FSSIM-DEV

- What does FSSIM-DEV stand for?

  Farming **S**ystem **SIM**ulator for **DEV**eloping Countries

- What is the main application?

  Simulate supply responses of farmers to policy scenarios

Outline of this presentation…

1   Problem Definition

2   Farmers' dilemma

3   Modelling Issues and Options

4   Model Structure

5   Modelling examples

6   Knowledge sharing & capacity building

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Problem Definition

- Compute Responses (Supply and Demand) to Price changes

- Supply Responses impact income ➡ change in cropping patterns, labour ➡ requires a farm supply model for crops

- Demand responses impact expenditure ➡ changes in family consumption ➡ requires information on commodity demand to estimate expenditure system

- Combination of responses possible **ONLY** if data available on cropping **and** expenditure.

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Farmers' dilemma

- Agro-Climatic zones and soil types define the type of crops that can be grown

- Farmers grow only a subset all possible crops (e.g. Cotton, Sorghum, Maize)

- Different farms have different crops. What drives these decisions?

- Work on own land or supply labour to other farms or both?

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Modelling Issues and Options

- Only Maximise Profits?

- Profits with environment concerns?

- Include Yield response to fertilizer input, soil types?

- Pure Economic models or use hybrid Agro-Economic models?

- **DATA** is the limiting factor! Determines the model structure.

Modelling Issues and Options

- Ex-ante Impact (**EI**) Analysis: detailed study of the policy/program and an estimation/quantification of its possible outcomes prior to its implementation

- **EI** analysis/assessment has become an integral and **systematic part** of policy **decision making** processes in many countries (evidence base policy)

- EI is **complementary** to the common and the scientifically well-founded **ex-post** impact analysis designed to evaluate past policy effects

- **EI** is based on available **DATA** and determines the model structure.

Modelling Issues and Options

- Model key features of Developing Countries agriculture (market imperfection, seasonality, interaction among farms)

- Capture spatial and farm-household heterogeneity in term of policy effects (e.g. small versus big farms)

- Provide detailed socio-economic results (i.e. average and distribution over population)

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Modelling Issues and Options

- Flexibility in aggregating results by farm-household type, economic size, village, region or country.

- Generic and modular setup: can be easily adapted and re-used for assessing different policies under various socio-economic and bio-physical conditions.

- In-house model development & maintenance

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FSSIM-Dev structure
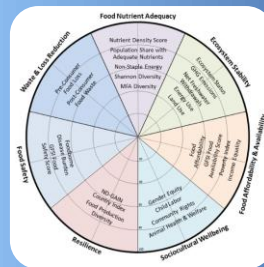
DATA

Farm data (Land, Family labour, Capital…)

Crop & Livestock data (price, yield, inputs, costs, lab…)

Household data (HH members, reference consumption, off-farm income, income & demand elasticities …

METHODS

Individual Farm Household (FH) model running for each single FH

Comparative static & non-linear optimisation model

Capture key features of DC (market imperfect., inter-action among FH, seasonality…)

INDICATORS

Socio-economic

FH income

Activity level

(ha & head)

Production

Land, labour, input use

Food security

Nutrition

Environment

APPLICATION

SENEGAL
IVORY COAST
NIGER
ETHIOPIA
TANZANIA

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Model Structure

Household model for policy analysis: FSSIM-Dev

- **Farm Household model** (i.e. production and consumption decisions)

- Comparative **statics & non-linear** optimization model

- Calibrated using a Positive Mathematical Programming (**PMP**) approach

- Covering the major agricultural and livestock production activities

- Generic & Modular setup

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Model Structure

Household model for policy analysis: FSSIM-Dev

- Capture key features of Developing Countries agriculture:

  - **non-separable** production and consumption decisions

  - **heterogeneity** of farm households

  - interaction among farm-households for factor markets

  - **seasonality** of cropping activities and resource use

  - effects of **transaction costs** on market participation

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Model Description

FSSIM-DEV's mathematical structure

- Maximize Farm household income

- Subject to:

  - Resource constraints

  - Consumption: Linear Expenditure System (LES)

  - Price bands & complementary slackness conditions

  - Market cleaning conditions

Model Description

Farm household income (i.e. full income)

$$R_h = Z_h \quad \longleftarrow \text{------------------------} \quad \text{Agriculture income}$$

$$+ \sum_{tf} b_{h,tf}\, p_{h,tf} \quad \longleftarrow \text{------------} \quad \text{Value of tradable factors (tf) rented-in \& out}$$

$$- \sum_{j} b_{h,j}\, p_{h,j} \quad \longleftarrow \text{----------} \quad \text{Value of purchased quantity of goods j}$$

$$+ exinc_h \quad \longleftarrow \text{------------} \quad \text{Off-farm incomes (exogenous)}$$

