BIOENERGY AND FOOD SECURITY PROJECT

Assessing the impacts of Bioenergy Developments on Food Security: Insights from the BEFS FAO Project

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Outline of Presentation

- The Bioenergy and Food Security (BEFS) project in FAO
- The BEFS Assessment Approach
- Some examples from Tanzania and Peru
- Where the project stands
- Conclusion

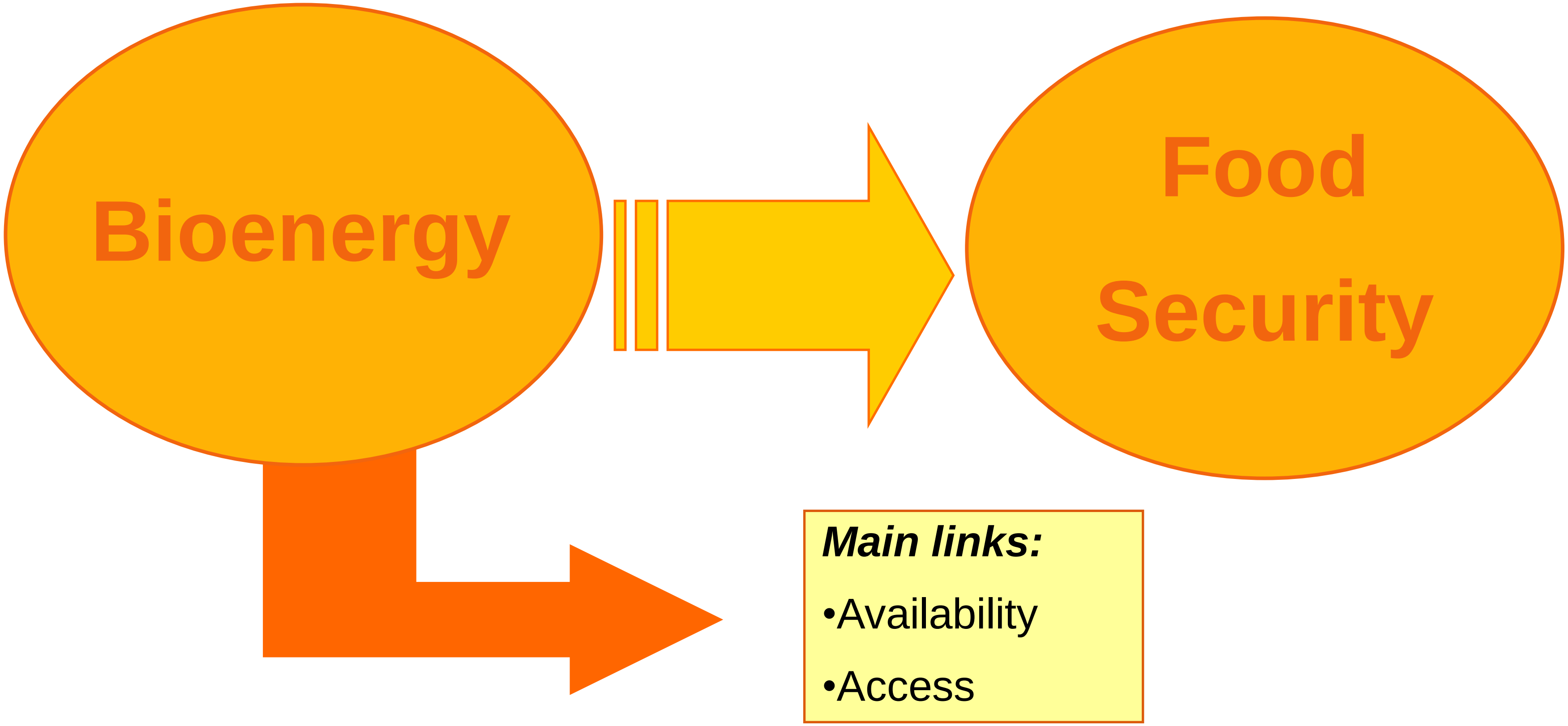
Bioenergy and Food Security Project (BEFS)

- ***BEFS Objective***: Mainstreaming food security concerns into national and sub-national assessments of bioenergy potential.
  - **Phase 1:** Develop analytical framework and guidance to assess the bioenergy and food security nexus
  - **Phase 2:** Implement the methodology in the country based on country specific data
  - **Phase 3:** Strengthen country capacity, exchange knowledge, feed into policy development and standard setting
- **BEFS Partners:** Peru, Tanzania and Thailand

- ***BEFSCI***: Aims to develop detailed principles, criteria and indicators on sustainable bioenergy production that safeguards food security.

