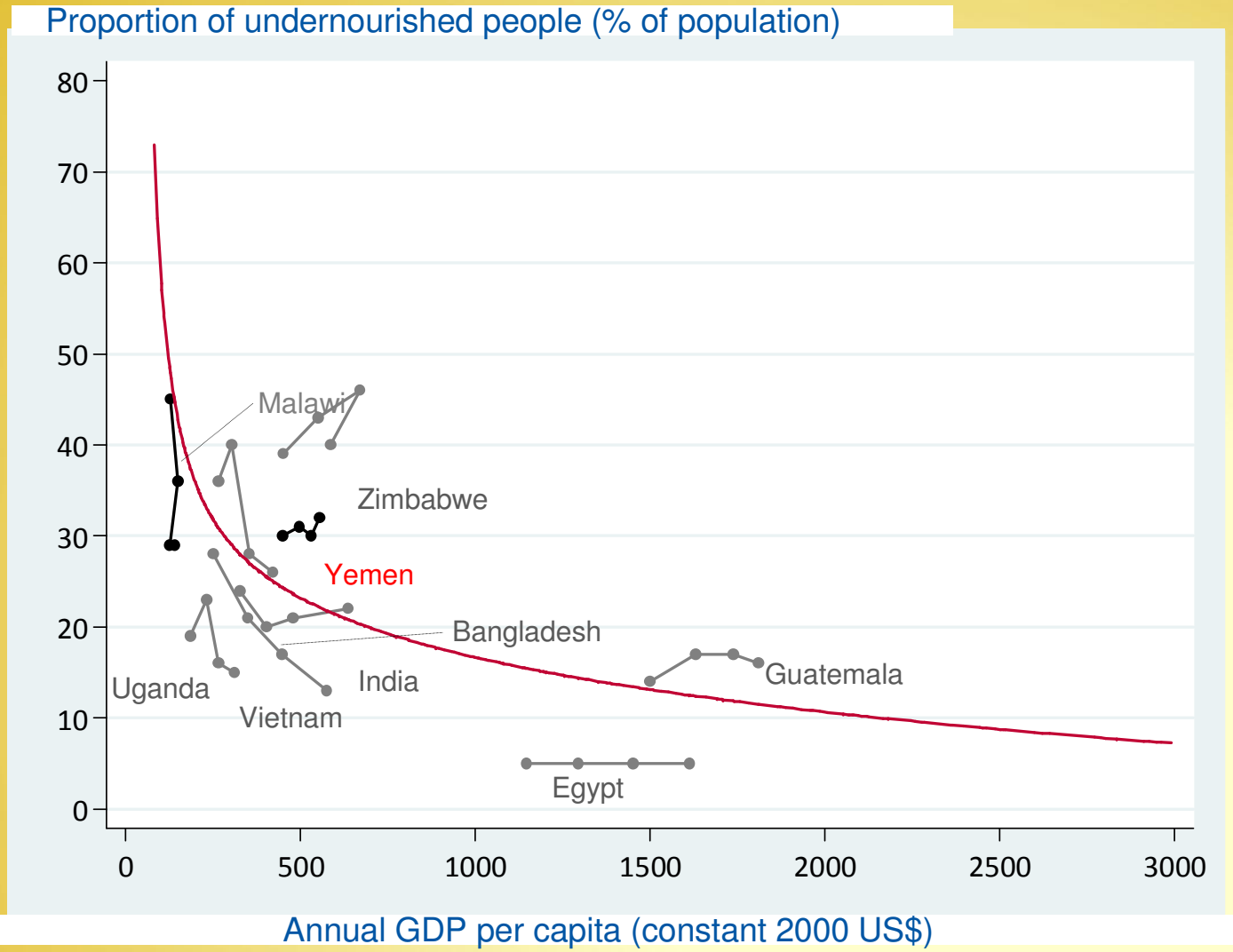
# Recent Achievements in Poverty Reduction

| **Ethiopia** | | | |
|---|---|---|---|
| | 1995/1996 | 1999/2000 | 2004/2005 |
| National | 45.5 | 44.2 | 38.7 |
| Rural | 47.5 | 45.4 | 39.3 |
| Urban | 33.2 | 36.9 | 35.1 |
| **Ghana** | | | |
| | 1991/1992 | 1998/1999 | 2005/2006 |
| National | 51.7 | 39.5 | 28.5 |
| Rural | 63.6 | 49.5 | 39.2 |
| Urban | 27.7 | 19.4 | 10.8 |

