

Synthesis of Research on Scaling of Multipurpose Legume – Maize Technology in Malawi

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Outline of presentation

- Background on GCFSI
- Background on the Malawi research projects
- Research projects implemented
- “Keystone” issues raised by the research results
- Recommendations for scaling up MLM systems
- Estimated medium-term impacts
- Relevance of findings for scaling of other crop value chains
- Next steps



Acknowledgments

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- Support from LUANAR senior administrators (including Vice Chancellor Kanyama-Phiri and innovation hub coordinator Dr. David Mkwambisi), and from faculty members, and students
- Warm welcome from farmers and private entrepreneurs in Malawi

Background on GCFSI

- GCFSI is 1 of 8 university innovation centers funded by USAID under the Higher Education Solutions Network
- The goal of GCFSI is to create, test and enable the scaling of innovations in the food system, using an approach that is:
 - Multi-disciplinary,
 - Focused on the entire food system, and
 - Forward-looking, considering major trends that will impact future food system performance
- These major trends include:
 1. Population growth, climate change, and pressure on land
 2. Rapid urbanization and income growth
 3. Workforce development

Background on research projects

- Decision made in early 2014 to implement a set of coordinated research projects in Malawi
- All research teams charged to answer the question:

“Where and how can multipurpose legumes be scaled for sustainable intensification of maize systems, and what would the potential impacts be, in the medium term, across the food system in Malawi?”

(Multipurpose means contributing to soil fertility and providing livestock fodder, fuel and building materials, as well as a nutritious food for family consumption.)

Research projects implemented

MegaTrend 1: Population Growth, Climate Change, and Pressure on Land

Climate Analysis, Hydrologic Modeling, Land Use Analysis

N Moore, J Messina, P Nejadhashemi, V Breeze, U Adhikari, B Peter, H Deindorfer, A Frake, M Devisser, M Herman

Impacts of Climate Change on Rice and Maize, and Opportunities to Increase Productivity and Resilience in Malawi

J Olson, G Alagarswamy, J Gronseth and N Moore

Agroecology for Resilient Farming Systems

SS Snapp, V Morrone, WG Mhango, LC Zulu



Research projects implemented, 2

MegaTrend 2: Rapid Urbanization and Transformation of Food Systems

Traditional Urban Legume Exchange in Lilongwe, with a Focus on Pigeon Pea

SA White, MW Hamm, A Mbachii Mwangwela, JFM Kamoto, JJM Kampanje-Phiri, FC Chigwa, M Thondolo

Institutional and Policy Constraints To Innovation in the Malawian Legume Value Chains: Current Status and Business Actors' Coordination for Institutional Change

D Dentoni, F Krussmann, M Degnet, A Noor

Mapping Market Prospects for Grain Legumes in Malawi

J Dzanja, M Matita, H Kankwamba, M Dolislager, and D Tschirley

Research projects implemented, 3

MegaTrend 3: Evolution in Skills Required by Food Systems

Skills and Workforce Development

J Dirx, T Smith, I Berzina-Pitcher, and M Vann

ICT4D: Using Participatory Video for Smallholder Farmer Training in Malawi

C Steinfield, S Wyche, H Chiwasa, J Mchakulu, and T Cai

Cross Cutting Themes

Gender: Gender Analysis of the Pigeon Pea Value Chain

N Me-Nsope and M Larkins

[Reports Status](#)

Focus on pigeon pea

- While soybeans and groundnuts are an FTF program priority in Malawi, pigeon pea was the multipurpose legume that received most attention in the research.
- Reasons for this included:
 - It provides the full range of “multipurpose” benefits
 - Its long growing cycle allows it to fix more N and add more organic matter to the soil, improving the level and stability of intercropped maize yields
 - It faces a strong export market—25% of Malawi’s production is exported
 - It provides income-earning opportunities for women



Features of the research

- Multidisciplinary and systems perspective on the legume value chain:
 - Focus not just on production
 - Focus not just on rural sector
- Attention to informal as well as formal marketing systems
- Regarding scaling potential—focus on institutional and social (e.g., gender) factors, as well as on technology factors