-This project builds on the technical assessments within BEFS

What BEFS Assesses



Potential (Suitability)

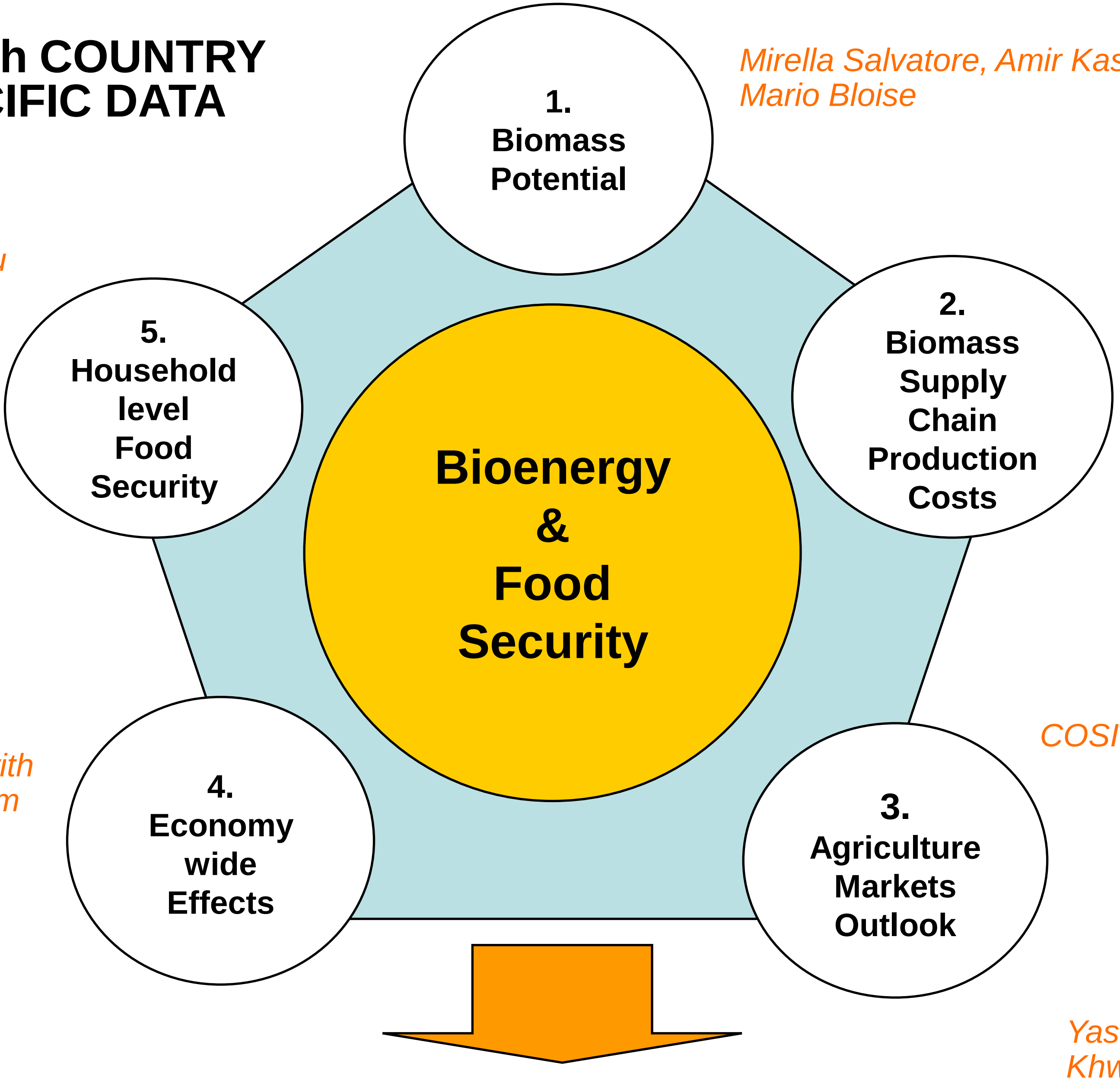
Technoeconomic feasibility

Food Production

Food Access

BEFS Analytical Framework

Fed with COUNTRY SPECIFIC DATA



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COSIMO Team

James Thurlow, IFPRI, with input from BEFS

Irini Maltsoglou and David Dawe

Supporting national policy development

Yasmeen Khwaja and country teams

Tanzania: Which commodities do we focus on?

- **Potential bioenergy feedstock**-**Government's indications:**
  - Ethanol: **Sugar** and **Cassava**
  - Biodiesel: **Palm oil and Jatropha**

- **Food security commodities:**

  Selected based on calorie consumption data.

Main focus on **Maize** and **Cassava**.

Ranking	Commodity	Calorie Share