Sources: National poverty data calculated from two countries' living standard surveys in the respective years

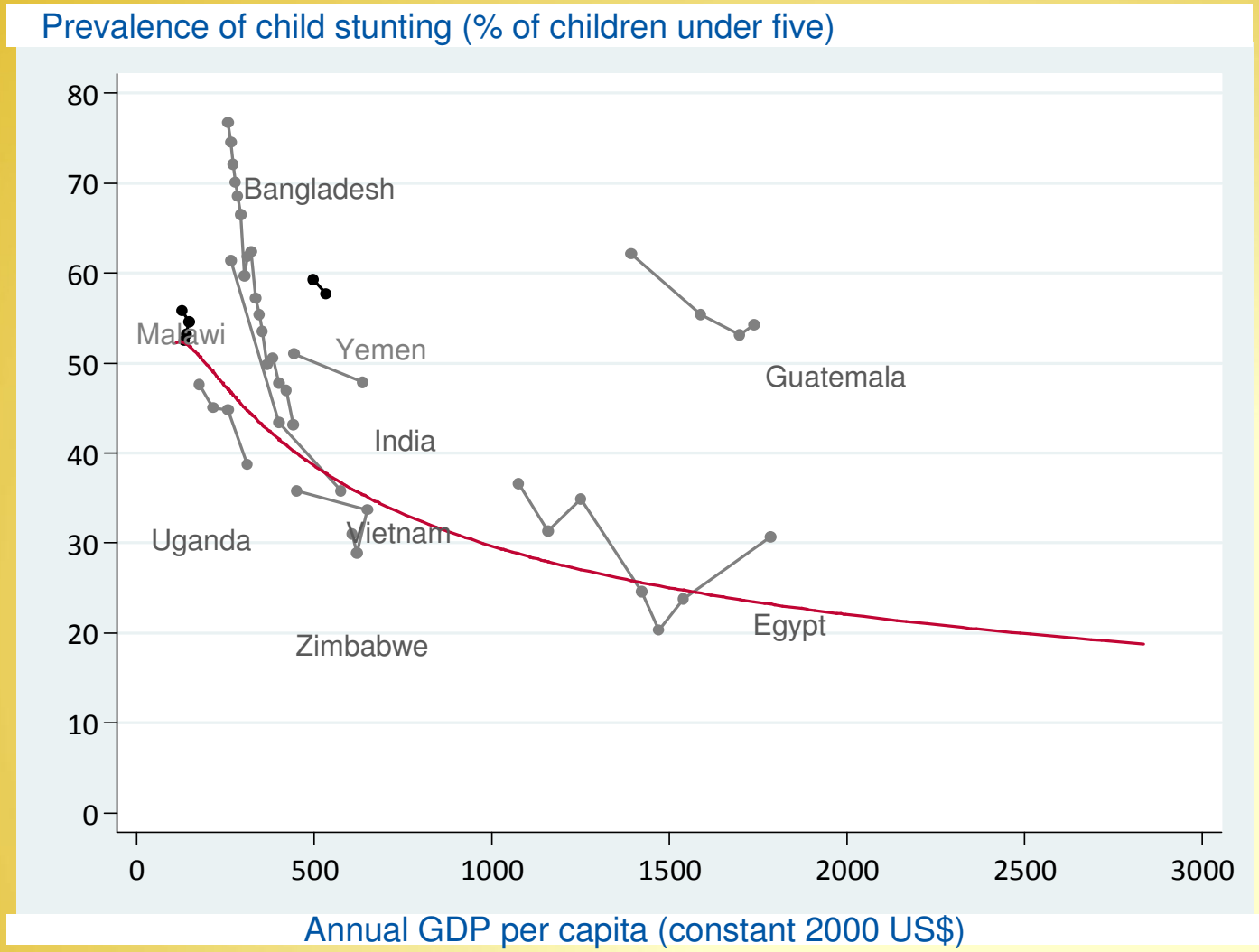
- **Ghana will achieve MDG1 several years before 2015.**
- **Ethiopia is unlikely to, based on 1995 – 2004 trends. However, growth has started to accelerate in recent years.**