“Keystone” issues raised by research

- Networking capacity: farmers and small entrepreneurs are not well connected to wider legume networks. Price information and market opportunities are not widely known, especially by women
- Infrastructure for post-harvest transportation, storage, and processing is inadequate, as are energy supplies

“Keystone” issues, 2

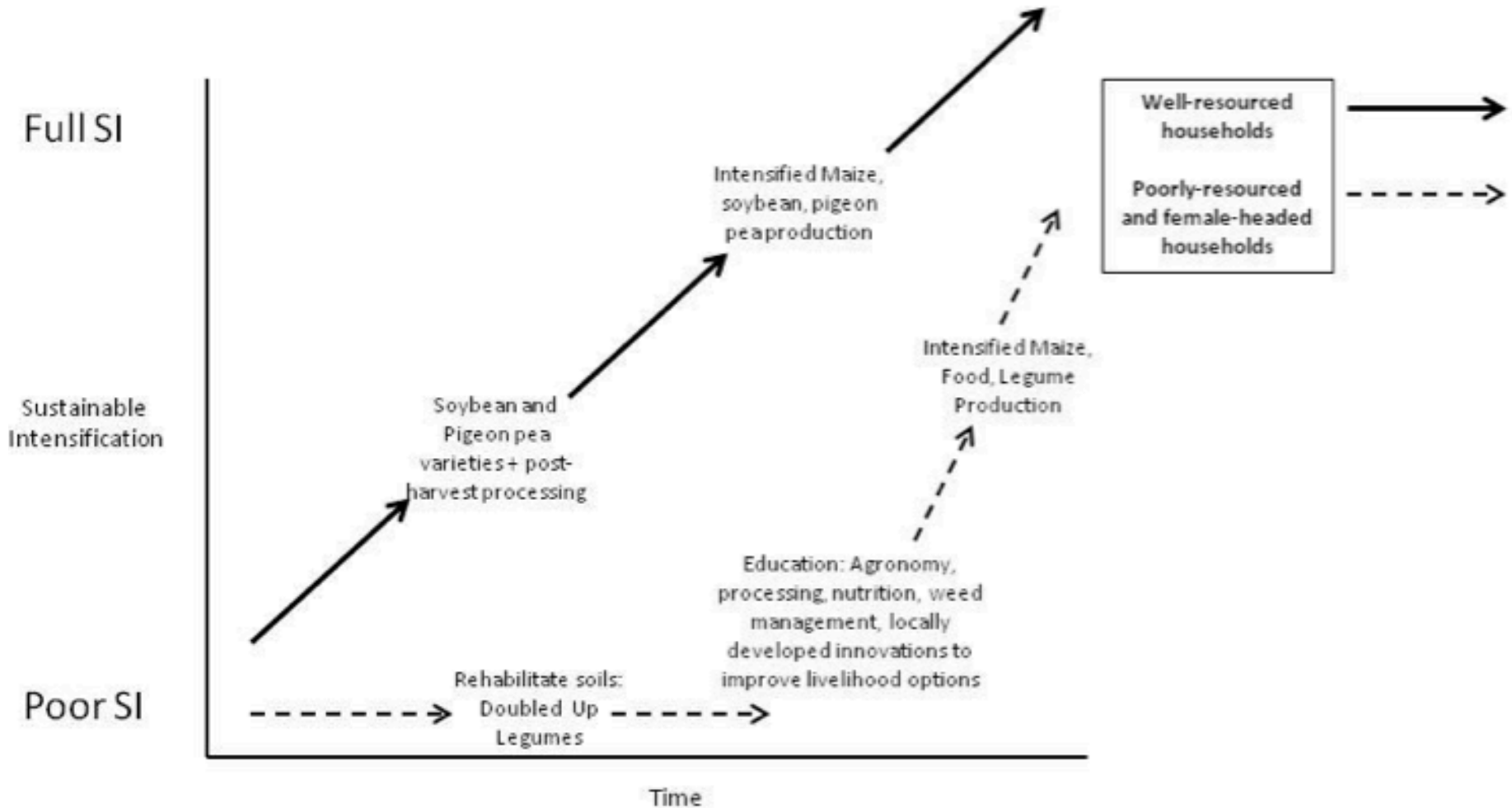
- Seed systems: commercial seed companies have little interest in supplying a diverse range of improved legume seeds—since farmers reuse their own seed—and the informal seed system is undeveloped
- Access to information, services, and capital is limited—especially for women—constrained partly by low penetration of mobile phones, and social norms.

