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HIGHER EDUCATION SOLUTIONS NETWORK - QUARTERLY REPORT

MICHIGAN STATE UNIVERSITY
GLOBAL CENTER FOR FOOD SYSTEMS INNOVATION - GCFSI
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TERI, USAID and GCFSI participants in the South and South East Asia Workshop, New Delhi, India

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Acronyms & Abbreviations

AFRE	(Department of) Agricultural, Food, and Resources Economics at MSU
AgMIP	Global Gridded Crop Model
AHRD	Academy of Human Resource Development
ArcGIS	Geographic Information System
BFS	USAID Bureau for Food Security
CGIAR	Consultative Group on International Agricultural Research
DFID	Department for International Development (United Kingdom)
DSI	Decision Support and Informatics
FACET	The Fostering Agriculture Competitiveness Employing Information Communication Technologies
FAO	Food and Agriculture Organization
FSHN	(Department of) Food Science and Human Nutrition at MSU
FSP	Food Security Policy Innovation Lab
FtF	Feed the Future
GCFSI	Global Center for Food Systems Innovation
GIN	Goal Indicator
GIS	Geographic Information System
HESN	Higher Education Solutions Network
iAGRI	Innovative Agricultural Research Initiative
ICT	Information and Communication Technologies
ICT4D	Information and Communication Technologies for Development
IFAMA	International Food and Agribusiness Management Association
IFPRI	International Food Policy Research Institute
IR	Intermediate Result
LU	Lincoln University
MIT	Massachusetts Institute of Technology
M&E	Monitoring and Evaluation
MOOC	Massive Open Online Course
MSU	Michigan State University
MT1	Megatrend 1: Population Growth, Climate Change and Pressure on the Land
MT2	Megatrend 2: Rapid Urbanization and Transformation of Food Systems
MT3	Megatrend 3: Evolution in Skills Required by Food Systems Transformation
NGO	Non-governmental organization
O1	Objective (1, 2, 3 or 4)
OST	USAID Office of Science and Technology
PIM	Policies, Institutions and Markets
RAID	Redundant Array of Independent Disks
RFA	Request for Application
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
SA/SEA	South Asia and South East Asia

SIG	Student Innovation Grants
SUA	Sokoine University of Agriculture- Tanzania
TechCon	Technical Convening
TERI	The Energy and Resources Institute - India
TSC	Translational Scholar Corps
UC	University of California (at Berkeley)
US	United States
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WIDER	World Institute for Development Economics Research at United Nations University
WUR	Wageningen University - The Netherlands

Executive Summary

The launch of a new project year was a great place for the Global Center for Food Systems Innovation (GCFSI) to discuss its strategy moving forward. The core GCFSI team met on various occasions during the quarter to strategize, realign resources, discuss the year two work plan, revise the budget, develop new operating structures and discuss university support. As part of the discussions, GCFSI sought opportunities to virtually meet with members of the Higher Education Solutions Network (HESN), which prompted a 2 hour call between Texas A&M Conflict Lab and GCFSI on November 7, 2013. This activity was followed by the HESN Technical Convening November 16-18, 2013, and Congressional visits on November 19th.

GCFSI and USAID Congressional Visit to Senator Stabenow

Michigan State University (MSU) hosted a breakfast meeting at the World Food Prize in Des Moines October 2013 to share information about GCFSI with prospective corporate and foundation partners. Sixteen external individuals attended, representing Deere & Co, Dow AgroSciences, DuPont-Pioneer, Land O'Lakes, Monsanto, Novus International, Bill and Melinda Gates Foundation and several universities and non-governmental organizations (NGOs). The presentations by MSU faculty were well received and direct follow-ups have resulted from the meeting that hold potential for external funding of future GCFSI projects.

In addition, GCFSI researchers Sieg Snapp and Joe Messina received a $1.49-million grant from the Bill and Melinda Gates Foundation to study the potential benefits of introducing a new type of crop to farms across Africa: perennial grain. The research team will examine perennial grains' ability to reduce soil erosion and farm labor, improve water quality and increase the storage of organic matter in the soil. It will also assess the potential risk of introducing a plant species into a new environment to ensure that the grains do not damage the local ecology.

During the third week of November we benefited from the visit of Prof. Sylvia Chindime of The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM). Prof. Chindime is the Program Assistant for Training and Quality Assurance at RUFORUM, and is actively working with Megatrend Three (MT3) to help in the design and implementation of a three-day workshop in Africa, concerning workforce development initiatives in the region, pursuant toMT3's first white paper findings.

During this quarter, GCFSI focused efforts on conducting research and literature reviews for the second iteration of the white papers (Asia White Papers), due March 2014. As part of this effort, GCFSI, jointly with the Energy and Resources Institute of India (TERI), conducted a 2-day workshop: "Food Systems

Innovation in South and South East Asia Workshop in New Delhi, India". The event included the participation of experts in the area of climate change, skills development and workforce, irrigation, simulation and mapping, urbanization from Nepal, Sri Lanka, Vietnam, Indonesia and India. The workshop helped the group to identify core needs in the South Asia and South East Asia (SA/SEA) region, such as the need to raise the skills of the people engaged in agriculture and in innovation in the food value chain, evaluate women farmer's access to resources, inputs, and credits, and understand policy issues and their impact on the development of food systems innovation, among other findings.

This quarter we completed the contracting process to disburse funds for the Student Innovation Grants (SIG) selected at the end of year one. The nine awardees included Purdue University with two projects: *Development of an Acquaponics System for use in Developing Countries* and *Multifunction Mobile Utility project for Food Security in Sub-Saharan Africa*. Makerere's project *Evaluation of Simple Biogas Technologies for Domestic Use in Urban and Peri-Urban Areas of Kampala, Uganda* was funded with an initial $2500 in November, as well as Michigan State University's (MSU) *Design a Carbon Neutral Algae-Based Animal Feed Culture System* and *Identification and production of marketable shelf-stable fruit juice products for developing regions.* Also awarded were University of Florida's *Sustainable hydroponic gardening to increase fresh food stocks in dense East African urban settings*; Wageningen's *Protix, insects for food and feed in Eastern Africa* and *The ProClimate Model: Bridging Innovation across Generations & Expectations along the Food Chain*, and UC Berkeley's *Designing Innovative Public Health Solutions – Food Systems Focus*.

Supported by the Office of the Vice-President for Research, Doug Gage and Mellissa Buell handled the 2013 Innovation Grants process, which included in this quarter the review of 115 concept notes, the submission of feedback to participants, and the request of full proposals from the selected 25 best concept notes. The process will continue and conclude in January 2014.

GCFSI student Ali Hussain with other lab students at the 2013 TechCon

Prof. Chip Steinfield and Prof. Susan Wyche of the Information and Communication Technology for Development (ICT4D) team participated in an ICT4D International conference in South Africa, and hosted their own GCFSI workshop. Nathalie Me-Nsope, our gender lead, participated in numerous conferences, among them the 2013 Gender Summit. Details of these, and other events are discussed further below. Also, Saul Daniel Ddumba, a Translation Scholar with GCFSI and a PhD student in the Department of Geography, presented at 94th American Geophysical Union meeting held in San Francisco, California, 9-13 Dec 2013. Daniel's research focuses on contributing to increasing food

security and creating sustainable natural resources in developing countries by assessing the impact of climate change on ecosystem functioning especially related to agricultural production.

Finally, GCFSI launched a new website look, and completed the hiring of CRDF Global and started discussions for the management of the year two innovation grants.

Part 1: Key Activities

1.1. Summary of Key Activities

1.1.1. Events

The first quarter of project year two, was devoted to defining the strategic direction for GCFSI's new project year and subsequent years, conducting research for the SA/SEA white papers, funding the SIG, conducting part of the review process of the 2013 Innovation Grants, conducting a large scale workshop in New Delhi India on "Food Systems Innovation in South and South East Asia Workshop in New Delhi, India". Specifically, some accomplishments for the quarter and the year were:

1. Hosted a breakfast meeting at the World Food Prize in Des Moines October 2013 to share information about GCFSI with prospective corporate and foundation partners. The presentations by MSU faculty were well received and direct follow-ups have resulted from the meeting that hold potential for external funding of future GCFSI projects.
2. Gates Award Sieg Snapp $1.49 Million in support of the two-year project *Bringing perennial grain crops to Africa*.
3. Ongoing internal discussions concerning a realignment of year two activities to migrate from sole white paper development to white paper development combined with implementation in the latter part of year two.
4. Teams working actively on the literature reviews for the SA/SEA white papers.
5. Connections and discussions with the Conflict Lab of Texas A&M University to identify points of connection and synergies for future work.
6. Participate in the USAID HESN Technical Convening, November 16-18, 2013 and following Congressional Visit on November 19, 2013.
7. Visit from Prof. Sylvia Chindime of RUFORUM, to discuss support for a three-day workshop in Africa, concerning workforce development initiatives in the region, pursuant toMT3's first white paper findings.
8. GCFSI participated in a week-long program in India, composed of three days of visits with local partner TERI, as well as the USAID India Mission, the Indian Council of Agricultural Research, the International Food Policy Research Institute, the TERI University and Digital Green. The visit also included a two-day workshop to discuss food systems innovation in the SA/SEA region with the participation of experts in the area of climate change, skills development and workforce, irrigation, simulation and mapping, urbanization from Nepal, Sri Lanka, Vietnam, Indonesia and India. Charles Steinfield, Tian Cai, and John Dirkx met with Digital Green, an NGO based in Delhi, India that provides video-based training to smallholder farmers in India and several countries in Africa. The meeting was on Dec. 20 and we presented the work of the GCFSI as

well as the work of the ICT team and the Megatrend 3 team. Rikin Gandhi, the Digital Green CEO, along with several members of his staff attended the meeting to explore potential collaboration between GCFSI and Digital Green.