# Global Nutrition-Growth Trend



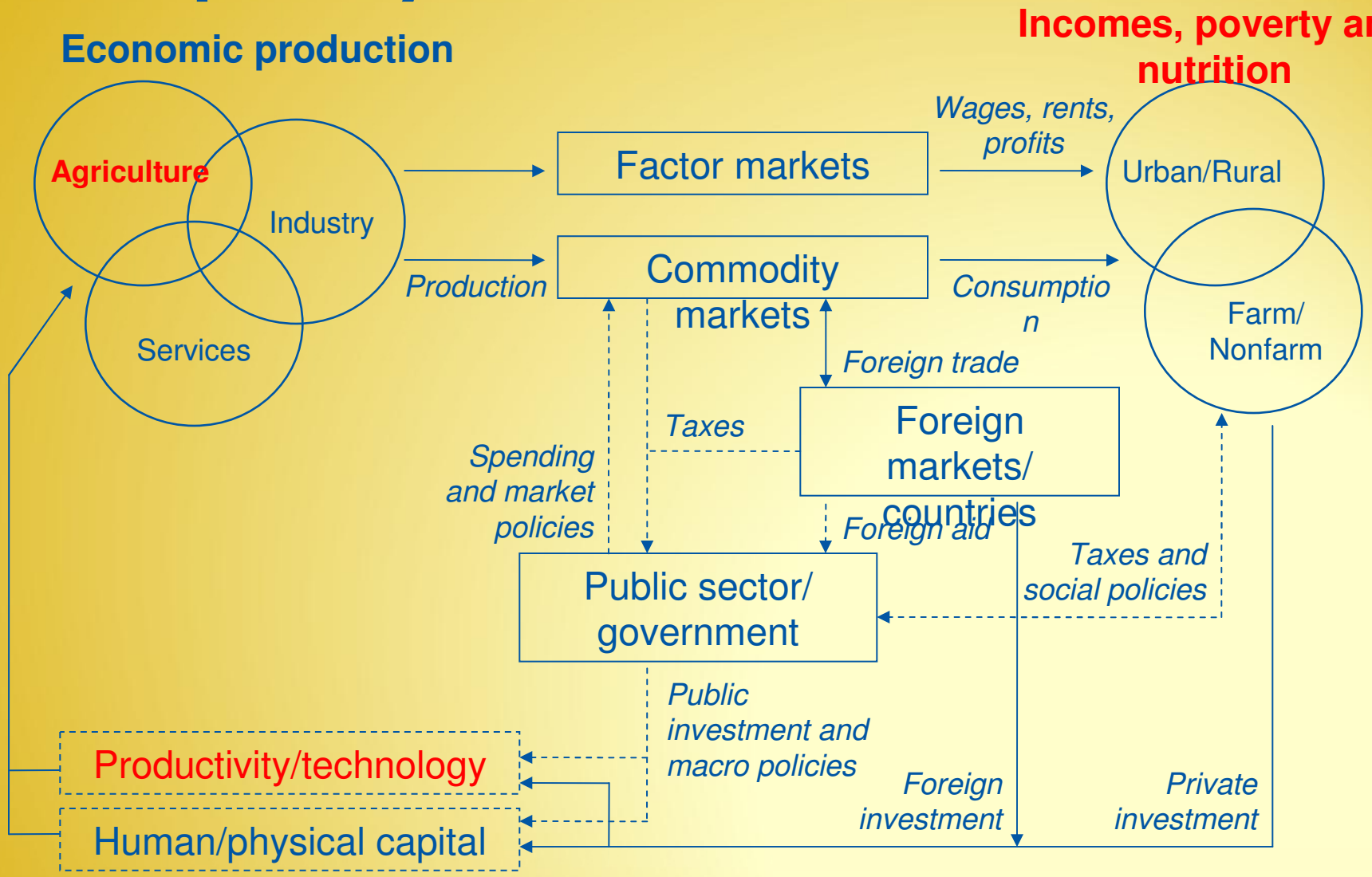

Source: World Development Indicator (WDI) database (World Bank), accessed Nov. 2010.