Target groups and zones for scaling MLM

Zone \ Target Group	Group 1: Farmers with access to capital resources: The strategy focuses on developing access to commercial or export market.	Group 2: Farmers with minimal access to capital resources: The strategy focuses on developing nutrition and livelihood security and improved soil fertility
North and Central (lower population density, more land, better growing conditions)	Soya and pigeon pea as cash crops (domestic livestock feed and export, respectively)	Pigeon pea rotation with maize (potential for climbing bean in northern region, where there is higher elevation)
South (higher population density, less land, more variable production conditions)	Pigeon pea for the Blantyre export market	Intercropping with maize in order to improve soil fertility and strengthen resilience in response to increasingly uncertain climate conditions



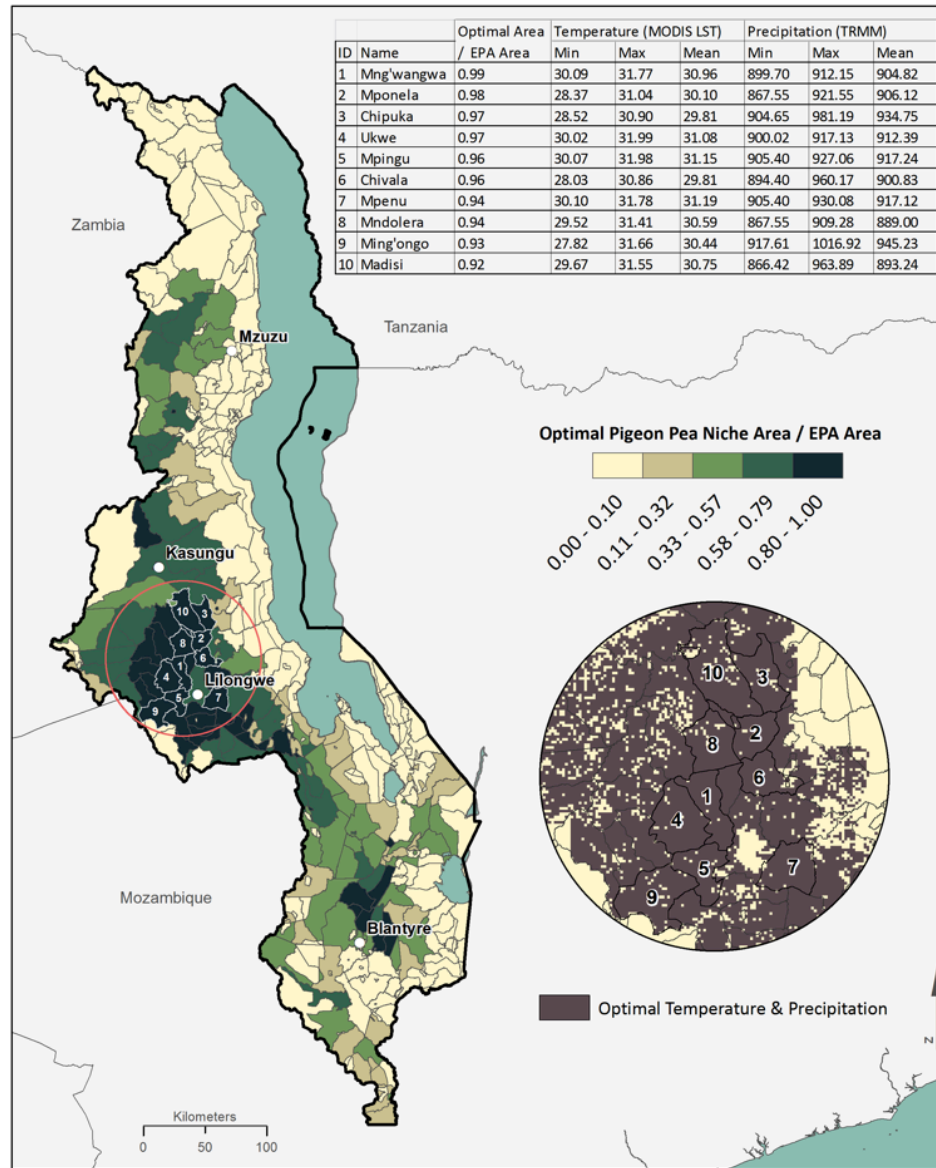
Pathways for scaling MLM technology



Pigeon pea scaling strategy

- To reach large numbers of farmers (both Groups 1 and 2), focus on Central Malawi, given its geophysical suitability and proximity to large urban market in Lilongwe
- To target Group 1 (focusing on exports through Blantyre) and Group 2 (challenged by low and variable productivity), focus on Southern Malawi
- Farmers in Northern Malawi are unlikely to perceive benefits of shifting to improved MLM technology, given existing productivity of maize and presence of tobacco as cash crop

Optimal Pigeon Pea Niche - Temperature & Precipitation



Investments needed for scaling MLM

1. Build farmer knowledge and capacity regarding use of appropriate agronomic practices.
2. Development of community-based seed systems involving women in multiplication and distribution.
 - Current policy requires certified seed, not just “quality-declared” seed?
3. Improve storage and transportation infrastructure to reduce food losses, improve seed quality, and reduce the need to sell at harvest.

Investments needed for scaling MLM, 2

4. Small-scale processing capacity to provide alternatives to expensive products processed by exporters, and reduce processor-to-consumer transport costs.
5. Access to information about market prices and volumes traded for legumes, and to capital, financial services, and business management training for traders and processors.