1	Maize	33.4
2	Cassava	15.2
3	Rice (Milled Equivalent)	7.9
4	Wheat	4.0
5	Sorghum	4.0
6	Sweet Potatoes	3.3
7	Sugar (Raw Equivalent)	3.3
8	Palm Oil	3.0
9	Beans	2.9
10	Beverages, Fermented	2.7
11	Milk – Excluding Butter	2.2
12	Bovine Meat	1.8
13	Pulses, Other	1.7
14	Plantains	1.5
15	Millet	1.4
Subtotal share for selected items		88.5
Total Calories per capita		1959

Source: FAOSTAT

Key Food Stuff Trade Position

Items	Production quantity (MT)	Import quantity (MT)	Export quantity (MT)	Net-importer	Net-exporter
Maize	3,288,000	44,500	98,985	-	0.02
Cassava	7,061,867	0	839	-	-
Rice	957,000	18,846	3,717	0.02	-
Wheat	87,133	254,732	36,428	0.71	-
Sorghum	653,644	0	0	-	-
Sweet potatoes	781,567	0	0	-	-
Sugar Cane	1,374,633	140,895	27,537	0.08	-
Palm oil	63,333	117,272	6,464	0.64	-
Beans	261,667	541	9,253	-	0.03
Banana	2,007,480	0	0	0	0