# Global Child Malnutrition-Growth Trend




Source: World Development Indicator (WDI) database (World Bank), accessed Nov. 2010.

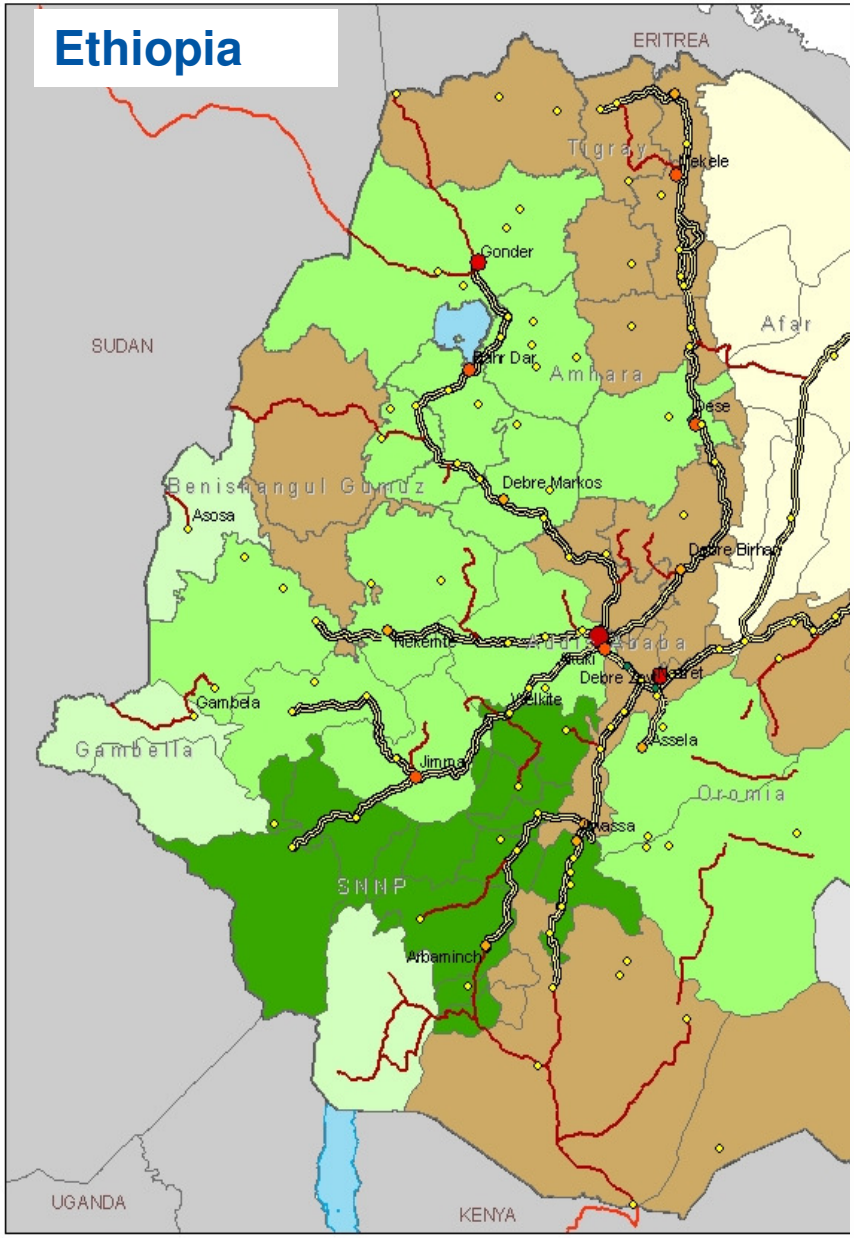
# What is agricultural productivity's role in poverty reduction and nutrition?