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Model Description

Agricultural/farm income

$$Z_h = \sum_j (s_{h,j} + c_{h,j}) p_{h,j} \quad \longleftarrow \text{ Value of sold and self-consumed quantities of good j}$$

$$+ \sum_i sb_{h,i} x_{h,i} \quad \longleftarrow \text{ Subsidies}$$

$$- \sum_i a_{h,i} x_{h,i} \quad \longleftarrow \text{ Accounting unit costs (inputs)}$$

$$- \sum_i (d_{h,i} + 0.5 Q_{h,i,i'} x_{h,i}) x_{h,i} \quad \longleftarrow \text{ Implicit costs}$$

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Model Description

Linear Expenditure System

Consumption of good _i_

Price of good _i_

$$C_{i,h} p_{i,h} = \beta_{i,h} [R_h - \sum_{i'} (\gamma_{i',h} p_{i',h})] + \gamma_{i,h} p_{i,h}$$

Marginal budget share of good _i_

Supernumerary income

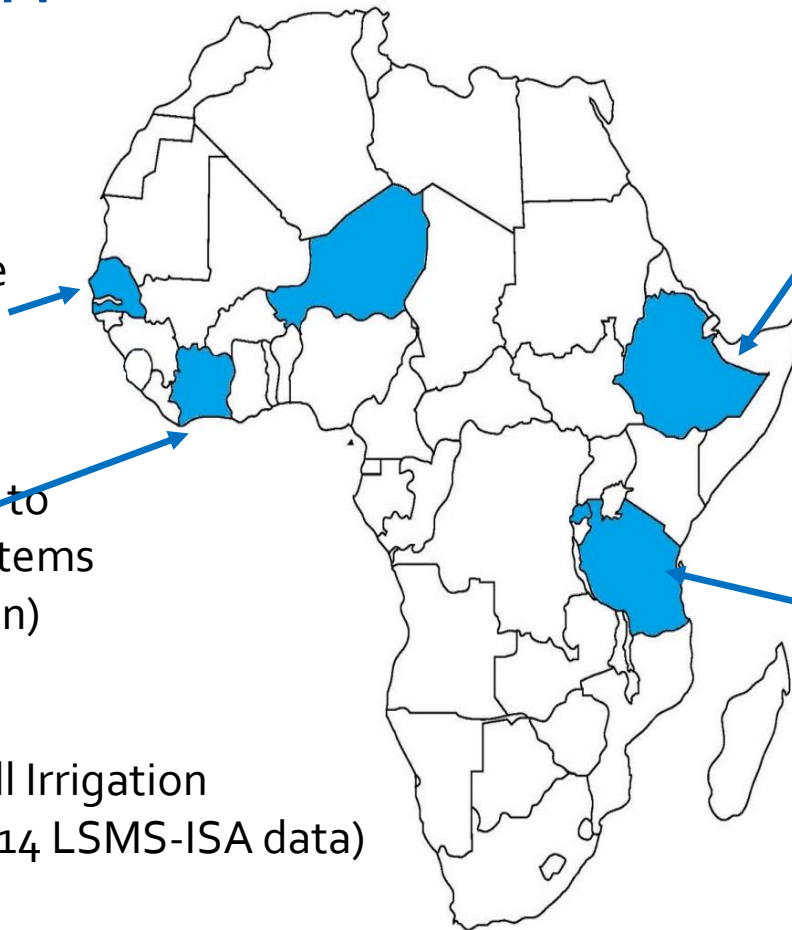**Uncompressible consumption**

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FSSIM-Dev applications

Senegal
Impacts of fertiliser subsidy programme (2011 ESPS data)

Ivory Coast
Impacts of support to cotton farming systems (own data collection)