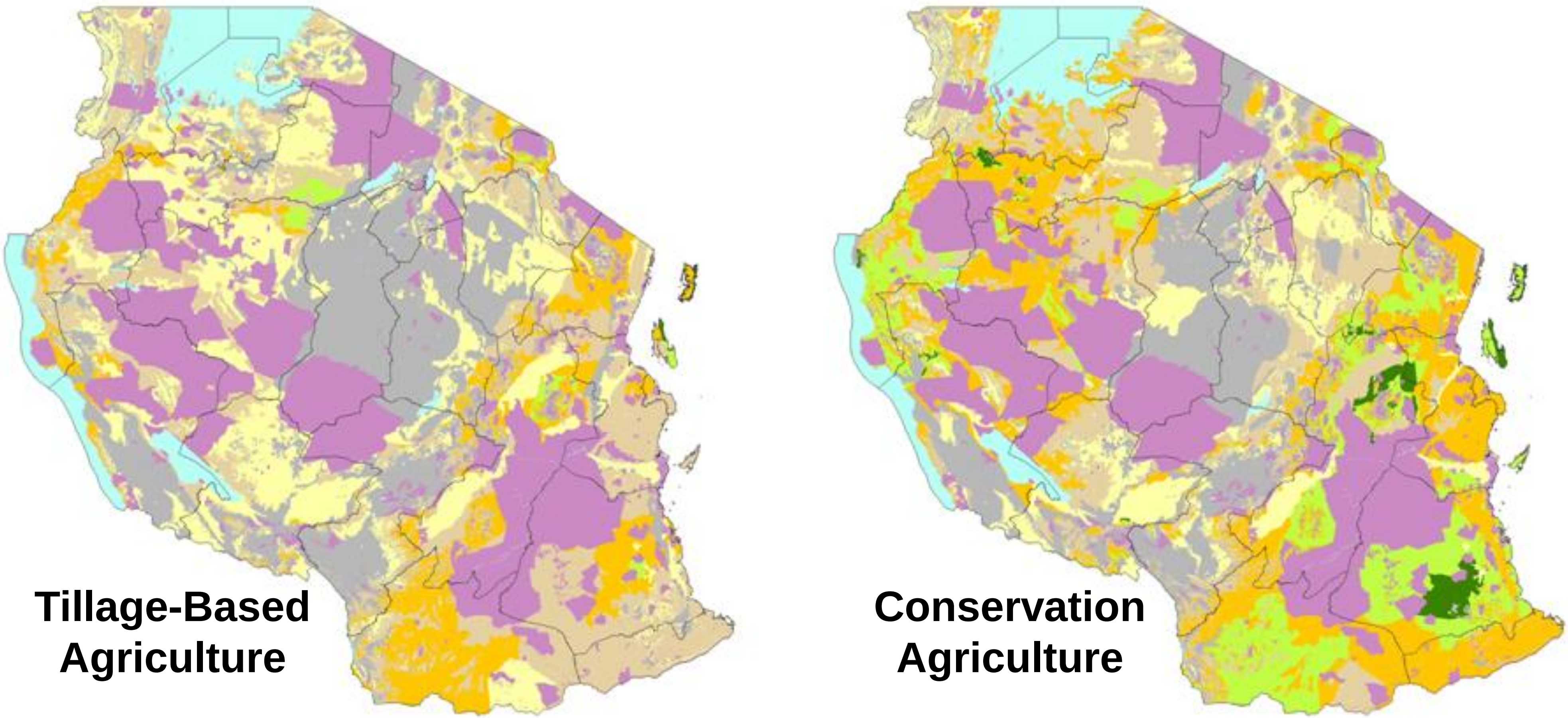
Source: FAOSTAT

Crop Suitability (Module 1, Methodology)

- ***Land Suitability Assessment Model*** and consists of two components:
  - 1) the ***Land Resources Inventory****:* biophysical information is compiled such as temperature, rainfall, soil and land-form
  - 2) the ***Land Suitability Assessment***. Once the inventory is set up, identify crop suitability areas based on climatic and soil-related criteria.
- This assessment is carried out for 28 **land utilization types** (LUTs), which are a combination of crop type (cassava, sugar cane, sweet sorghum, oil palm and sunflower), production system (tillage-based and conservation agriculture) and input level (low and high).
- Having determined suitable areas by crop, **attainable yield and potential production** are calculated. In this, non-agricultural and environmentally sensitive areas (such as forest areas, protected areas, urban areas, etc.) are excluded. An evaluation of the **potential competition with food production** is undertaken using land cover, land use and agriculture statistics.
- Next steps of the analysis to carry out the assessment under irrigated condition evaluating the actual and potential irrigation scheme; an evaluation of the existing and required infrastructure and considerations on land requirements for future food consumption.
- To date the analysis is showing that infrastructure access will be one of the key parameters to enable the country to reap the benefits from the development of bioenergy schemes.

Suitability index for cassava

using low input level under different production systems



Suitability classes

- Very Suitable (80-100%)
- Suitable (60-80%)
- Moderately Suitable (40-60%)
- Marginally Suitable (20-40%)
- Very Marginally Suitable (< 20%)
- Not Suitable
- Inland water bodies
- Excluded areas
- Region administrative boundaries

Technoeconomic feasibility of the biomass supply chains (Module 2)

- Each feedstock is assessed under different processing systems based on the relevance of the following characteristics for the feedstock analyzed:
  - (i) stand alone versus integrated mill and refinery
  - (ii) plant scale: large, medium or small
  - (iii) feedstock origin: (a) commercial, (b) outgrowers (c) a mix of these two
- Based on the relevant mix of (i), (ii) and (iii), this part of the assessment evaluates technical and economic aspects of biofuel production under the local knowledge base and manufacturing capacity.