6. Networking and collective action to reduce costs and increase bargaining power for small-scale legume producers and agribusiness entrepreneurs—especially for women.

Time frame for scaling interventions

Intervention	Time Required to Implement
Extension on agronomic practices	One to two years
Establishing storage facilities	Two years
Establishing processing facilities	Two years
Building seed system	Two to three years
Creating access to information, financial services, and capital	Two to three years
Networking and collective action	Two to three years

Estimated medium-term impacts

1. MLM would provide higher and more stable, climate-resilient yields than maize cultivation alone.
2. Target group 1 (less than 10% of farm households) would gain higher cash incomes, improved nutrition, and more sustainable levels of soil fertility.
3. Target group 2 (70% of farm households) would gain greater food security: improved nutrition, more resilient cropping, and less reliance on food purchases.
4. Other impacts: introduction of MLM technology in the north; improved seed system in center and south; and greater availability of legumes in urban markets, with more consistent prices and quality.

Relevance to other crop value chains

- Several reports cover soybeans and groundnuts (Dzanja et al., Dentoni et al.)
- Systems approach to scaling is generally applicable: combination of social, institutional, and technology factors
- Insights into high and low potential growing areas based on mapping of satellite-based information on land use and productivity, and weather data and climate trends

Next steps

1. GCFSI Year 4 work plan discussions:
 - Continued focus on innovation, but
 - Greater emphasis on collaboration with other USAID-funded projects, such as Legume Innovation Lab (seed system development) and Climate Resilient Maize
2. Continued support for GCFSI innovation hub hosted by LUANAR:
 - Innovation grants for LUANAR and University of Malawi (Chancellor College) faculty and students
 - Potential institutional capacity building for LUANAR, e.g., in communication and “research translation” skills, skills for agricultural innovation, grant and research proposal writing