Niger
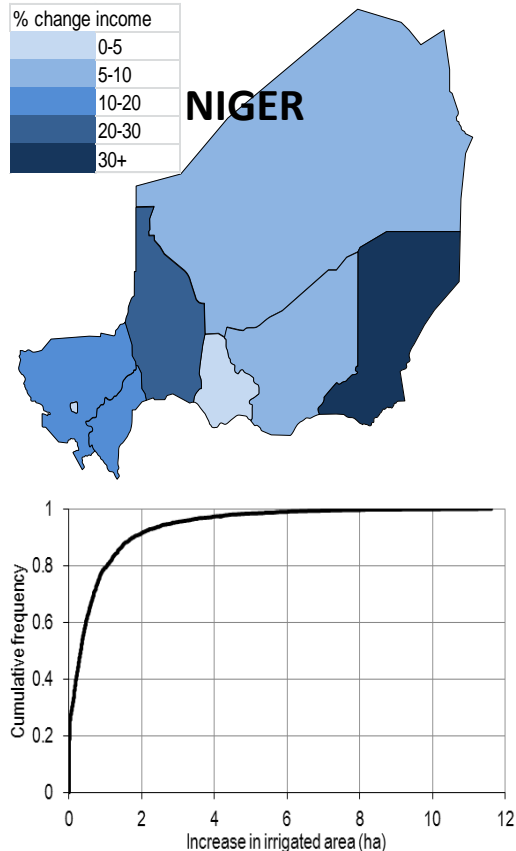Impacts of Small Irrigation programme (2014 LSMS-ISA data)

Ethiopia
Impacts of minimum price support for cereals (2012 LSMS-ISA data)

Tanzania
Impacts of local fiscal policy (produce cess) and new price regulation (2013 LSMS-ISA data)

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FSSIM-Dev applications

% change income
- 0-5
- 5-10
- 10-20
- 20-30
- 30+

NIGER

- In Niger, support to EU Delegation & Ministry of Agriculture to estimate the micro-level (farms/households) impact of Small Irrigation programme (SPIN) on food security and rural poverty (contribution of EU-Development Fund through budgetary support)

- Overall impact (2020): SPIN increases cropped land and total output, improve/stabilize yields, offer opportunities for off-season cropping and does not necessarily requires heavy investment / government support.

- +7% household Income (preliminary results). Higher positive impact for poorest households than for richest.

FSSIM-Dev applications
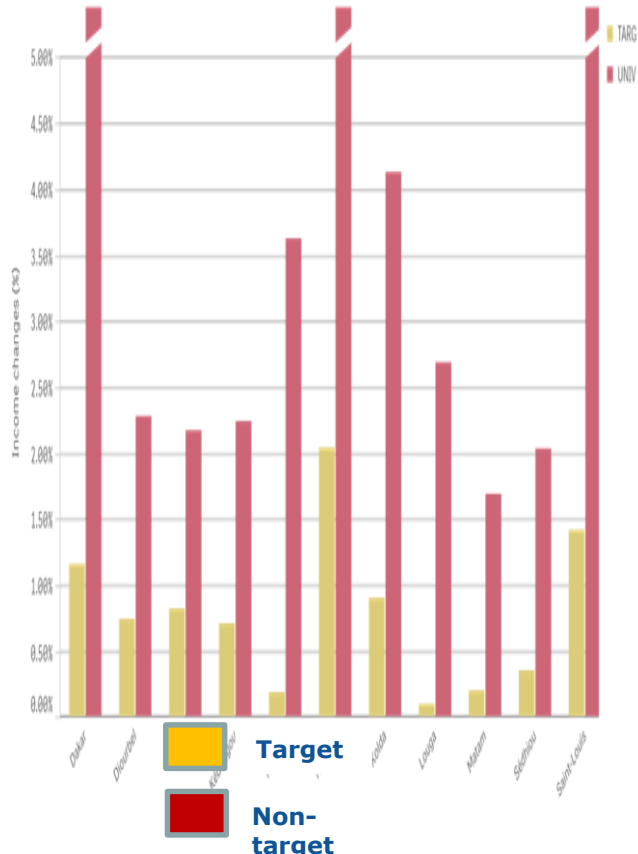
SENEGAL

- In Senegal, we assess impact of a targeted versus non-targeted fertilizer voucher program.

- Overall impacts (preliminary results): very low impact at aggregated level. Impact is lower for smaller farmers (targeted programme) than for larger farmers - only few farms would be positively affected, for some farms income increase may reach 70%.

- The limited use of fertilizer programme and the resultant limited increase in productivity/income - especially among smaller farmers - could be explained by the limited available cash flow

Knowledge sharing & capacity building

Workshops in Partner Countries to discuss methodology, database and preliminary results.

Advanced training for selected colleagues from key institutions on quantitative methods/models developed within this project Shared projects to share model "ownership".

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Thank you

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