Technoeconomic feasibility of the biomass supply chains (Module 2)

Data → **Technology Simulation** → **OUTPUTS**

Secondary data

Reports
Documents:
Research
Government

Country Specific data

Available Technologies
Level Technology
Local Capacity
Energy Matrix
Potential Market

Simulations:
Feedstock:
Chemical composition
Software:
Commercial package
Aspen Plus
combined with Jacaranda, ModELL-R, GAMS, MatLab, Delphi, Octave, Polymath, Hysys
Superpro Designer

Under different technologies:

- Cost per Litre biofuel
- Capital cost
- Operating cost
- Energy use
- By product reuse

Recommendations

- Feedstock selection
- Technology
- Competitiveness in global market
- Human capital

Production cost cassava ethanol

- Comparison of medium (~160K liters/day) and large (~300K liters/day) refinery technologies including co-products credit (biocompost, biofertilizers)

Input costs	Medium-size (fresh)	Medium-size (dry)	Large-size (dry)
Raw material	$0.20	$0.25	$0.26
Processing	$0.15	$0.15	$0.14
Capital	$0.064	$0.064	$0.046
Cost at plant	$0.42	$0.47	$0.44
Distribution costs			
Domestic	$0.46	$0.51	$0.48
International	$0.54	$0.59	$0.56

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Agriculture Market Outlook (Module 3)

- **Module 3** projects the impacts of bio-fuel production and bio-fuel policies on agricultural markets in the context of Tanzania over a 10 year outlook period by providing an outlook for international and national agricultural commodity markets

- The Outlook is produced with a partial equilibrium model called **AGLINK-COSIMO** including biofuels and allows to assess
  - What is the outlook for main food corps in Tanzania under different conditions i.e. biofuel production, lower oil prices? What are the impact for major agricultural commodities in Tanzania?
  - What are the implications of domestic and global biofuel policies for biofuel development in Tanzania?

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Agriculture Outlook and biofuels in Tanzania

- **Baseline Outlook:** Overall, the projections show that for most crops (the ones that Tanzania receives most of its calories from) the country will have to rely on more imports to meet domestic demand and this is in the absence of biofuels markets.
- **Scenario 1:** Blending mandates 49 million litres of ethanol (10%) and 55 million litres of biodiesel (5%) by 2017, no land expansion
- **Scenario 2:** Based on investors requests for land (314,000 ha) for biofuel development, ethanol production would reach 800 Mlt in 2017 and biodiesel 695 Mlt. Biofuel production would exceed domestic demand and be directed to exports.

Agriculture Outlook and biofuels in Tanzania

- The biofuels blending mandate does not require a significant amount of biofuels feedstocks and it could be possible to meet these mandates with limited expansion of cultivated lands and moderate increase in average yields
- Based on investors requests for land for biofuel development, ethanol production would reach 800 Mlt in 2017 and biodiesel 695 Mlt. Biofuel production would exceed domestic demand and be directed to exports.
- Total production would be excessive, it would rely on EBA and there might be significant risks attached if the policy environment were to change.
- Less aggressive biofuel development

Economy wide, growth and poverty impacts (Module 4)

- National dynamic computable general equilibrium model
- Based on 2007 economy wide database (social accounting matrix)
- Survey-based microsimulation module for poverty-effects
- New feedstock and biofuels sectors in the model are based on Module 2's technologies and production cost estimates

- The model is run forward for the period 2007-2015
- Initially tracks recent demographic and growth trends
- Then simulates different biofuel production scenarios or options:
  - Feedstock (sugarcane/molasses vs. cassava)
  - Scale of production (large estates vs. smallholder outgrower schemes)
  - Source of production (land expansion/displacement vs. yield improvements)
  - Scale of biofuel processing (small plants vs. single large-scale plant)

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Main findings (Module 4)