9. This quarter we completed the contracting process to disburse funds for the Student Innovation Grants selected at the end of year one.
10. Supported by the Office of the Vice-President for Research, Doug Gage and Mellissa Buell handled the 2013 Innovation Grants process, which included in this quarter the review of 115 concept notes, the submission of feedback to participants, and the request of full proposals from the selected 25 best concept notes. The process will continue and conclude in January 2014.
11. ICT4D Team Leads, Prof. Steinfield and Prof. Susan Wyche held an ICT4Ag workshop titled *Opportunities and Challenges for using Technology to Reach Rural Farmers in the Developing World* at ICT4D conference in Cape Town, South Africa on December 7, 2013. The session brought together leading scholars and practitioners to discuss the opportunities the digital revolution offers to smallholder farmers in developing countries and how to overcome challenges that hinder widespread adoption. Susan Wyche, Charles Steinfield, and Tian Cai gave a workshop, "ICT4Ag: Opportunities and Challenges for Using Technology to Reach Rural Farmers in the Developing World" at the 2013 Information and Communication Technologies and Development (ICTD) conference, held December 7-10, 2013 in Cape Town, South Africa. Approximately 30 people attended the workshop, including attendees from South Africa, Malawi, Nigeria, Kenya, Burkina Faso, Ethiopia, India, Ghana, Angola, the U.K. and the U.S. Participants were affiliated with the following organizations: Digital Green, University of Cape Town, The Ghana Library Authority, The Malawi National Library Service, Frontline SMS and others.

GCFSI's Charles Steinfield presenting at the ICT4Ag workshop in Cape Town, South Africa

12. Nathalie Me-Nsope, the Gender Lead for GCFSI, was featured in an article on *Harvesting gender equality among Africa's rice farmers*. Me-Nsope said "We cannot continue talking about farmers when we know that women are not a homogenous group because they face specific challenges that limit their production and the marketing of their produce, challenges which men do not face," Me-Nsope added "There are serious gender inequalities in the rice sector in Africa and specific efforts must be made to address these gender-based constraints as a result of roles, responsibilities and division of labor by doing a detailed analysis of what happening." In addition, she participated in various gender conferences, among them the 2013 International Gender Summit along with Graduate Assistant Danielle Ami-Narh.

13. Chris Geith and Ayesha Razzaque talked about the Translational Scholar Corps at GCFSI at the 10th Annual Open Education Conference in Utah. Video: https://www.youtube.com/watch?v=D5DMAukWF6I#t=1357
14. Saul Daniel Ddumba, a Graduate Assistant with MT1 and a PhD student in the Department of Geography, presented at 94th American Geophysical Union meeting held in San Francisco, California, 9-13 Dec 2013. Daniel's research focuses on contributing to increasing food security and creating sustainable natural resources in developing countries by assessing the impact of climate change on ecosystem functioning especially related to agricultural production.
15. GCFSI hosted a visit from Rajesh Veeraraghaven, PhD student at UC Berkeley, to speak on his work with Digital Green. He also gave a talk on October 8, 2013 to the MSU community on "Controlling last-mile corruption: The Use and Subversion of ICT in a South Indian Bureaucracy."
16. Susan Wyche gave a talk at the University of North Carolina highlighting the work in the ICT area within the GCFSI: "Facebook is a Luxury:' Discussing High Costs and other Barriers to Social Media Adoption in Rural Kenya," University of North Carolina, School of Information and Library Science, Chapel Hill, NC, September 27, 2013.
17. Susan Wyche gave a talk at the University of Michigan highlighting the work in the ICT area within the GCFSI: "Facebook is a Luxury': No Electricity, High Costs and other Barriers to Social Media Adoption in Rural Kenya," University of Michigan, School of Information, Ann Arbor, MI, October 8, 2013.

Prof. Susan Wyche presenting to the ICT4Ag Conference

18. Charles Steinfield attended the October 15-16 IFPRI CGIAR Research Program on Policies, Institutions and Markets (PIM) Workshop: Research on Agricultural Extension Systems: What Have We Learned, and Where Do We Go From Here? October 15-16, 2013, Washington DC, USA. He gave a presentation on Extension and the Application of ICTs. A summary of the workshop, including pdfs of the presentations, is available at the following URL: http://www.pim.cgiar.org/2013/11/14/summary-of-pims-extension-workshop-now-available/
19. The DSI team launched the WebIT website for full use. They collected and added relevant information for each of the megatrends and deployed the web applications for data visualization including:
    - Triple side-by-side map comparison
    - Swipe map comparison for overlapping indicators
    - Drag and drop capabilities for map creation from geocoded csv files
    - A visualization of African aid projects
    - An interactive charting system for FAO and World Bank data

- Included Tableau visualizations for each of the megatrends
- Created a bank of 700 maps on the servers
- Fully integrated the FAO and World Bank data
- Maintained the website for the new traffic concerns with minimal downtime
- Collected traffic statistics on the website
- Configured the newest server as a test-bed machine
- Installed mirrored copies of ArcGIS, MSSQL, IIS, and the WebIT site on the test-bed server
- Procured and added Remote Desktop licenses to the servers

20. TSC organized a moderated panel discussion on international development on October 31, 2013. Panelists responded to topics such as etiquettes of research and practice in international contexts, building relationships with local stakeholders, possible barriers as well as strengths to leverage in international development work, and sustainability issues with development projects. Discussion took place from the perspective of students and young professionals interested in international development work.
21. In November, TSC in partnership with MSU Global organized a training event for GCFSI students on using a research collaboration tool 'Colwiz' and creative note taking through 'One Note.'
22. TSC has been nominated ambassador for the Agriculture Innovation Prize being sponsored by 40 chances (www.agprize.com). As ambassadors TSC received $1000 to promote the agprize contest which will award over $200,000 in cash prizes to students who develop innovative plans to address social, environmental and agronomic challenges within food systems, improving the standard of living and quality of life for the world's population.
23. GCFSI developed a Gender Strategy Document. Still in draft form, the document provides justifications for a gender-responsive approach in GCFSI's activities as well as guidelines on GCFSI's strategic approach to mainstreaming gender into its research and implementation activities. The document will be shared with the management team as well as USAID for any suggested modifications. Once the content has been approved, the document will be made available on the GCFSI website.
24. GCFSI Gender Brochure Developed: Based on a realization that earlier GCFSI's megatrend information briefs were void of any gender content, the gender team developed a gender brochure which highlights gender as a core tenet within the Center and summarizes the Center's strategic approach to addressing gender issues in its work. The brochure will be used to showcase GCFSI's focus on gender. The brochure is still pending review by GCFSI's management.
25. Integrating Gender into Megatrend White Papers. Worked with the megatrends to ensure that a gender perspective is incorporated in research planning. Our activities focused on providing assistance to the megatrends by carrying out a comprehensive review of literature on gender as it relates to the topics covered by each of the megatrends. The literature review focused on understanding the social context of the planned research activity, identifying any existing

publications on gender (including country-wide gender analysis and gender assessment publications), identifying the major debates, the conceptual and analytical frameworks that have been used to understand gender issues in food systems related activities. In addition, the review of literature focused on identifying empirical evidence on gender issues in food system activities, focusing on East Africa and South East Asia. Through the review of literature, gender-related information/data were identified and inculcated into megatrend research papers. Potential areas for gender specific research as well data gaps were also identified. Several meetings were held with megatrend leads and sub-leads to discuss gender mainstreaming in their work.

1.1.2. Publications

1. With David Ortega as lead author, MT2 submitted a food safety review article to *Global Food Security* (see Appendices).
2. Drew on work under MT2 and MAFS in paper submitted to WIDER (World Institute for Development Economics Research at United Nations University) on the rise of the African middle class. Paper will eventually go under review for special issue of *Journal of Development Studies* (see Appendices).
3. The ICT4D team prepared one paper that has been submitted for publication and is currently under review: Wyche, S.P. and Steinfield, C. "Why Aren't Farmers Using Cell Phones to Access Market Prices?: Uncovering Barriers to M-Agriculture Service Adoption in Rural Africa." (under review) *Information Technologies & International Development.*
4. The model of Translational Scholars Corps was presented at the Open Education Conference 2013 in Utah, November 06-08. Presentation can be found at http://openeducation2013.sched.org/event/3e219e4e3171a457524b99fd2f8bc465
5. A paper on Translational Scholars Corps as a model for student engagement has been accepted for presentation at the Comparative and International Education Society's Conference CIES 2014 in Toronto, Canada.

1.1.3. Communications

1. *Bringing perennial grain crops to Africa is aim of new Gates Foundation-funded project*, MSU ANR Communications, http://www.anrcom.msu.edu/anrcom/news/item/bringing_perennial_grain_crops_to_africa_is_aim_of_new_gates_foundation_fun.
2. *MSU research team to look at new crop for Africa*, NewsOK/Associated Press, http://newsok.com/msu-research-team-to-look-at-new-crop-for-africa/article/feed/615155.
3. Also reported in:
    a. Washington Times: http://p.washingtontimes.com/topics/sieg-snapp/354413/t/photos/
    b. PBS: http://wkar.org/post/msu-study-viability-perennial-grains-africa
    c. http://www.merid.org/en/Content/News_Services/Food_Security_and_AgBiotech_News/Articles/2013/Nov/12/Perennial_crops.aspx
    d. http://blackburnnews.com/agrimedia/agrimedia-news/2013/11/13/perennial-grain-introduced-in-africa/
    e. http://www.foodlogistics.com/news/11230509/michigan-state-to-research-sustainable-food-sources-in-africa

4. *Africa: Harvesting Gender Equality Among Africa's Rice Farmers,* All-Africa, December 4, 2013, http://allafrica.com/stories/201312040188.html?viewall=1.