GCFSI website and media materials

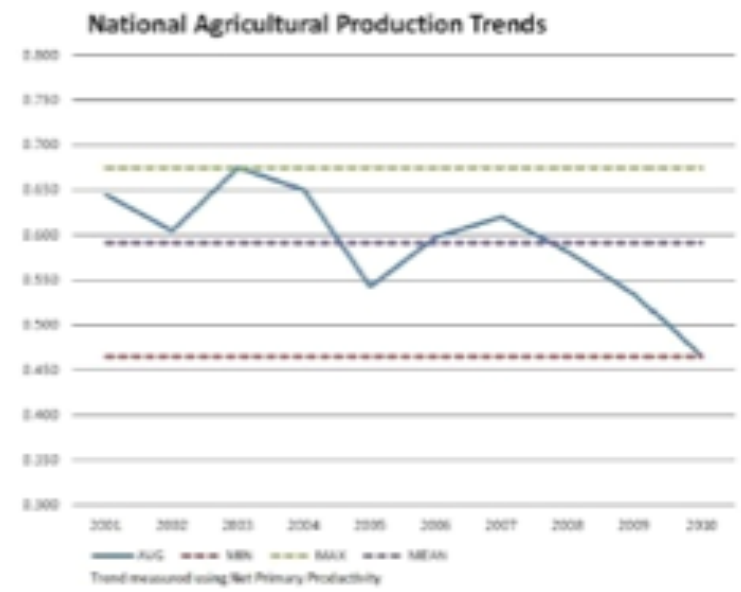
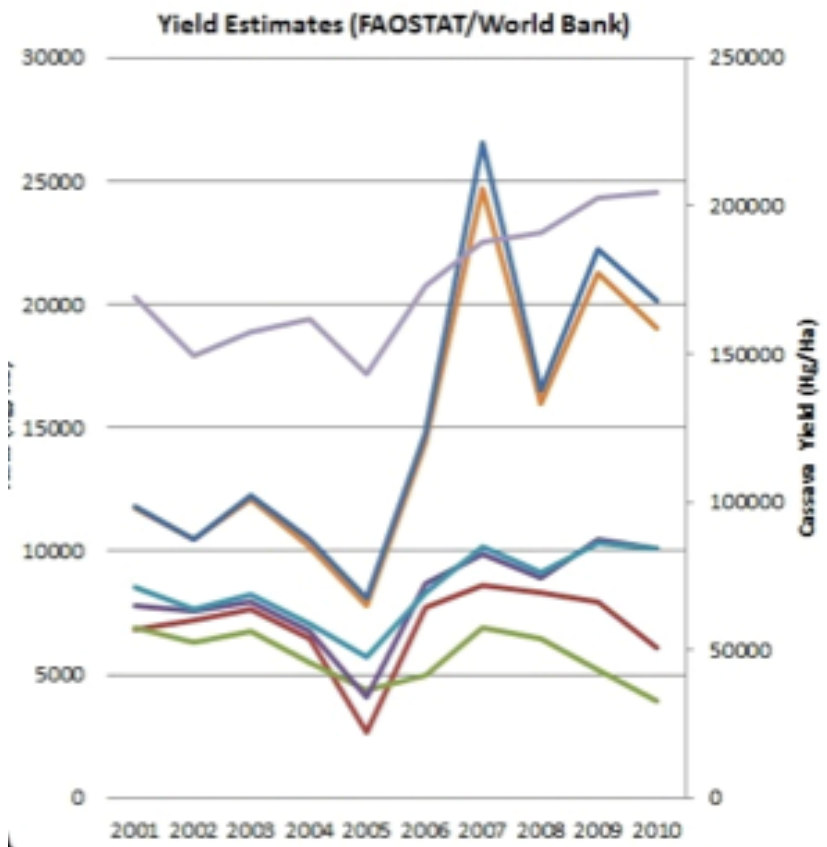
- Main website: <http://gcfsi.isp.msu.edu/>
- Publications: <http://gcfsi.isp.msu.edu/downloads/>
- Videos (many on Malawi): <http://gcfsi.isp.msu.edu/videos.htm>
- FoodFix podcasts: <http://foodfixpodcast.podomatic.com/>
- Materials on Malawi Frugal Innovation practicum:
 - [Podcasts](#)
 - [Student notes from the field](#)

Thank you!

Questions?