- Biofuel production accelerates growth and poverty reduction
- There is no medium to long-run food/fuel trade-off
  - An appreciating exchange rate from expanding biofuels exports (or reducing fuel imports) hurts existing traditional agricultural exports
  - Tanzania's large existing export crop sector means that food production remains 'unaffected' by land/labor displacement for biofuel crops
- Engaging more smallholder farmers strengthens poverty-effects
  - Outgrower sugarcane schemes are currently not a cost-effective option
  - But smallholder cassava is cost-effective and is also more pro-poor
  - Improving yields rather than displacing cultivated lands makes sugarcane and cassava outgrower schemes equally pro-poor and more cost-effective
- Switching to small-scale sugarcane processing plants has only small additional employment- and poverty-effects

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Household level Food Security Impacts--Reminders

- The analysis will focus on changes in the access dimension of food security due income changes deriving from food price increases.
- Changes in food prices can derive from international and domestic supply and demand shocks including biofuels' demand.
- What matters for households are domestic price increases, whereby domestic prices can change due to international and national price movements depending on policies, exchange rate movements, level of price transmission etc.
- Price increases will affect different groups in different ways:
  - *Net consumers*: Those who buy more food than they sell will be hurt by higher prices.
  - *Net producers:* Those who sell more food than they buy benefit from higher prices.

Measurement of household level net welfare impacts

- The impact of a price change on household welfare can be decomposed into:
  - the impact on the household as a consumer of the good and
  - the impact on the household as a producer of the good.

  The **net welfare impact** will be the **difference between the two** and is calculated with the **Net Benefit Ratio** (NBR)
- $\mathbf{NBR_{crop}}$=

%Producer price change$_{crop}$*(producer ratio) $_{crop}$

-%Consumer price change$_{crop}$*(consumer ratio) $_{crop}$

Producer ratio=Value of the commodity production as a proportion of income

Consumer ratio=Value of the commodity consumption as a proportion of income

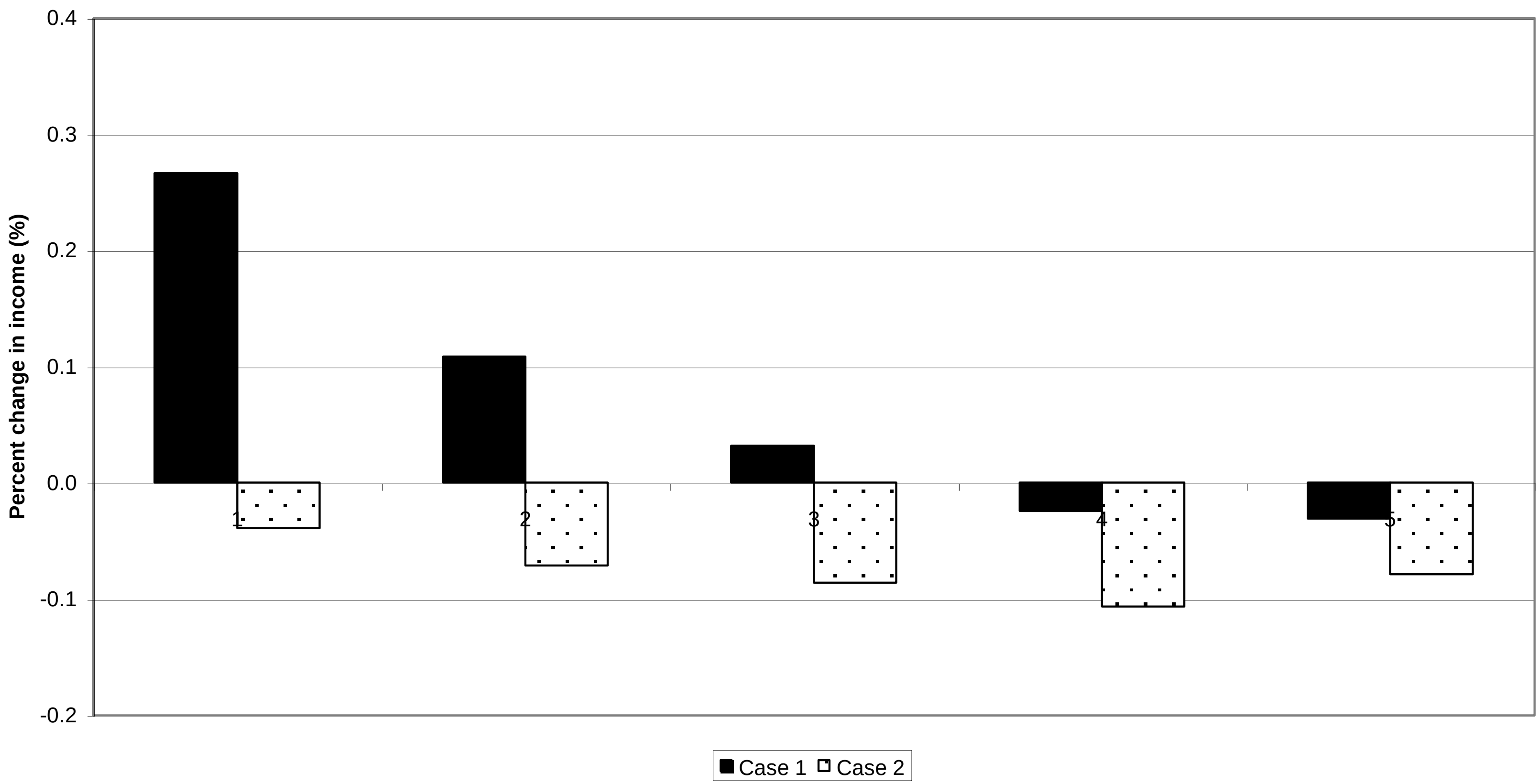
Which commodities do we focus on?