1.1.4. Travel

The following international travel using full or partial HESN funding occurred during the past Quarter:

Location (City and Country)	Number of Travelers	Partner(s) Engaged (If applicable)	USAID Engagement (If applicable)	Outcome(s) & Next Steps
New Delhi, India	16	TERI	Ken Scheffler USAID Mission India	Reviewed TERI deliverables, presented work from year 1, planned for continuing collaboration with TERI, particularly for implementation work in the coming year White papers, implementation for SA/SEA
Cape Town, South Africa	3 (Charles Steinfield, Susan Wyche, Tian Cai)	None	None	Gave ICT4G workshop at the ICTD Conference. Made connections with Digital Green, and other potential partners who could aid in implementation projects. Also stimulated researchers to engage in the study of ICT for agriculture.
Guanajuato, Mexico	1	None	None	"Fostering social justice, global citizenship, and cultural competence through study abroad experiences", World Education Research Association Focal Meetings

Part 2: Intra-Development Lab/ University Engagement

2.1. Interdisciplinary Collaboration

Aside from ongoing intra-MSU collaboration reported in previous quarters, of importance for this quarter is that DSI staff members have been working with MSU Global to develop a knowledge sharing platform that will allow for broad connections to the GCFSI and will create an environment in which the complex and interlinked nature of our work can be understood. Pouyan Nejadhashemi and three graduate students from the DSI presented their works and DSI capabilities to the MSU Global staff members and discuss possible collaborations. In addition, DSI has been working with the Megatrend teams to establish datasets for analysis and to build understanding of trends. In this regard, they worked closely with MT3 leaders to provide required information for development of the work plan and presentations on several occasions.

In addition, the TSC team had active collaborations with various departments and centers in MSU. Noteworthy are:

- Four TSC students worked with MSU Global to set up the repository and a social media component linked to it.
- The College of Communication Arts and Sciences is setting up a TSC program in the College and the TSC team is closely coordinating to facilitate transfer of learning and best practice.
- The TSC team is helping conduct an assessment of student experiences for the B-HEARD.
- TSC is helping conduct an assessment of student experiences for the MasterCard. Possibility of pairing MasterCard students with TSC students on GCFSI projects is also being explored.
- An initial conversation has been held with the Peace Corps to explore opportunities of engagement for TSC students in their new university engagement program.

2.2. Partner Engagement

The MT1 team worked closely this quarter with Dr. Joseph Maitima from EcoDym Africa (Nairobi), who is a partner in the white paper development and review process. He has since completed the tasks for MT1, but may be retained in the future. They also initiated contacts with Dr. Barry Haack (SERVIR (East Africa)), Dr. Pariwate Varnakovida (Bangkok, Thailand), Dr. Tanita Suepa (GSDA Thailand) and Dr. Jim Jones (AgMIP) as potential future collaborators and reviewers.

On the other hand, MT2 team worked closely with Wageningen, who provided a detailed overview of Foreign Direct Investment trends in Africa's food systems as part of the MT2 white paper preparation.

On their side, MT3 continued work with the University of Rwanda (formerly the National University of Rwanda) Faculty of Agriculture to develop a partnership and build network for the future work of MT3/GCFSI in East Africa. December 2013 trip/conference focused on faculty engagement, gender in the classroom and pedagogy of experiential learning, as well as engagement with the external advisory group for the program, an example of multi-stakeholder engagement.

The following partners were engaged during the past quarter:

Partner	Partner Type (Funded/ Unfunded)	Location (City and Country)	Outcome(s)

TERI	Funded	India	Developed the South and South East Asia Workshop for GCFSI Completed their year One Deliverables with significant research useful for year two activities (SA/SEA engagement)
WUR	Funded	Netherlands	Completed all their year one deliverables
LIN	Funded	Pennsylvania, US	Worked on research for East Africa white papers

Part 3: High Value Areas of Collaboration [HVAC] (Lab-to-Lab)

3.1. Summary of Collaboration Across the HESN

Noteworthy for this quarter were the following interactions:

- GCFSI held a conference call in early November with the representatives of the TAMU Conflict lab. Each team took time to explain our work and plans, and we identified points of collaboration that were further discussed in the TechCon.
- GCFSI participated in the TechCon, and had individual team meetings with all the other HESN Labs.
- DSI is actively participating in the HESN Data Working Group. In this regard, Pouyan Nejadhashemi was invited by Dr. Tom Zearley to present the Decision Support and Informatics (DSI) and USAID-WebIT (http://dsiweb.cse.msu.edu/index.aspx) to the HESN Data Working Group. The DSI involves creation of a dynamic and interactive platform in which different hypotheses can be tested. Visualizations are shown spatially, graphically and can be filtered based on Feed the Future (FtF) and non-FtF countries, time-slice and Indicators. Data is drawn from different sources such as the World Bank, the United Nations, USAID, academia, and others to provide a robust information platform that includes tabular as well as geo-spatial data. We received lots of feedback and interest from other labs for collaboration as a result of this presentation.
- DSI lead, Pouyan Nejadhashemi and Mr. Salim B. Sawaya (ESRI-Manager, Nonprofit & Global Organizations) held a conference call with Mr. Joshua Powell from College of W & M in November to discuss how AidData can consume some of GCFSI's content into the AidData 3.0 site. We decided to continue our conversation in future to facilitate this collaboration.
- DSI staff has been in contact with the College of William and Mary in an effort to collaborate on data sharing.
- Georgina Sanchez, one the graduate students from DSI team won the Student Story Mapping Challenge at HESN TechCon. Their submissions can be seen at this link: http://bit.ly/TechConStoryMaps. This has been posted on GCFSI Facebook, Twitter, and website.

3.1.1. Student Engagement

Partner	Completed / Ongoing Activity [Indicate tie to activity number]	Outcome(s)
UC Berkeley	Invited Rajesh Veeraraghavan, PhD student, UC Berkeley, to campus to give a talk to GCFSI and MSU community	Strengthened ties to ongoing work at Digital Green and at Berkeley, and connected Digital Green to work at GCFSI on education and training approaches. Public talk attended by approximately 20 faculty and students from multiple departments on campus

Part 4: USAID Engagement

4.1. USAID/Washington Interactions

GCFSI actively participated in the TechCon which allowed various team members direct interactions with Alex Dehgan, Ticora Jones, Ken Scheffler, and many more from the HESN team. We were able to clarify many issues and discuss GCFSI and USAID position on a variety of subjects. We discussed the nature of the deliverables, the process of proposal production, and general expectations. During this quarter, various teams engaged USAID directly through the problem definition process and multiple phone conversations (conference calls).

Specifically, the work done under HESN MT2 and MAFS was discussed at length with USAID Bureau for Food Security, in particular with (a) the managers of MSU's Food Security Policy Innovation Lab (FSP), and (b) Steve Gale of Office of Science and Technology. These discussions led to a request for proposal sent to MSU for an associate award under FSP to put on a fore sighting conference and related activities. The award, if it is won, will be managed by FSP but will feature active input from HESN.

For MT3, Clara Cohen, Susan Owens and Ken Scheffler participated in some of their team weekly meetings. Karen Duca joined the MT3 team as a regular participant. Team member Sandra Boyers actively engaged with Genevieve Croft in helping with the HESN TechCon.

The ICT4D team had ongoing exchanges with Judith Payne of USAID regarding her potential participation in the ICT4Ag workshop in South Africa as well as to discuss her review of the year 1 white paper. Although Judy was initially confirmed as a speaker at the workshop, she was ultimately not able to attend.

DSI team members presented the USAID-WebIT website to USAID GIS Specialists Workshop. They talked about how Decision Support and Informatics can help USAID missions and other key development stakeholders with reliable information to make informed decisions. This team worked with Ken Scheffler and Carrie Stokes from USAID and had several conversations on how mission projects fit with DSI, what support DSI might provide, the level of effort and expertise required, and how DSI and the GeoCenter can work together. Finally, Pouyan Nejadhashemi was invited by Dr. Tom Zearley to present to the HESN Data Working Group.

4.2. USAID Mission Interactions

GCFSI received great support for the South and South East Asia workshop from USAID India; with whom we met on our way out of the country (the presentation used is attached as Appendix IV). In addition, David Tschirley discussed HESN themes, especially MT2 and MT3, with the USAID Malawi mission in the context of possible long-term work by FSP in Malawi. The mission's focus on New Alliance commitments fits well with much of the thematic focus of these two megatrends. This is an example of the cross-unit synergies (within MSU) that add value to the work under HESN, and vice versa. John Dirkx connected with the USAID Mission in Cambodia (William Bradley).

Part 5: Monitoring & Evaluation

5.1. Progress Narrative

The Center is making progress towards the goals set in the M&E plan. In this quarter, we received notice of Sieg Snapp and Joe Messina's award by Gate Foundation of a $1.48 million project which aligns with and is being leveraged by GCFSI (Gin1). We also had the kick-off of the implementation of 9 SIG's (Gin2 and IR2.2In4), and made significant progress in the development of the USAID-WebIT (DSI) platform (O1in1; O1in2). We completed and received approval for the first iteration white papers of the Center (IR2.1In1) and the conference in India and in Cape Town contributed to IR3.1In2.

Part 6: Lessons Learned / Good Practices

We appreciated USAID's effort to bring the centers together at TechCon. Having all the teams in one place provided a face-to-face interaction between labs that has no comparison in virtual or e-mail communications. It would be ideal if at least the lab management teams would meet with more frequency, maybe at least 2 more times a year, to continue the dialogue, not only between labs, but also with the USAID team.

In terms of our research, we noted that the scope of a science deliverable ought to be well defined before a team can effectively be assembled. Despite the extraordinary resources of a major research institution, as the science questions expand, focusing early in particular regions is critical to ramp up the necessary regional expertise.

Finally, regular communication is both a challenge and important. USAID, and Mr. Scheffler, have been fully responsive, but the academic culture is not always conducive to routinely effective communication. It might be worth exploring more effective methods.

Part 7: Future Activities

7.1 Milestones

1. Produce the final SE Asia white paper draft and submit to USAID (February 2014).
2. Award the first round of Innovation Grants (February 2014).
3. Establish a Hub in Malawi with LUANAR (March 2014).
4. Establish an implementation project in Malawi (April 2014 launch).
5. Issue a new RFA with support from CRDF Global (April 2014).

7.2 Events

1. Scaling conference to be held in MSU Campus (August 2014).

7.3 Publications

1. White papers East Africa (expected publication by March 2014).
2. White papers SE Asia (expected publication by June 2014).