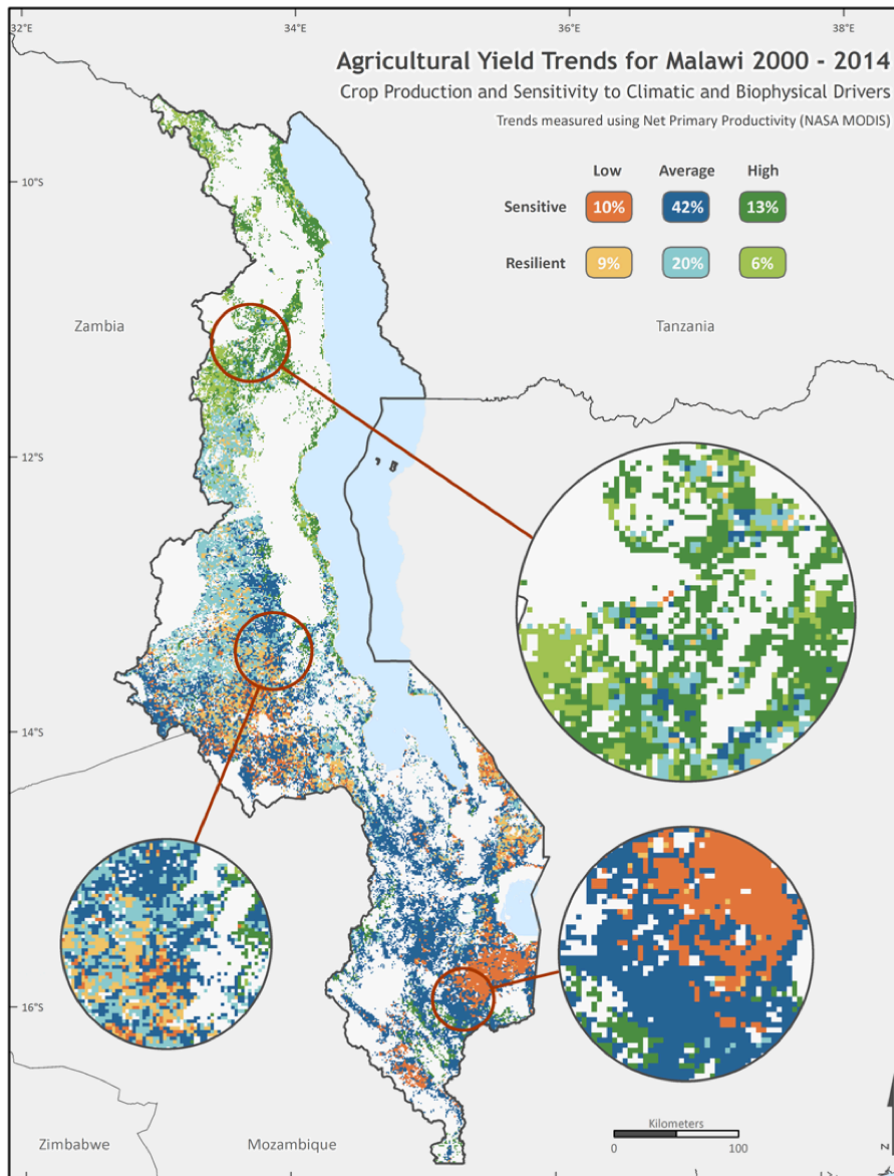
Supplementary slides

Agricultural productivity trends



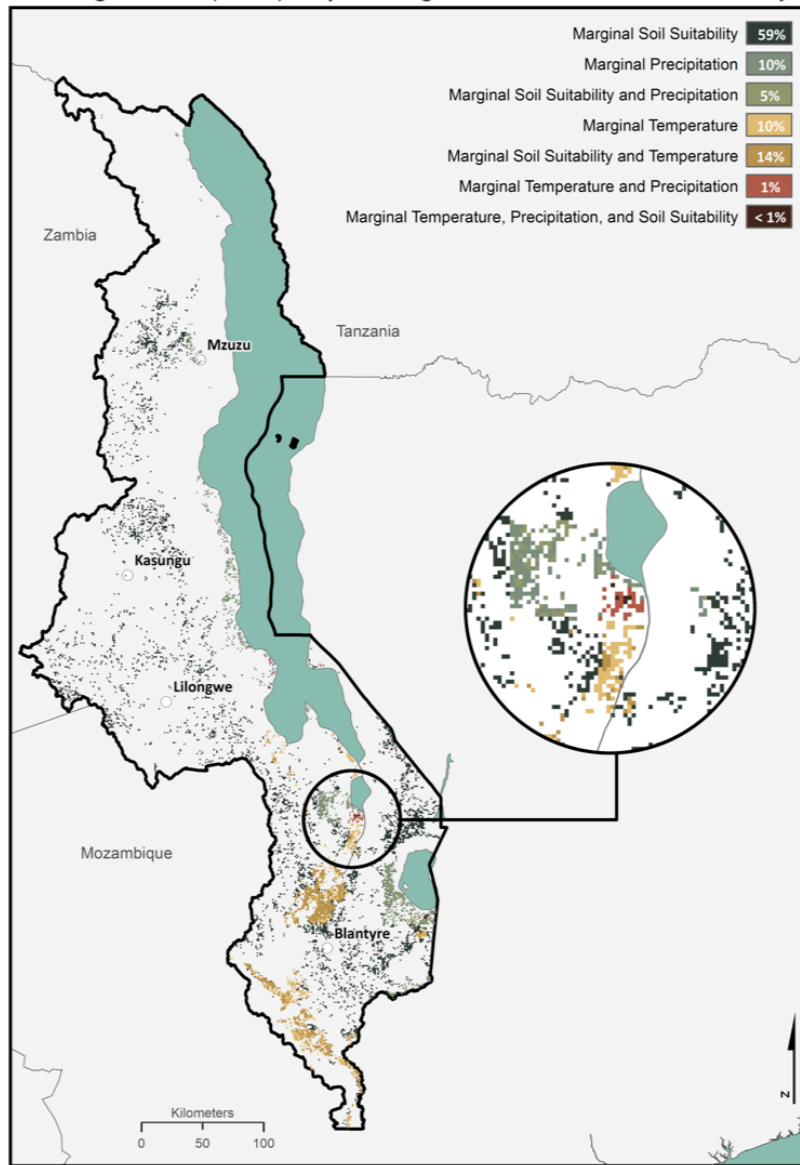
- World Bank - Cereals
- FAOSTAT - Maize
- FAOSTAT - Sorghum
- FAOSTAT - Cow peas, dry
- FAOSTAT - Pigeon peas
- FAOSTAT - Groundnuts, with sh
- FAOSTAT - Cassava

[Back](#)



- North: mostly high productivity, mix of sensitive and resilient
- Center: mostly average productivity, some low & high; mix of sensitive and resilient
- South: substantial area of low productivity + sensitive (sandy soils, high water table, prone to waterlogging)

Marginal Land (Maize) + Optimal Pigeon Pea Niche + Poor Productivity



- Map plots points that are optimal for pigeon pea (PP) with those that are marginal for maize for the seven reasons shown in the legend
- Question: where to promote PP to improve level and resilience of maize yields? Answers:
 - In areas where PP addresses soil fertility constraints on maize (dark green, light green)
 - Not in areas where constraint on maize yield is temperature (orange, red), which PP cannot affect

Climate and land use analysis

- Question: “What methodologies and tools can better characterize how ag productivity and land use are changing over space and time in relation to changing biophysical parameters?”
- Method: Climate and land use models employed to:
 - Analyze past trends in timing of start of rainy season
 - Analyze agricultural [productivity trends](#) (shows inconsistency between published statistics and declining trends revealed by satellite imagery)