- **Potential bioenergy feedstock**
  - Ethanol: Sugar, palm oil
  - Biodiesel: Jatropha, sweet sorghum, sunflower and rapeseed (canola)
- **Food security basket** based on calorie consumption data (FAOSTAT)

Ranking	Commodity	Calorie share
1	Rice (Milled Equivalent)	19.2
2	Sugar (Raw Equivalent)	14.0
3	Wheat	13.6
4	Potatoes	7.6
5	Maize	5.2
6	Cassava	4.3
7	Soyabean Oil	3.5
8	Milk - Excluding Butter	3.1
9	Plantains	3.0
10	Fish, Body Oil	2.5
11	Poultry Meat	2.3
12	Barley	1.5
13	Beverages, Alcoholic	1.3
14	Pulses, Other	1.3
15	Palm Oil	1.1
16	Fruits, Other	1.1
Subtotal share for selected items		84.4
Total Calories per capita		2176

Sensitivity to margins assumption

**Figure 2a. Sensitivity of welfare results (quintiles 1 to 5) to assumptions about price changes
Case 1 and Case 2 for potatoes, Peru 2006
Entire country**



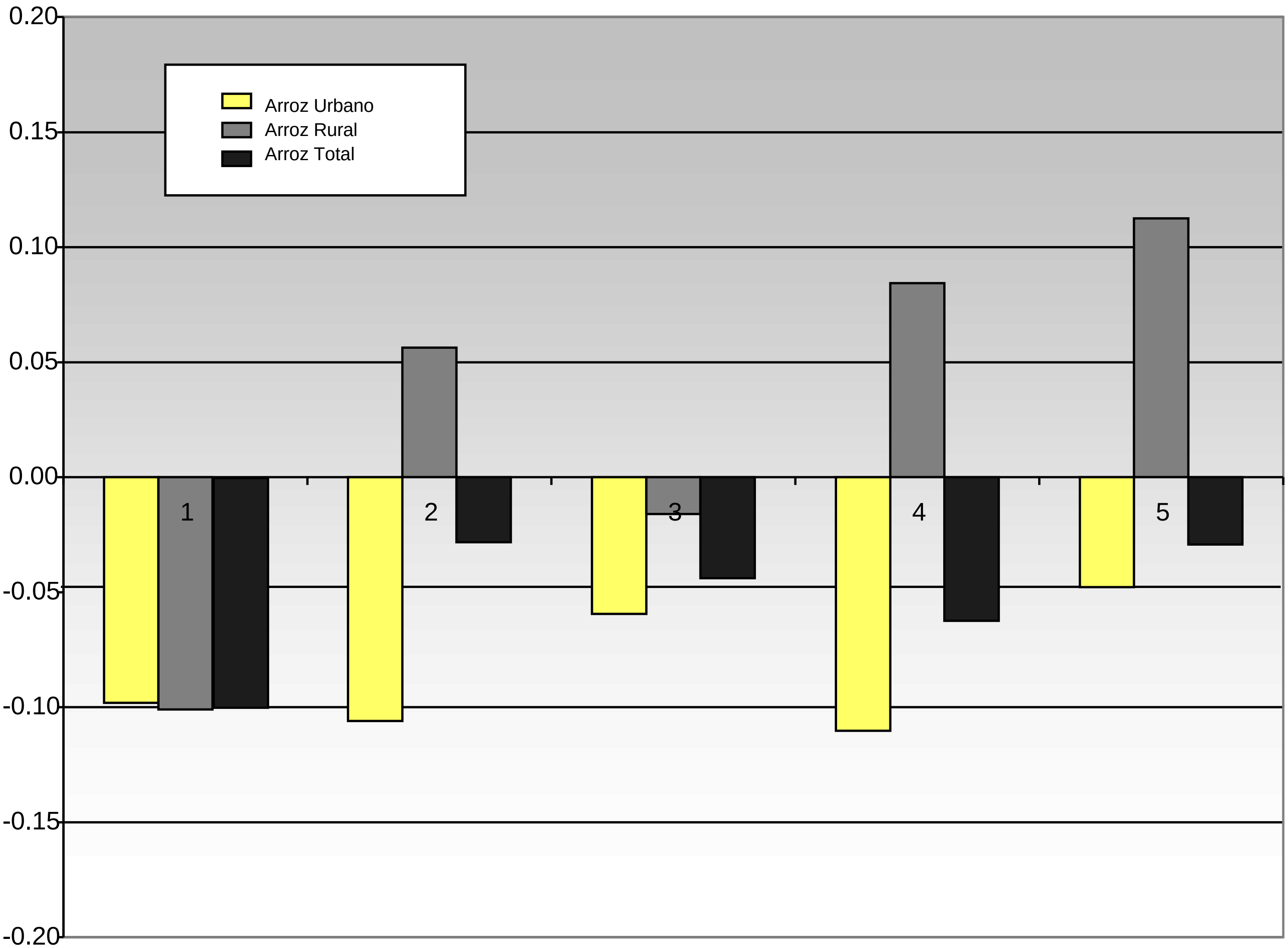
Aspects included in the net welfare impact analysis

- Propose an alternative calculation for consumer price percentage change accounting for the margin assumption

Dawe and Maltsoglou (FAO, 2009) ftp://ftp.fao.org/docrep/fao/011/aj990e/aj990e.pdf

- Include for purchasing power differences across rural and urban areas
- Include for crop to food transformation chain

Welfare impact for a 10% producer price increase for rice



Producer price changes

Commodity	Real percentage price changes 2006-2008
Rice	45
Sugar (White, brown) *	-37 , -57
Wheat	9
Potato	-7
White maiz	30

* Based on the wholesale price

Source: Author calculations based on INEI data.

Where we stand....

- Wrapping up the country assessments, using the technical analysis components to feed into the domestic policy dialogue while considering country institutional constrains

- Training in the country on each Module's methodology: Different issues in different countries

- Supporting domestic policymakers with the two activities above to feed into the National Biofuels Taskforce

Conclusions

- BEFS can show which areas should be developed for biofuel production, whilst accounting for food production and environmental constraints
- BEFS can show implications for the economy, labour, poverty and which segments of the population will loose or will gain

....nevertheless, the success of sustainable bioenergy developments will heavily rely on meticulous managements and, as generally for agriculture, on investment in infrastructure, agriculture R&D and human capital development...

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THANK YOU!

http://www.fao.org/bioenergy/foodsecurity/befs/home/en

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