7.4 Communications

1. Improve communication with the external labs and related partners. Improve coordination among the megatrends and other HESN labs.
2. Prepare material for the IFAMA conference and other conferences.
3. Develop an openly accessible e-learning competency based program for students and young professionals in international development.

Part 8: Appendix

Appendix 1. Conferences and Summits

Presentations at conferences and workshops:

1. Promoting Vocational Training as an Economic Driver: "Developing partnerships to promote high quality skills training programs" Phnom Penh, Cambodia - November 7, 2013, J. Dirkx
2. "Fostering social justice, global citizenship, and cultural competence through study abroad experiences", World Education Research Association Focal Meetings, Guanajuato, Mexico - November 19 – 22, 2013, I. Berzina-Pitcher
3. The third North America Gender Summit at the Washington Hilton in DC from November 13th to 15th 2013. The Summit had a section on integrating gender into food security and climate change research. An objective was to learn about current approaches/tools/methodologies in gender integration, case studies and success stories on integrating gender into food system topics. Another objective was to identify opportunities for networking and collaboration with other researchers and institutions working on similar issues as the GCFSI.
4. Gender in Agriculture E-Learning Course Launch Event. Dr. Nathalie Me-Nsope (GCFSI's Gender Lead) and Gwyn Shelle (Assistant Director, Production at MSU Global) attended the Gender in Agriculture E-Learning Course Launch event at the World Bank, DC on 01/09/2014. The course developed is a product of a joint collaboration between MSU (MSU Global) and the World Bank and it provides answers across different sub-sectors to the question of "how will the development outcome of my intervention improve if I mainstream gender?" The GCFSI gender team is currently collaborating with MSU Global on developing a Gender and Agriculture Massive Open Online Course (MOOC).
5. Two students from the DSI traveled to the World Food Prize in Des Moines, Iowa, on October 16, 2013. The students presented the DSI WebIT site to a group of interested parties. The presentation detailed the DSI's work on the WebIT site. During the presentation they were able to answer specific questions about site use and capabilities from the actual users. Additionally, they raised interest in the website and will hold follow-up meetings with some of the companies attending the demo and presentation.

Conferences attended by team members:

1. HESN TechCon 2013, Williamsburg, VA – November 16-18, 2013

2. Food Systems Innovation in the Southeast Asia Region, Magnolia, India Habitat Center, New Delhi - December 17 and 18, 2013,

Webinars/online discussions attended:

1. "Mentoring & Other Ways to Leverage the Impact of Training", APLU webinar (Oct 3)
2. International Development Panel hosted by TSC at MSU (Oct 13)
3. "How to Leverage Institutional Impact After Training is Over", APLU webinar (Oct 24)
4. "Great Decisions-Myanmar Presentation", MSU in person (Oct. 24)
5. "Scaling Agricultural Technologies Through Public-Private Partnerships" webinar (Oct. 30)
6. "Reflections on Community Engagement", Dr. Suvedi on his engagement in Southeast Asia, MSU in person (Nov 5)
7. "Surveying the Landscape: Mobiles and Youth Workforce Development" webinar (Nov 6)
8. RUFORUM Brown Bag Lunch, MSU in person (Nov. 20)
9. "A New Effort to Embed Systems Thinking in USAID" webinar (Nov. 21)
10. "Seeds of Change: Leveraging Community Video for Agriculture and Nutrition Behavior Change in South Asia and Sub-Saharan Africa" webinar (Dec. 17)

Peer-reviewed papers and abstract accepted:

1. Multi-Sector Collaboration for Capacity Building in Developing Countries: A Context for Theorizing Transformative Learning at a Systems Level (L. Hill, J. Bonnell, J. Dirkx, and T. Smith), Manuscript accepted for presentation at the 55th Annual Adult Education Research Conference, Harrisburg, PA: Penn State, June 5-7, 2014.
2. Illuminating the Tension between the Personal and the Social in Workforce Development: A Critical Review of Entrepreneurial Training in Developing Countries, (S. Boyers, J. Dirkx, and T. Smith), Manuscript accepted for presentation at the 55th Annual Adult Education Research Conference, Harrisburg, PA: Penn State, June 5-7, 2014.
3. Translational Scholar Corps: An Innovative Curricular Model for Professional Preparation and Continuing Professional Development (B. Corbin, E. Doyle, M. Flanders, S. A. Hussain, J. Dirkx, and T. Smith), Abstract accepted for presentation at the 2014 AHRD International Conference in the Americas, Huston, TX: Feb 19-24. Manuscript accepted.
4. Multi-Sector Collaboration: An Innovative Approach to Capacity Building and Workforce Development in Countries with Emerging Economies (L. Hill, J. Bonnell, J. Dirkx, and T. Smith), Manuscript accepted for presentation at the 2014 AHRD International Conference in the Americas, Huston, TX: Feb 19-24. Manuscript accepted.
5. (Re)conceptualizing the role of higher education in systems transformation: The case of Agricultural Education and Training in East Africa (J. Bonnell, L. Hill, J. Dirkx, T. Smith, and P Roy). Manuscript accepted for presentation at the 58th Annual Conference of the Comparative and International Education Society, Toronto, March 10-14, 2014.

Appendix II. Food Safety Issues in Emerging and Developing Countries: A Research Agenda

David L. Ortega[a*] and David Tschirley[a]

Department of Agricultural, Food, and Resource Economics

Michigan State University

Justin S. Morrill Hall of Agriculture, 446 W Circle Drive

East Lansing MI 48824 USA

* Contact Author, E: dlortega@msu.edu , T: +1 (517) 353 2981

Abstract

Food safety in developing and emerging countries is receiving increased attention from economists, researchers and policymakers. As urbanization proceeds, and if incomes continue to rise at robust rates, consumers in sub-Saharan Africa (SSA) and Asia will become increasingly aware of food safety issues, more demanding of food safety guarantees, and more sophisticated in their approach to food safety. From simple visual inspection of freshness and cleanliness, consumers will come to expect more sanitary shopping environments and to rely on third-party certifications and formal food safety standards to underpin their confidence in the food supply. Yet assuring food safety in modernizing food systems involves significant costs, and current incomes in developing SSA are far lower than in Asia. A comprehensive review of the literature finds that overall consumer awareness of food safety problems in SSA is fairly low relative to Asia; consumer risk perceptions are strongly correlated with income; and that knowledge of African consumer willingness to pay for food safety is very limited. Based on these findings a research agenda is developed.

Keywords Food Safety, Developing Countries, Food System Transformation

Highlights

Consumers in developing and emerging economies will become increasingly aware of food safety issues and demand more food safety guarantees.

Assuring food safety in modernizing food systems involves significant costs that not all consumers are willing or able to pay for.

Consumer awareness of food safety problems in sub-Saharan Africa is fairly low relative to Asia.

Consumer food safety risk perceptions are strongly affected by incomes.

Knowledge of African consumer willingness to pay for food safety is very limited.

Food Safety Issues in Emerging and Developing Countries: A Research Agenda

1. Introduction

Food safety in developing and emerging countries is receiving increased attention from economists, researchers and policymakers. The dynamics of the development process are amplifying food safety issues associated with rapid urbanization, changing consumer demand, and agrifood supply chain transformations. The increasing concentration of people in urban areas, related to rural-urban migration, lengthening of food supply chains, changing demographics and food consumption are all contributing to increased food safety risks (Unnevehr 2003).

There is a stark contrast between food safety issues that arise in developed versus developing countries. Though scientists and researchers generally consider food supplies to be safe in industrialized countries, evidence suggests that foodborne illnesses are prevalent but affect small numbers of consumers, gaining greater visibility through a process of 'social amplification,' by which affected parties bring increased attention to the problem (Henson 2003). In developing countries, the prevalence of foodborne illness is considerably higher due to factors associated with low levels of economic development such as low income, lack of education, poor sanitation and water quality. The World Health Organization estimated that 800,000 children under ten years of age died from diarrheal diseases in 2009, over 80% in developing countries (WHO 2009).

As urbanization proceeds, and if incomes continue to rise at robust rates, consumers in developing countries will become increasingly aware of food safety issues, more demanding of food safety guarantees, and more sophisticated in their approach to food safety. From simple visual inspection of freshness and cleanliness, consumers will come to expect more sanitary shopping environments and to rely on third-party certifications and formal food safety standards to underpin their confidence in the food supply. As Unnevehr and Hirschhorn (2000) state, "food safety interventions build from basic investments and simple interventions to more complex regulatory systems as economies develop." Currently, most African countries have severely limited abilities to design, maintain, and properly adapt over time these types of complex regulatory structures. Yet, existing legal, regulatory, and marketing systems (both public and private) have not evolved to respond to these concerns. African countries currently have severely limited abilities to design and implement these types of complex regulatory structures and, as evidenced by recent food safety outbreaks in Asia, emerging economies are not equipped to properly adapt to the dynamic nature of the problem.

The food system transformations and the rise of incomes and education in these regions provide an opportunity to make major progress on food safety regulation and practice. This progress hinges on our understanding along several fronts. These include knowledge of consumer willingness to pay for food

safety, the influence of marketing chains on the transmission of consumer preferences down to processors, packagers, traders, and farmers, and the ability and willingness of all these actors to change their operating procedures to respond effectively to consumer food safety concerns. Country-specific factors such as culture, gender roles and other social matters that play a key role in the development and transformation of a country's supply chain also need to be explored.

Knowledge of these factors is currently limited because the vast majority of research on food safety has, to date, been focused on exports from developing to developed countries; very little research has been conducted that illuminates the economic and human health costs of poor food safety in domestic food systems of developing countries, and that attempts to anticipate how food safety measures need to evolve in these systems. We thus have little understanding of how agent behavior changes at various levels of development, which hinders the design and implementation of incentive mechanisms to improve the situation in an economically rational and sustainable fashion.