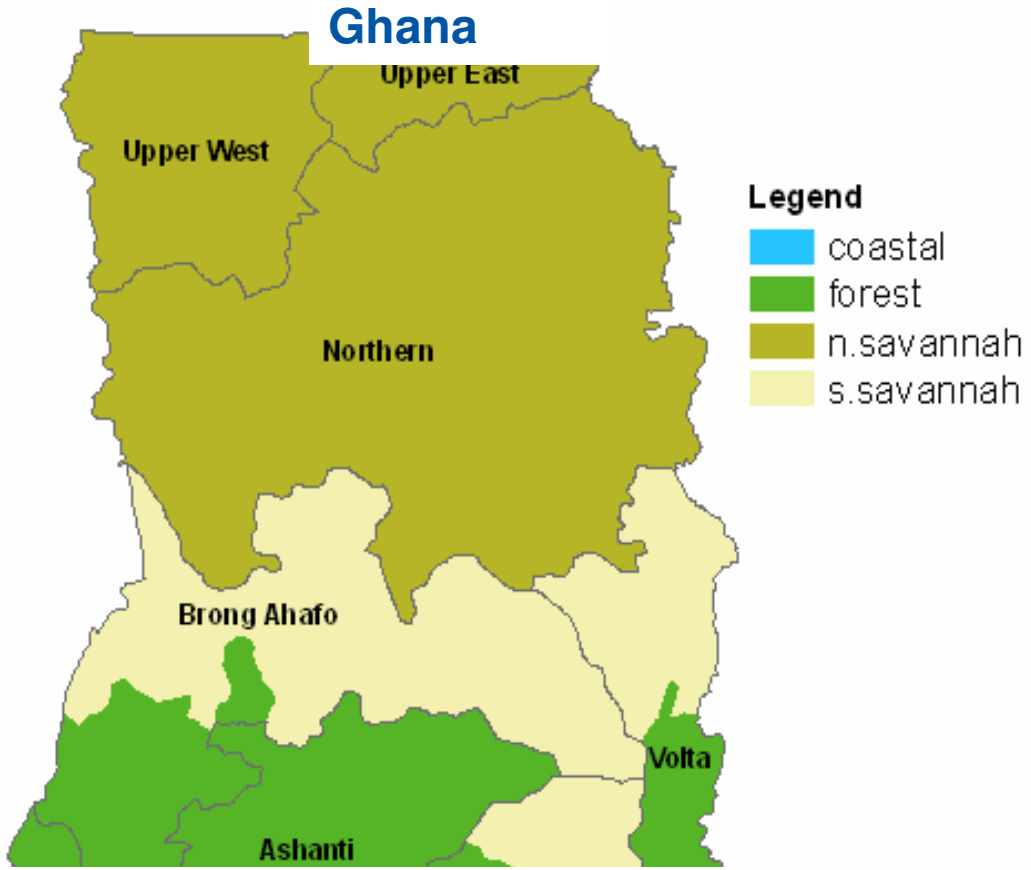


# A Macro-Micro Linkage Method

- The **dynamic** CGE models with **spatially disaggregated**, **detailed agricultural** production and highly disaggregated household data, for example according to **gender**
- The **microsimulation** models defined for all sample households in the most recent country living standard surveys (Ethiopia: HICE 2005; Ghana: GLSS5 2005/06, Yemen 2005/06)
- Macro-to-micro link to measure the **poverty** (example Ethiopia, Ghana) **and under- nutrition effect** (Yemen)
- **Forward looking** scenarios to simulate accelerated **agricultural** growth **and other options** using the dynamic CGE models

# Agriculture and Households in the CGE Model




- 28 agricultural sectors disaggregated by 4 agro-ecological zones
- 42 nonagricultural sectors
- 90 representative households by rural and urban, zones, and 10 decile groups

# Growth scenarios (based on potential)

## Ethiopia:

1. **Cereal-led growth:**
   - Additional TFP growth in 5 cereals only
2. **Export-led growth:**
   - Additional TFP growth in 7 export crops only
   - Additional land expansion for export crops
3. **Livestock-led growth:**
   - Additional TFP growth in 4 livestock sectors only
4. **Agriculture-led growth:**
   - Combination of 1-3
5. **Nonagriculture-led growth**
   - Additional TFP growth in the private nonagricultural sectors
6. **Combined growth:**
   - Combination of 4 and 5

## Ghana:

1. **Staple-led growth:**
   - Additional TFP growth in 20 staple crops and livestock only
2. **Export-led growth:**
   - Additional TFP growth in 6 export crops only
   - Additional land expansion for export crops
3. **Agriculture-led growth:**
   - Combination of 1 and 2
4. **Industry-led growth**
   - Additional TFP growth in the industrial sectors excluding mining
5. **Service-led growth**
   - Additional TFP growth in the private service sectors
6. **Combined growth:**
   - Combination of 3 - 5