 - Map optimal locations for [pigeon pea](#) and marginal maize + pigeon pea.
- Results:
 - Shift to later start of rainy season, by average of about six days
 - See links to maps above

Hydrologic analysis

- Question: “What is the impact of climate change on the land-water resources in Malawi?”
- Method: Used SWAT model (Soil and Water Assessment Tool) to compare baseline and future water balances for eight watersheds and six climate change scenarios.
- Results:
 - Calibrated watershed models, available for use by LUANAR researchers
 - Consistent increase in annual rainfall in the north, and decrease in south
 - Same results for soil moisture content and surface runoff

Impacts of climate change on rice and maize

- Question: “How are farmers and policy-makers responding to changes in agricultural production due to climate change?”
- Method:
 - Four global climate models were downscaled to a DSSAT crop model.
 - Key informant interviews and a literature review on government policies and farmer responses to climate change.
- Results:
 - Temperatures slowly warming and number of hot days over 35° increasing
 - Rainfall declining in the north, though still relatively high
 - In south, dry spells in Jan/Feb more intense and rainy season shortening
 - Increase in temperature and rainfall variability and extreme values
 - Yields in cool, high-elevation areas will increase as temperatures rise
 - Most of the south will see yield declines as heat and water stress become limiting, and reduce the response to fertilizer