This paper provides a comprehensive review of the literature currently available on food safety issues in developing countries and highlights the gaps in knowledge needed to ameliorate the problems that are identified. Common threads of existing methodologies to study food safety problems are identified. Next, we organize the review by geographical region, which roughly groups countries with similar levels of economic development; in descending order of development these are East Asia, Southeast Asia, South Asia and Sub-Saharan Africa (SSA). We conclude with an agenda that highlights the most pressing research needs for evidence-based, economic approaches to tackling food safety issues in emerging and developing economies.

2. Synopsis of Methodologies

Various methods have been employed to study the economics of food safety. Most notable in the literature are case study analyses of agrifood supply chains and experimental economic methods to assess individual behavior and preferences for food safety product attributes. Behavioral choice modeling has become an increasingly important mode of studying economic behavior and demand patterns. By examining real-world consumer behavior, this method allows researchers to estimate marginal values for various attributes embodied in different goods or services. The method can be applied to non-market goods, such as food safety, for which such marginal valuations are difficult or impossible to measure. Choice modeling allows for relatively straightforward estimation of welfare effects arising from incremental changes in the levels of the attributes included in the analysis, such as implementation of traceability systems and quality certifications (Colombo et al. 2008). Within the agricultural and environmental economics literature, choice experiments are used extensively for analyzing consumer preferences for food certification and food safety attributes (e.g., Loureiro and Umberger 2007; Ubilava and Foster 2009; Ortega et al. 2011), adoption of voluntary traceability systems in farming operations (Schulz and Tonsor 2010), and quantifying welfare effects of various agricultural and food policies (Ortega et al. 2012; Lusk, Norwood and Pruitt 2006; Tonsor et al. 2009). Table 1 categorizes the food safety studies reviewed in this paper based on geographical scope, products analyzed, and methods used.

3. Review of the Literature by Region

3.1 East Asia

Due to recent food safety incidents, most of the studies available on food safety in East Asia focus on China. Many of China's food safety problems can be traced to the farm level. For example, many farmers use heavy applications of highly toxic pesticides to control insects and other production problems (Calvin et al. 2006). The use of antibiotics in the livestock sector has also led to public health concerns focused on the rise of new antibiotic-resistant bacteria strains. Downstream factors, especially China's fragmented food supply chain, also play a role. Its food system is composed of millions of small farmers, traders, and retailers, making it extremely difficult to supervise food safety practices and to design and implement a comprehensive and effective domestic food safety system. In an effort to keep the food supply of the world's second largest economy safe, China's government has approved a series of new food safety laws and regulations (Ramzy 2009). Although publicized as a tough approach to remedying food safety concerns, it is unclear whether this latest effort will make China's food safer and improve the country's image with its agricultural trading partners.

While worldwide media attention has focused on the problems plaguing China's food quality and inspection system, recent research has been dedicated to analyzing Chinese consumer concerns over food safety and their preferences for various food safety assurance programs. A study conducted by Ortega et al. (2011) uses a choice experiment method to assess urban Chinese consumers' willingness-to-pay (WTP) for various food safety attributes in pork, the staple meat in the Chinese diet. These include a traceability system that informs consumers of the product origin, government-administered food safety certification, third party certification, and a labeling approach that includes information on specific product additives that were used. Consumers, on average, were found to have the highest WTP for government certification, which was valued at \$1.55 [1] per 500g of pork, followed by third party certification (\$1.02), a product traceability system (\$0.87) and a product-specific information label (\$0.42). Significant preference heterogeneity was found. Specifically, four distinct groups of consumers, ranging from 'price-conscious' to 'certification-conscious' as well as 'worried consumers' and 'pork lovers', were identified with varying preferences. This study also explores the effects of food safety risk perceptions on consumer demand for the various product attributes and finds that increased risk perception increased consumers WTP for all of the attributes under consideration. Zhang et al. (2012) find that consumers' WTP for food traceability is positively affected by their knowledge of traceability and of other certification systems as well as their income; more knowledgeable and affluent consumers are more willing to pay for food safety.

The role of the certificate issuer, the entity responsible for overseeing safety certification, on consumers' WTP for milk traceability in China was also assessed using a choice-based experiment (Bai et al. 2013). The authors find that Chinese consumers prefer government certified traceable milk, followed by industry and third-party certified products. These results are similar to those found in other studies in China, where consumers are found to have the highest trust in government safety certification, and are indicative of regional preferences shaped by socio-political and cultural factors. Ortega et al. (2012), measures aggregate welfare changes of specific food safety policies in China's dairy industry. This study estimates that urban consumers' welfare would increase by approximately \$2.4 billion per year if they were given the option to purchase third-party certified UHT milk, and assesses consumers' valuation for current government certified UHT milk at \$3.8 billion per year. These results show that while Chinese consumers prefer government food safety certification, third party safety assurance is also highly valued

[1] At the time this study was conducted, 1RMB= 0.148USD.

and could potentially eliminate some of the inefficiencies that arise from a government monopoly on food safety.

Though most studies on food safety in this region focus on consumers, some supply chain studies have been done. Brown et al. (2002), use a series of case studies to compare the economics of animal slaughter at the household level with various types of abattoirs in the Chinese beef industry, and explain why household slaughtering and wet markets – open air markets that sell predominantly fresh, perishable product - dominate beef processing and distribution in China. They investigate the willingness/capacity of consumers to pay the added costs of better food safety inspection and other services. The authors find that while most consumers exhibit a willingness to pay for beef that is perceived to be safe, the mass market for beef is a low-price, low-value market, which does not provide the safety assurances consumers seek (Brown et al. 2002).

The emergence of supermarket retail and its implications for agricultural development and food safety has also received increased attention. Hu et al. (2004) discuss the challenges that supermarket managers face in procuring their products. Due to small farm size and the fragmented nature of production, sourcing safe foods is difficult and implementing safety measures becomes very costly. Given that this study finds a positive impact of consumers' education, income, and tendency to shop in supermarkets on their level of concern with food safety, supermarket managers and other supply chain actors need a better understanding of how consumer preferences vary according to retail channels to better meet consumer demand (Zhang 2005; Hu et al. 2004).

3.2 Southeast Asia

Though the role of supermarkets and modern distribution businesses has begun to grow in the food marketing system of Southeast Asia, traditional retail markets and itinerant retailers continue to dominate the sales of fresh foods, including fruits, vegetables, meats and fish (Cadilhon et al. 2003). A study in Vietnam by Cadilhon et al. (2006) describes the development of vegetable markets in Ho Chi Minh City, where modern distribution outlets are competing fiercely with traditional traders for wholesale and retail customers. Using a series of in-depth interviews with marketing system stakeholders, the authors found that upstream players, including farmers, rural traders, wholesalers and supermarket managers in traditional supply chains, had little to no knowledge of the satisfaction of the final consumer with regards to product safety, appearance, freshness, price or availability. The researchers highlight both positive and negative impacts of the rise of modern distribution on Vietnamese society. Positive effects include increased formal employment, a general improvement in food quality, decreased retail prices and the development of productive agribusiness farms to supply the modern distribution sector. Negative consequences include the squeezing out of small farmers from these companies' supply chains, and the potential for wholesale markets, as the modern channels over time take over increasing market share, to turn into cheap clearinghouses for low-quality and unsafe produce (Cadilhon et al. 2006).

A study in neighboring Thailand identifies the characteristics of shoppers frequenting supermarkets and wet markets (Gorton et al. 2011). In Thailand, wet markets, outdoor venues that sell fresh food products and live animals, such as fish and shellfish for consumption, account for the majority of consumers' fresh produce expenditures, while supermarkets are more important outlets for packaged goods and beverages.

This study found that, on average across wet markets and supermarkets, consumers ranked food safety high in importance when evaluating it along with quality and speed of service, convenience and price. Moreover, shoppers in supermarkets ranked food safety higher in importance than shoppers in wet markets. This study also found a significant positive association between the importance consumers gave to food safety and the share of their expenditures on fresh and frozen vegetables and fresh meat that they made in supermarkets as opposed to wet markets. This result is particularly important given the rise of supermarkets in the region and outbreaks of bird flu in the 2000s that led to the slaughtering of millions of chickens and heightened concern over the safety of poultry.

Ifft et al. (2012) conducted a field experiment to assess Vietnamese consumers WTP for safely produced free-range chickens in Hanoi. By providing several vendors with safety-labeled free-range chickens and observing consumer preferences for various discount coupons, the researchers were able to value a product characteristic in an informal market, which is challenging to do when implementing field experiments in developing countries. Their results suggest that consumers in their sample, who were mostly relatively affluent women, will pay at least a 10-15% premium per chicken for safety labeling that highlights safe production, processing and transport conditions. The potential cost of the labeling scheme was found to be covered by consumers' willingness to pay. As a result, the researchers note that the additional production-related costs of certification should not be a barrier to product labeling in this particular case. While this study was conducted in the city of Hanoi, with a more affluent populations sample, additional research is needed in rural and peri-urban areas, to better inform nation-wide food safety policies.

Aquaculture is vital to the economy of many countries throughout Asia. Tran et al. (2013) focus on the impact of public sector standards for food safety and private sector food safety certifications in Vietnam's shrimp industry. Using global value chain theory and a series of in-depth interviews, they find that food safety standards are driven by buyers. The governments of importing countries are imposing food safety standards, often marginalizing small-scale farmers and traders. While importing countries and non-governmental organizations have aggressively promoted the safety of aquaculture products coming from the region, and while local governments have made efforts to ensure that their exports meet those requirements, little is known about the effects of those export standards on the condition of products grown for the domestic market.

3.3 South Asia

There are numerous challenges to making improvements in food safety in South Asian countries. Restrictive government marketing regulations, weak policy and regulatory frameworks, scarce enforcements of existing standards, and inadequate market infrastructure and agricultural support services are some of the obstacles impeding food safety progress in agricultural supply chains in India and Bangladesh (Umali-Deininger and Sur 2007). India has encountered significant food safety issues in its aquaculture industry. Problems related to antibiotic residue, heavy metals and bacterial inhibitors have plagued the sector in recent years. Heavy metal contamination is increasingly becoming a concern, not only in the aquaculture sector. Marshall et al. (2003) found alarming rates of lead in fresh cauliflower, okra and spinach in urban and peri-urban regions in India. This was attributed to contamination of irrigation water by sewage and industrial effluents. While there has been some limited food safety spillover effects from the export sector into the domestic market, farmers do not see any need to alter their

practices since the vast majority of production is consumed domestically, and they perceive little effective demand for improved safety measures (Umali-Deininger and Sur 2007).