**Yemen:** Phasing out of petroleum subsidies

# Simulation Results of Ethiopia CGE Model – Annual Growth

| | | *Growth led by* | | | | | |
|---|---|---|---|---|---|---|---|
| | Base-run | Cereals | Export agriculture | Livestock | All agriculture | Non agriculture | Combined |
| GDP | 6.1 | 6.3 | 6.2 | 6.3 | 6.8 | 7.2 | 7.8 |
| AgGDP | 4.2 | 4.8 | 4.5 | 4.7 | 5.9 | 4.4 | 6.0 |
| Cereals | 4.8 | 6.6 | 4.8 | 4.8 | 6.7 | 4.8 | 6.7 |
| Export crops | 5.0 | 5.0 | 7.6 | 5.0 | 7.6 | 5.0 | 7.6 |
| Livestock | 3.9 | 4.0 | 3.9 | 5.6 | 5.7 | 4.0 | 5.8 |
| NonagGDP | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.6 | 9.2 |
| Manufacturing | 7.7 | 7.6 | 7.7 | 7.8 | 7.7 | 9.7 | 10.0 |
| Agro-processing | 6.9 | 6.9 | 7.0 | 6.9 | 7.1 | 8.4 | 8.7 |
| Private services | 8.0 | 8.0 | 8.0 | 8.0 | 8.1 | 10.0 | 10.0 |

# Simulation Result of Ghana CGE Model – Annual Growth

| | | *Growth led by* | | | | | |
|---|---|---|---|---|---|---|---|
| | Base-run | Staples | Export agriculture | All agriculture | Industry | Private services | Combined |
| GDP | 5.2 | 5.5 | 5.4 | 5.7 | 6.0 | 6.0 | 7.3 |
| AgGDP | 4.5 | 5.4 | 5.2 | 6.1 | 3.9 | 4.0 | 5.8 |
| Cereals | 4.9 | 6.6 | 4.8 | 6.6 | 3.9 | 4.7 | 6.9 |
| Export crops | 4.4 | 4.3 | 7.1 | 7.0 | 4.2 | 4.6 | 7.1 |
| Livestock | 5.9 | 6.8 | 6.6 | 6.3 | 6.5 | 6.4 | 8.4 |
| Industry | 5.0 | 4.9 | 4.8 | 4.8 | 7.8 | 5.0 | 7.8 |
| Manufacturing | 5.2 | 5.3 | 4.8 | 4.9 | 8.2 | 7.1 | 8.5 |
| Services | 6.1 | 6.2 | 6.1 | 6.1 | 6.1 | 8.4 | 8.2 |
| Private services | 6.2 | 6.2 | 6.2 | 6.2 | 6.2 | 9.4 | 9.3 |

# Poverty Reduction Results through Macro-to-Micro Link: Ethiopia

| | | *Growth led by* | | | | | |
|---|---|---|---|---|---|---|---|
| | Base-run | Cereals | Export agriculture | Livestock | All agriculture | Non agriculture | Combined |
| **Poverty rate by 2015** | | | | | | | |
| National | 28.6 | 26.1 | 28.1 | 27.9 | 24.8 | 27.0 | 23.9 |
| Rural | 29.6 | 27.0 | 29.2 | 29.0 | 25.6 | 27.5 | 24.4 |
| Urban | 23.5 | 22.1 | 22.9 | 22.5 | 20.7 | 24.5 | 21.5 |
| **Additional number of the poor lifted out poverty by 2015 from base-run (1,000)** | | | | | | | |
| National | | 2,075 | 422 | 600 | 3,194 | 1,357 | 3,922 |
| Rural | | 1,871 | 328 | 460 | 2,799 | 1,502 | 3,629 |
| Urban | | 204 | 94 | 140 | 395 | -145 | 294 |
| Poverty-growth elasticity | -1.13 | -1.40 | -1.16 | -1.16 | -1.41 | -1.05 | -1.24 |

Note: poverty-growth elasticity is the ratio of % reduction in poverty rate over % change in GDP pc growth rate. Base-year (2008) national poverty rate is **37.3%** and **37.8%** for the rural.