Agroecology for resilient farming systems

- Objective: To identify geographic extent of multi-purpose legume cultivation, and to collect data to inform curriculum for Farmer Field Schools (FFS)
- Method: Interviews with 323 farmer experimenters
- Results:
 - Farmers are increasingly adopting pigeon pea
 - Female farmers more likely to expand area under multipurpose legumes and maize (MLM)
 - Giving farmers agroecological knowledge will promote adoption of MLM, so this needs to be part of the FFS curriculum
 - Prototype cards developed to communicate extension messages
 - Livestock damage is a problem; alternative livestock management approaches are needed

Traditional legume exchange in Lilongwe

- Question: “What constraints do small-scale legume entrepreneurs experience and how might they affect the urban ‘pull’ factors that influence the integration of legumes into maize-based farming systems?”
- Method: 108 interviews of traders in 21 markets in or around Lilongwe re: pigeon pea and general legume sourcing, transportation, and storage.
- Results: Provides evidence to municipalities on how to support small-scale entrepreneurs, and suggests specific interventions for storage and transportation.

Institutional and policy constraints to legume value chains

- Questions: “How do institutional and policy issues currently constrain innovation in legume value chains, and how are business actors responding to these constraints?”
- Method: Interviews with 59 business actors plus stakeholder and value chain network analysis
- Results: Five main constraints:
 - Uncoordinated information system for farmers
 - Weak credit and input markets
 - Poor infrastructure
 - Problems with farming as a business and cooperative formation
 - Weak public monitoring and auditing of quality standards

Mapping market prospects for grain legumes

- Objective: To assess market growth prospects for grain legumes in Malawi over next 15 years.
- Method:
 - Analyzes 2010/11 Integrated Household Survey to determine pattern of production, marketing, and consumption of legumes (soybean, pigeon pea, cowpea, groundnut)
 - Maps structure of legume markets in Lilongwe
 - Assesses growth prospects for legumes and demand for meat (which creates a derived demand for legumes for animal feed)
- Results:
 - If income growth continues, legumes will enjoy strong domestic and export market prospects
 - Challenges: reduce aflatoxin contamination; assist small-/medium-scale food processors; identify and test small-scale food processing technology to help small firms compete with imports

Skills and workforce development

- Question: “What is the capacity of LUANAR to meet the demands of the WFD system for post-secondary education?”
- Method:
 - Created 9 educational capacity assessment variables: accessibility, purpose and vision, curriculum, teaching, research and knowledge, support, collaboration, value, responsiveness
 - Focus group discussions with LUANAR faculty members and students
- Results:
 - Access is complicated by increasing student enrollment numbers
 - Students would benefit from more hands-on learning opportunities
 - Government and donor funding is insufficient
 - Much collaboration with external stakeholders, but little coordination
 - Proposal: establish a “Food Systems Accelerator” or business incubator, and establish a corps of Research Fellows within the lecturer staff

Participatory video for farmer training

- Objective: To test use of participatory videos to improve capacity of extension agents to deliver agricultural support and education to smallholder farmers.
- Method: Filming of videos with low-cost battery-operated equipment and local community “actors”
- Results:
 - Mobile phone usage is low in rural areas (less than 30% of farm households in Dedza district), and even lower among women
 - Participatory videos were found to produce knowledge gains equal to or better than those from live training sessions
 - Integrating participatory video and live training sessions provided even higher short-term knowledge gains

Gender analysis of pigeon pea value chain

- **Objective:** To examine gender issues along the pigeon pea (PP) value chain and their implications for participation and accrual of benefits, for both men and women
- **Method:**
 - Fieldwork was conducted in the North, Central and South regions
 - Data collected from key informants along the value chain
 - The Gender Dimensions Framework (Rubin et al. 2009) was used to examine gender-based constraints to participation in the value chain, control over benefits, and implications for legume adoption and for household food security
- **Results:**
 - Women are more knowledgeable about PP and have specific preferences about cooking time and taste, which must therefore inform breeding work
 - Women experience gender-related constraints that restrict mobility and access to resources (land, labor, capital)
 - Export companies and their traders have market power that results in high prices for processed (split, polished) PP in domestic markets