Improved knowledge is needed in at least two areas before food safety will become a priority in the region. First, companies and governments need to better understand consumer WTP for food safety and how this WTP varies across different types of consumers. Second, these same actors need to better understand how WTP is transmitted across the supply chain. Minten et al. (2013) find that farmers in Bangladesh do not necessarily benefit from consumers' increased WTP for rice quality characteristics; instead the millers and retailers capture the quality premiums. This finding questions the widespread belief that farmers would be better off if they can produce products that obtain a higher price in retail markets. Price formation along the supply chain with regards to enhanced food safety characteristics needs to be investigated to better craft policies and investments that transmit quality and safety premia to farmers and thus incentivize them to produce safer, high quality foods.

3.4 Sub-Saharan Africa

A review of the literature in this region finds food safety to be a critical issue for market development and trade. Importing countries' are insisting that food be safer and that it be produced according to certain social responsibility standards (Jaffee and Masakure 2005). Maertens et al. (2012) explore the welfare effects of changes in developing country high-value horticultural export supply chains in SSA. They find that increased high-value exports have direct and indirect effects on product and labor markets which lead to positive welfare effects for rural development and poverty reduction. These effects vary depending on the structure of the supply chain, with smallholder farmers seldom participating in the labor market. Jaffee (2003) notes that for small-scale producers, the start-up investment to comply with enhanced food safety standards in the export market is prohibitive, especially in regions where farmers do not have access to credit markets or institutions

A case study of Hortico Agrisystems, one of the largest fresh produce exporters in Zimbabwe, finds that the challenges of complying with stricter food safety standards are excluding small-scale producers from export supply chains of high valued products (Henson et al. 2005). This case study also finds that while many exporters have shifted to a more consolidated supply base of medium and large-scale producers, various mechanisms can be implemented such as training, financing and increased exporter-to-farmer relations, which will permit small scale farmers to make the investments necessary to comply with higher safety standards. Jaffee and Masakure (2005) examine how European retailers are utilizing private food safety and quality standards as risk management and competitive tools as well as the strategic response of leading Kenyan suppliers to such practices. They find that leading fresh produce growers in Kenya – none of them smallholders - have re-positioned themselves at the high end of the market and have made investments in a range of food safety and quality systems and business approaches (Jaffee and Masakure 2005).

While research on domestic SSA consumers is sparse, a few studies provide insight into consumer preferences and set the stage for future research in this area. Africa is urbanizing faster than any other continent. Associated with this urbanization (and income growth) is a shift in dietary habits towards fresh, perishable products, processed products, and away-from-home food consumption. Probst et al. (2012)

study vendor and urban consumer preferences for certified organic vegetables in the food vending sectors of cities in Benin, Ghana and Burkina Faso. They find that urban vegetable production is common in the region and that farmers rely on toxic synthetic pesticides to reduce the risk of harvest and income loss. While the overuse of pesticides in the region is raising serious health issues, general consumer awareness of the problem remains low. Currently organic production and marketing is implemented solely as a response to overseas demand, and organic standards are implemented by European agencies to qualify producers and exporters for the overseas market. As a result, domestic consumers receive little benefit from the contribution of organic production systems to food safety. Probst et al. (2012) found that the median weekly expenditure on prepared food varied between $9.94 in Accra (Ghana) and $22.24 in Cotonou (Benin). Tomatoes, cabbage and lettuce were considered to be the most risk prone by vendors and consumers alike. Using a choice experiment framework, the authors estimated the median WTP of vendors for organic certified fresh tomatoes to be $0.85, a premium of 12%-53% over the market price, depending on location and season. Consumer WTP for organic certification of vegetables used to prepare a meal was estimated at $1.04 per plate. This translates to a premium between 19% for meals purchased in restaurants and 177% from street food vendors. This study found that vendors in higher-class establishments attributed lower utility to organic certification while elite consumers associated it with relatively higher value. This result is likely due to vendors not understanding the safety implications of organic certification to their customers. As a result, this research concludes that demand from the food-vending sector alone is unlikely to nudge vegetable production and marketing systems towards safer sustainable alternatives such as organic production. The results from this study are similar to those found in Coulibaly et al. (2011), who calculated that consumers are willing to pay over a 50% premium for chemical-free vegetable products and organically grown produce in urban Ghana and Benin. While both studies find evidence of preference heterogeneity as well as information awareness, generalization of these results is only appropriate to a subset of urban consumers who are more affluent and educated than the general population.

Alphonce and Alfnes (2012) elicit Tanzanian consumers' willingness to pay a premium for tomatoes that have been inspected by health officials to meet the standards set by the Tanzania Bureau of Standards. They find that consumers of both genders and all income groups are willing to pay a premium for product attributes that can be associated with food safety, and that those preferences were positively correlated with their income. Lagerkvist et al. (2013a) find that food safety conditions at high-end retail channels (mostly supermarkets) in Nairobi, Kenya are perceived by their customers as providing safer and higher quality vegetables than traditional markets. Evidence of objective risks, however, do not support this perception. The authors explore differences in, and determinants of, food related health perception of consumer and key players in the fresh vegetable supply chain in Kenya. Using data from various interviews, the authors find differences in perceived risks among consumers, farmers and traders. Consumers in more informal markets were found to have a low perceived risk of food health risk, indicating a weak awareness of the causality between production method and food safety status. They suggest public awareness campaigns to address the potential hazards that inappropriate production practices can have on health. Additionally, they find that farmers and traders have higher levels of both subjective and objective knowledge than consumers, along with high levels of perceived risk, suggesting that they are often aware of how unsafe their practices are (Lagerkvist et al. 2013a). In an extension of this study in Kenya, Lagerkvist et al. (2013b) find that consumers' WTP for safer vegetables is driven by

trust and perceived risks. Further research and analysis is needed to better understand consumer preferences, especially in rural areas.

Mycotoxin contamination is a food safety concern in tropical and sub-tropical regions such as SSA (Henson 2003). These naturally occurring toxins are able to contaminate a wide-range of foods including raw commodities, processed cereals and snacks. In Africa, street-vended snacks are consumed readily. Rubert et al. (2013) carried out a study in Nigeria that evaluated the intake of 23 mycotoxins in African snacks. The products studied varied from street-vended local foods such as kulikuli (groundnut cake) and wara (milk curd), to coconut products and fresh and dried tiger nuts sold informally by random street vendors. Using a QuEChERS procedure, a streamlined approach for testing pesticide residue commonly accepted by analysts, the researchers found three mycotoxins at problematic levels in 23.8% of the snacks under consideration. Products affected were predominantly cassava, coconut and groundnut-based snacks. Though this study highlights the toxicological threat to consumers from mycotoxins and aflatoxins, little is known regarding consumer knowledge of this important food safety hazard.

While genetically modified (GM) technology is readily implemented in the Americas and Asia, African countries have been hesitant to adopt GM crops due to fears of loosing the European export market. Though a highly debated subject, GM crops could potentially aid both food security and food safety in SSA by introducing pest-resistant strains of staple crops to the area. A study on consumer WTP for GMO food in Kenya found that consumer awareness of GM crops was limited, though people in higher income and education groups were more aware (Kimenju and DeGroote 2008). Regardless of awareness levels, consumers were found to be accepting of this technology and the majority was willing to buy GM maize. Additional research is needed to fully understand consumer demand surrounding GM products, specially the determinants of consumer preferences.

4. Research need

The existing literature on food safety in developing countries paints an inconsistent picture of an emerging problem that needs to be addressed. Most research on food safety to date has focused on the challenges and impacts on export-oriented firms and global trade as a result of food safety standards in developed countries. Yet, rapid urbanization and income growth, paired with rising levels of education and other demographic changes, mean that regional and local markets in most developing countries will see rapid growth in demand for safe and high quality local production over the next several decades. As a result, issues of food safety will become increasingly important to local consumers, producers and policy-makers (Unnevehr and Hirschborn 2000).

Research is needed in three specific areas: first, consumer demand for food safety in developing countries; second, price transmission through the supply chain; and third, producer behavior with regards to safety and quality practices. Specific questions that need to be answered are: what is consumer demand and willingness to pay for food safety how does it vary across consumer characteristics, and how does it change over the course of food system transformation? How and to what extent does that consumer demand get transmitted to producers, and who are the other key players in the supply chain? How willing and able are farmers to change and improve their practices?

Ensuring food safety, and accurately conveying food safety information to consumers and producers, has

costs that not all consumers are willing to pay or producers willing to accept. The most up-to-date research on consumer preferences for food safety is skewed towards a focus on several Asia countries and provides an incomplete picture of developing country consumers' preferences, especially in SSA. Because producers utilize this market information to meet new demand opportunities and ultimately employ food safety measures, an understanding of consumer behavior is crucial to improving food safety in the developing world. Research efforts need to be devoted to understanding heterogeneity in consumer preferences for food safety, the specific drivers of that heterogeneity, how economic development, and what other factors (culture, local politics) influence consumer demand for various product attributes. Heterogeneity across country and within country must be assessed, being cognizant of the knowledge gap that is created when rural consumers are excluded from these studies.

Determinants of consumer WTP, such as socio-demographic characteristics, retail location and level of perceived risk must be assed in order to better understand and tackle food safety problems in developing countries. Moreover, work on producer food safety practices is currently absent in the literature and must be studied in order to address problems that emerge upstream in the supply chain. Generating reliable knowledge of consumer and producer preferences for food safety across developing countries, with various levels of income, economic development and across households with different demographic characteristics, will provide new and important information. Private and public sector actors and donors will use this as they work to design and implement food safety systems that meet the needs of their societies at costs that consumers are willing and able to bear and producers willing to accept.