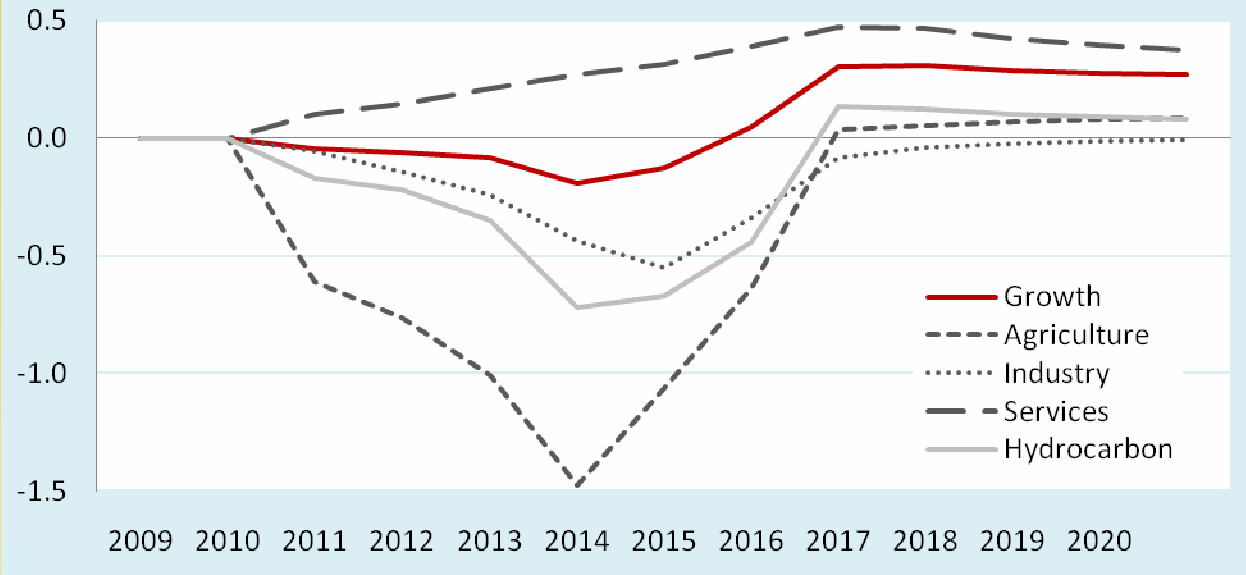
# Poverty Reduction Results through Macro-to-Micro Link: Ghana