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Table 1. Studies on Food Safety in Developing and Emerging Countries

Authors	Year	Countries/Region	Product	Method(s)*
Alphonce and Alfnes	2012	Tanzania	Veg	E
Bai, Zhang and Jiang	2013	China	Milk	E
Brown, Longworth, Waldron	2002	China	Beef	C
Cadilhon, Moustier and Poole	2003	SEA, Vietnam	Veg	C
Cadilhon et al.	2006	SEA, Vietnam	Veg	C
Coulibaly et al.	2011	West Africa	Veg	E
Calvin et al.	2006	China	NA	C
Gorton, Sauer and Supatongkul	2011	Thailand	NA	C, O
Henson, Brouder and Mitullah	2000	Kenya	Fish	C
Henson	2003	Developing Countries	NA	C, R
Henson, Masakure and Boselie	2005	Zimbabwe	Veg	C
Ifft, Holst and Zilberman	2012	Vietnam	Chicken	E
Jaffe	2003	Kenya	Veg	C
Jaffe and Masakure	2005	Kenya	Veg	C
Kimenjuand and DeGroote	2008	Kenya	NA	C
Lagerkvist et al.	2013a	Kenya	Veg	C, O
Lagerkvist et al.	2013b	Kenya	Veg	E
Marshall et al.	2003	India	Veg	C, O

Maertens, Minten and Swinnen	2012	SSA	Hort	C, O
Minten, Murshid and Reardon	2013	Bangladesh	Rice	C
Ortega et al.	2012	China	Milk	E
Ortega et al.	2011	China	Pork	E
Outski, Wilson and Sewadeh	2001	Africa	NA	O
Probst et al.	2012	West Africa	Veg	E
Rubert et al.	2013	Nigeria	Snacks	O
Tran et al.	2013	Vietnam	Shrimp	C
Umail-Deininger and Sur	2007	India	NA	R
Unnevehr	2003	Developing Countries	NA	R
Unnevehr and Hirschhorn	2000	Developing Countries	NA	R
Ubilava and Foster	2009	Georgia	Pork	E
Zhang, Bai and Wahl	2012	China	Pork, Milk	E
Zhang	2005	China	Veg, Dairy	C

Notes: * 'E' denotes an experimental economics study, 'C' a case study, 'R' a review and 'O' overview.

Appendix III. The Rise of the African Middle Class: Projections and Implications in East and Southern Africa to 2040

David Tschirley, Michael Dolislager, Thomas Reardon, and Jason Snyder

Michigan State University

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The Rise of the African Middle Class: Projections and Implications in East and Southern Africa to 2040

1. INTRODUCTION

A broad set of indicators suggests that, after decades of stagnation, economic and social conditions in Sub-Saharan Africa (SSA)[2] have improved meaningfully since about the late 1990s. First, macroeconomic performance has shown a clear reversal, with average growth of nearly 5% per year in per capita incomes since 1998. From 1962 to 1998, per capita GNP growth in developing SSA was only 29% of the world average, and did not exceed 40% of that achieved by any other area of the world; SSA badly lagged the world in economic growth during this period. From 1998 to 2012, in contrast, developing SSA's per capita income growth exceeded the world average by 25% and exceeded that in every area of the world except for developing East Asia and South Asia; and it did not lag those regions by large margins (61% total growth compared to 83% and 70%, respectively)[3]. Second, analysis suggests that economic growth in Africa over the past 15 years has been stronger, more stable, and accompanied by more productivity growth than it was in the past (Martinez and Mlachila, 2013). Third, broad evidence suggests that inequality within countries of the region has remained roughly constant or has declined slightly (Thorbecke, 2013; Go et al, 2007; Martinez and Mlachila, 2013). If inequality is at least not worsening, then the improved average income growth seen over the past 15 years should have translated into relatively broad increases in welfare. Finally, both the IFPRI Hunger Index and the UNDP's Human Development Index (HDI) support this assertion. After showing no change from 1990 to 1996, the Hunger Index in SSA declined by about 16% from 1996 to 2012, and now lies below that of South Asia, though well above other areas of the world. The UNDP's HDI improved more from 2000 to 2010 in percentage terms in SSA than it did in Asia during either of the previous two decades. Martinez and Mlachila (2013) also show that social indicators such as education, health, and poverty reduction have improved overall, though progress is uneven across countries. Even agricultural performance has improved, as measured by cereal yields: reported growth in these yields from 1998 to 2012 exceeded that in developing East Asia by 42%, nearly equaled growth in South Asia, and exceeded the world average by 22% (World Bank WDI). This growth has followed a long-sought reversal in the decline in funding for agricultural R&D on the continent (Lynam et al, 2012).

[2] We will use "SSA" and "Africa" interchangeably in the paper. By "developing SSA" or "developing Africa" we mean SSA excluding South Africa.

[3] Data for this calculation downloadable from World Bank Development Indicators site, file NY.GNP.PCAP.PP.CD_Indicator_MetaData_en_EXCEL.xls.

This range of improvement has been associated with – and one could argue it has been confirmed by -- a sharply improved view of SSA as a destination for private investment. From 1970 to 1998, total percentage growth of FDI in the region was only 14% as large as the world's growth, and 3.4% and 5.7%, respectively, as large as the growth in East and Southeast Asia and South Asia. Contrast this with 1998 through 2011, when the percentage growth of FDI in SSA exceeded that in East Asia by nearly 5% and was more than three times world average growth. Multinationals from the West, from China, Brazil, and India, and within SSA (primarily but not only South Africa) increasingly see the African consumer market as a growth market, in contrast to years past when investment in Africa was primarily oriented towards international exports. At retail, Walmart, Carrefour, Spar, and several South African and Kenya retailers are investing to satisfy what they see as a growing market.

All of these patterns, and especially the surge in private sector interest in the region, suggest the rise of an economic class in SSA that has spending power beyond basic necessities – the rise of a middle class. Such a development promises to transform the economies, and most especially the food economies, of Africa. Because average incomes are still very low and poverty rates vary on the continent, growing disposable income will be heavily spent on food – more food and different food – with huge implications for the structure of the food economies from production to processing/ wholesaling / packaging to retail and consumption. Transformation will affect obviously the private sector but also the public sector and the challenges it will face and skills it will require to facilitate positive change rather than inhibit it.

Empirical assessment of this phenomenon is still in its infancy. African Development Bank (African Development Bank) has shown that, after remaining steady between 26% and 27% of the population in continental Africa (including North Africa) from 1980 to 2000, the middle class surged to over 34% of the population in 2010 (AfDB 2011). They found similar patterns when limiting the sample of countries to SSA. While growth of the middle class in developing Asia was much stronger, rising from 21% of the population in 1988 to 56% in 2008, the trends in SSA show a clear reversal of past patterns of stagnation and even decline in this area of the world.

This same analysis showed, however, that the growth of the middle class in Africa has been entirely concentrated in the lowest level of the middle; the share of the African population in the upper middle and upper classes has not measurably changed since 2010. Commonly referred to as the "floating class", people on the fringes of the middle class are acutely vulnerable to falling back into poverty with economic downturns. This is perhaps not surprising, given that perhaps one-third of African countries in 1980 had *average* per capita incomes of less than $2/day in today's dollars, and that even by 1990 over three-quarters of the population of SSA was estimated to live on less than $2/day, the most commonly used cutoff for the middle class (Ravallion, 2009). Yet much empirical research suggests that continued economic growth in SSA should be strongly poverty reducing, leading to an increasingly rapid entry into the middle

class (Ravallion 2009; Ravallion 2001; Thorbecke 2013; Martinez and Mlachila 2013; Fosu 2009)[4].

This paper takes a foresighting approach to anticipating and assessing the impacts of the rise of the middle class. It focuses on East and Southern Africa (ESA). It first documents the current (2010) size, location, and food- and non-food spending levels and patterns of the middle class in the region. It then uses quantitative scenario analysis to examine – 30 years hence in 2040 – the possible growth of the middle class and its impact on the structure of demand for food and, relatedly, on the structure of the downstream and midstream segments of the food system that will need to satisfy this demand. The paper proceeds as follows. Section two lays out the data and methods used. Section three presents results, first for the current status of the middle class and then for projections to 2040. The section also discusses likely qualitative changes in demand over the projection period. Section four finishes with implications for Africa's development trajectory.

2. DATA AND METHODS

We use data from the World Bank's PovcalNet data base, from Living Standards Monitoring System (LSMS) Surveys for five countries and seven years, population settlement data from Landscan, and data on cropping patterns and agro-ecological zones to build a food consumption projection model for three Food Staple Zones (FSZs) of ESA. The three FSZs together capture 81% of the population of developing ESA[5]. The model projects total value of food demand in these FSZs broken-down by two separate food item aggregations, one based on type of commodity and another based on processing content. The model does these projections separately by income class and rural/urban residence, in five-year increments from 2010 to 2040. This section explains the data and methods used in developing the model.

2.1. Food Staple Zones

Staple consumption patterns vary across the continent depending in part on agro-ecological conditions and related cropping patterns, influenced also by history[6]. For example, the share of maize in total food consumption ranges only from 3% to 6% in West and Central Africa, but

[4] Note that Fosu (2009) finds that the impact of growth on poverty reduction is less in SSA than in other developing areas of the world, but that it is still positive.

[5] We consider only continental ESA and exclude South Africa. Countries of the region with population in at least one of the three FSZs are Namibia, Swaziland, Lesotho, Zimbabwe, Mozambique, Zambia, Malawi, Tanzania, Kenya, Uganda, South Sudan, and Ethiopia. Burundi and Rwanda lie entirely in a separate FSZ (Highland Perennial) and are not included. Other areas whose populations are not included in the model are southern Uganda (Highland Perennial) and northwestern Tanzania. Semi-arid pastoral areas are also not included, but their low population gives them low relevance for the purposes of projecting food demand.