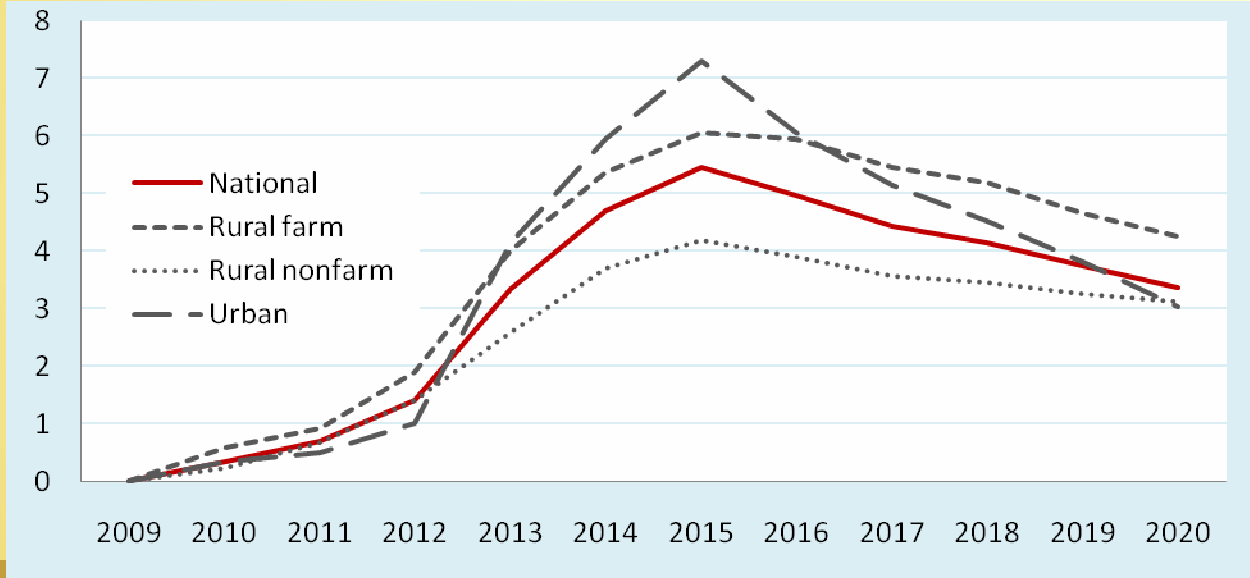
| | | *Growth led by* | | | | | |
|---|---|---|---|---|---|---|---|
| | Base-run | Staples | Export agriculture | All agriculture | Industry | Private services | Combined |
| **Poverty rate by 2015** | | | | | | | |
| National | 20.2 | 19.1 | 19.3 | 18.3 | 20.3 | 19.7 | 16.3 |
| Urban | 7.6 | 7.1 | 7.4 | 7.1 | 7.1 | 6.6 | 5.6 |
| Rural | 29.6 | 28.0 | 28.3 | 26.7 | 30.0 | 29.3 | 24.2 |
| North | 58.1 | 56.3 | 58.0 | 56.1 | 61.7 | 61.1 | 53.1 |
| **Additional number of the poor lifted out poverty by 2015 from base-run (1,000)** | | | | | | | |
| National | | 231.6 | 182.9 | 398.1 | -17.4 | 108.5 | 799.8 |
| Poverty-growth elasticity | -1.45 | -1.62 | -1.60 | -1.71 | -1.16 | -1.30 | -1.49 |

Note: Base-year (2007) national poverty rate is **28.5%** and **39.2%** for rural.

# Example: Micro simulation nutrition: Phasing-out Fuel Subsidies in Yemen

- High negative effects without add. measures
- Agriculture will be hardest hit due to rising irrigation costs.
- Food insecurity will increase significantly.
- Reform frees ample fiscal resources.



# Conclusion

- Agriculture, especially staple crops driven growth remain a main driver of growth and poverty reduction
- CGE models are good tools for capturing farm-non farm at **very disaggregate spatial and agricultural** sector levels and poverty effects
- Progress is made in the fields of linking growth on **nutritional outcomes,** more research is needed
- CGE models can help integrate different impact assessment tools, for example **micro-level adaptation studies and farm-level models**
- Potential **WIN-WIN** situation of CGIAR Impact assessment and pushing the research frontier in integrating different levels of analysis

# Measuring and assessing the poverty impacts of the diffusion of improved maize varieties in Africa: A proposal jointly submitted to SPIA-Bioversity by CIMMYT, IFPRI, Uni. of Life Sciences (UMB), Norway

- Existing maize variety **adoption and productivity change probabilities are econometrically** estimated across different household groups in the three major maize growing countries (Ethiopia, Malawi and Zambia)
- This information is used in the CGE model developed for each country in **modeling productivity change in maize sector** over time (through an adoption curve).
- **Maize sector is further disaggregated** according to technology adoption, use of different seed varieties and relevant inputs (fertilizer). Country level different policies on seed and input delivery systems are considered.
- The CGE model allows to study both the direct and indirect effects and various linkages exist between the farm and non-farm economies. Combining CGE model outputs with information from published household living standard surveys on the distribution of **poverty and malnutrition** allows for assessing impacts on poverty and malnutrition

# Other

# Remarks on Ghana and Ethiopia results

- No single sector has a dominant role in all aspects along the development process:
  - Staple-led growth is more effective in poverty reduction through its strong consumption linkage effect, while high productivity in staple production will release labor and has limitation in job creation
  - Export-agriculture-led growth increases labor demand, while the size of the sector is rather small
- Avoid to favor a few selected staple crops or livestock products to mitigate price effect
- Importance of concurrent growth of agriculture and non-agriculture for stabilizing agricultural prices
- Pay attention to the rising food price accompanied by accelerated nonagricultural growth, which has become more important in these days
- Pay attention to urban poor, which has become increasingly important