[6] For example, while much of southern Africa receives too little rainfall to be optimal for maize, it is a dominant staple due to historical factors related to its introduction during the colonial era.

from 11% to 21% in ESA. Cassava's share ranges from 21% to 44% in West, Central, and East Africa but is only 6% in Southern Africa and 3% in the Sahel. Yam consumption shares are well over 10% in Coastal West Africa, Nigeria, and the Horn of Africa, but nowhere else on the continent do they exceed 1%. We have systematized these differences to define 10 "Food Staple Zones" across the continent (Figure 1). These sharp differences in staple consumption patterns suggest that the trajectory of change in consumption patterns may also differ across zones. Understanding what these differences might be is one important element in any forward-looking exercise.

We were able to analyze the food staple zones using Landscan shape files on spatial population distribution, overlaid on a GIS file of FSZ boundaries[7]. Combined with spatial referencing data linked to LSMS data sets, this mapping enables the calculation of total rural and urban populations per FSZ, the allocation of sampled households in LSMS data sets to FSZs, and thus the characterization of income and expenditure patterns in each FSZ.

To fully reflect these varying expenditure patterns while representing a more intuitively understood region of SSA, we focused on three FSZs from Figure 1: "Rest of Africa Maize Mixed", "ESA Cereal Root Crop Mixed", and Ethiopian Highlands. "Rest of Africa Maize Mixed" (henceforth Maize Mixed) is the Maize Mixed food staple zone (yellow in Figure 1) not including South Africa nor the small portions of the FSZ found in DRC and Central African Republic. "ESA Cereal Root Crop mixed" (henceforth Cereal Root Crop) is that portion of the Cereal Root Crop Mixed FSZ (green in the figure) found in the countries of ESA. From the figure, this definition excludes portions of the FSZ in DRC, Angola, and the Sahel west of South Sudan. We included the entirety of the Ethiopian Highlands FSZ, shown in blue in Figure 1. Together, these three food staple zones hold an estimated 81% of the population of the countries in our defined area, including the capital cities of all countries except Uganda.

Construction of Expenditure Classes

We use the income classes from AfDB (2011) in this analysis, based on real per capita purchasing power parity (PPP) income as of 2010 (base=2005). The income classes are as below, with the middle three classes constituting the middle class:

Poor: $0-$2 per day

Floating middle class: $2-$4 per day

Lower middle class: $4-$10 per day

Upper middle class: $10-$20 per day

Upper class: > $20 per day

[7] See Haggblade et al (2012) for details on construction of the FSZs.

Landscan population data and PovcalNet data from World Bank (http://iresearch.worldbank.org/ PovcalNet/index.htm) were used to create 20-tiles of income for each FSZ and to allocate population from the three FSZs to each income class, as follows. First, Landscan data and GIS software were used to determine population for the portion of each country falling within the FSZ, and for the FSZ in total (the sum of the country portions). Second, the shares of each country in total FSZ population were used as weights to aggregate from country-level 20-tile incomes (from PovcalNet) to population-weighted FSZ-level 20-tile incomes. Prior to doing this, country-level expenditure data that came from years prior to 2010 were brought to 2010 levels by applying an annual 2% real expenditure growth rate. Third, the FSZ-level 20-tile incomes were converted to FSZ/rural and FSZ/urban 20-tile incomes using a logarithmic relationship, estimated from the four LSMS data sets, that predicts the rural:urban total expenditure ratio across expenditure percentiles. Fourth, when income class cut-offs fell between 20-tile income levels in the FSZ, linear interpolation was used to determine the proportion of the five percent population fraction that belonged in each income class. This procedure was followed for all three FSZs, then populations were summed across them.

Table 1 shows populations of each country in our FSZs, the percent of that population captured by the FSZs, and the contribution of each country to the total population of our defined region (these are the weights used in generating FSZ-level incomes). Population estimates by income class are presented later, in the results section.

2.2. Food Item Aggregation and Estimation of Budget Shares and Expenditure Elasticities

We used LSMS data sets from five countries and seven years to develop two distinct food item aggregations and to compute budget shares and estimated elasticities. The countries and years of LSMS data are:

- Mozambique (’02-’03 & ’08-’09): representing the Cereal Root Crop and Maize Mixed FSZs;
- Tanzania (’08-’09 & ’10-’11): Maize Mixed and Cereal Root Crop FSZs;
- Uganda (’09-’10): Maize mixed;
- Ethiopia (’04-’05): Ethiopian Highlands and Maize Mixed; and
- South Africa (’10-‘11): used only in the expenditure elasticity estimates

We aggregated the food items found in the five LSMS data sets into two groups, one distinguished by processing level and the other by 23 food groups. Processing level groups are as follows:

- **Own Production**: Consumed food items that were produced by the individual consumer. Note that this category is also considered unprocessed but is distinguished from that group by being directly consumed by the producer, rather than purchased;

- **Unprocessed foods**: Food items such as maize grain or fresh fruits or vegetables that were purchased in unprocessed form. Our definition of processing involves any physical transformation of the commodity, from simple milling of maize grain into maize meal up to high value added products such as soft drinks, beer, breakfast foods, and others;
- **Processed Low**: Food items that have been minimally processed through either small-scale informal channels (e.g. food sold by street vendors, fish dried artisanally by fishermen, locally ground cassava, maize meal ground in small hammer mills – if the questionnaire indicated this) or through larger-scale processing technology. The latter includes butchered fresh meat, breads, washed imported rice, and factory ground maize meal, among others;
- **Processed High**: Food items that have received higher value added in larger-scale processing. These include breakfast cereals, restaurant foods, industrially manufactured alcoholic beverages, soft drinks, and juices, and others.

We did not always allocate similarly titled food items to the same processing class across multiple data sets, but rather used best judgment on how the item is primarily processed within the specific country.

Certain data sets include specifications of where foods were purchased for consumption and even designated foods as prepared foods for consumption away from home. We took advantage of the additional specification in these cases while in other cases we had to allocate certain items based on the food item titles which were given.

The 23 food groups are designed to generate more detailed expectations than are typically found regarding the evolution of consumption patterns over time. Many food items such as maize grain or various fruits and vegetables can be easily allocated to one food group. Other items such as bread, condiments, breakfast cereals, certain beverages, and others require more explanation of the commodity groupings to properly allocate the items. Many products have multiple food ingredients that would fall into different groupings; in these instances the items are allocated according to the primary ingredient of the product. Therefore, for example, bread is put in the "wheat" group. Details are in the methodological document. A few issues of note are as follows:

- "Staple Vegetables" include tomatoes, onions, cabbages, and green leafy vegetables such as lettuce and spinach. "Other Vegetables" include all other vegetables. This distinction was based on knowledge of consumption levels of different vegetables and the dominance over many countries of these items in vegetable consumption;
- "Sweets" include candies and sugar-based items. Jams and marmalades are sweet, but are allocated within the "Fruit" grouping as their primary input is fruit;
- Although fruit and vegetable juices are non-alcoholic beverages, we allocate them according to their primary input; therefore these are "Fruit" and "Other Vegetables";
- "Prepared foods consumed away from home" was given its own group, given the impossibility of knowing what kind of food was consumed;

- Condiments were allocated to the "Other Foods" category;
- "Other Foods" is a miscellaneous category containing items that do not clearly belong to one of the other categories. Spices, soups, frozen dinners, and condiments are among the items that were placed in this category.

The LSMS data include locational identifiers (administrative units at or below district level) which allow households to be allocated to specific FSZs. This allocation enabled the calculations of expenditures, budget shares, and expenditure elasticities across urban and rural areas within their identified FSZ. Specifics on these calculations can be found in Dolislager and Tschirley (2013). These calculations were then aggregated across data sets to form FSZ level estimates using the population weighting shown in table 2.

Bennett's Law states that expenditure elasticities decline as total expenditure rises; households with higher incomes spend less of each additional dollar on food, and more on non-food items. Properly estimating by how much these elasticities decline with income becomes very important when projecting consumption patterns out 30 years with growth rates of total expenditure that range from 2% per year to 6% per year (see below for definitions of scenarios). Incomes over this time increase by, respectively, 1.8 times and 5.7 times at these annual growth rates. To generate reliable estimates for our purposes, we used LSMS data from all five countries, including South Africa. Inclusion of the latter was crucial to provide a range of income sufficient to generate good elasticity estimates for the incomes reached near the end of the projection period.

Details of the approach are found in Annex A. In summary, the approach took advantage of the wide variation of incomes across our five LSMS data sets to estimate log-linear relationships between total expenditure and expenditure elasticities of demand for each food group, separately for rural and urban areas in each FSZ. Elasticities for the projections were then selected using these relationships evaluated at mid-point total expenditure from each expenditure class. The essential gains from this approach are that (1) the regression captured the non-linear relationship that typically exists between elasticities and income – elasticities fall with income but this decline typically slows as incomes rise beyond some level – and (2) it did so over a range of income that included the highest projected incomes in the region. Finally, we use LSMS data from the four non-RSA countries to compute food budget shares and total budget shares for each of the categories explained above in the elasticity discussion. These are aggregated to our consolidated FSZ using the population weighting factors discussed above.

2.3.Scenarios

Through a process of scenario thinking, three key drivers of uncertainty were identified and based on these uncertainties four plausible scenarios where developed. The three key uncertainties are the rate of growth in real per capita expenditure, the distribution of that growth across income classes (inequality of growth), and its distribution across rural and urban areas (urban bias). The four scenarios and the settings of each of these variables are shown in Table 3.

Business as Usual (BaU) is based on patterns observed in ESA over the past decade 5-10 years. During this time, real per capita GDP has grown about 4% - 5% per year in the region (World Bank)[8]. Available evidence (see previous section) indicates that this growth has generally not changed current (high) levels of inequality within countries. BaU thus features *inequality neutral growth*, in which all income classes enjoy the same percentage growth. Though studies are scarce, we assume in this scenario that income growth has shown an urban bias, due to widely appreciated factors that tend to drive higher income growth in urban- than in rural areas (World Bank, 2009). Computationally, we define *positive urban bias* as growth in which urban households enjoy 50% greater annual percentage income growth than rural households, independent of any distribution effects across income levels.

BaU with unfavorable environment assumes the same pattern of growth (inequality neutral with positive urban bias) but with unfavorable macro-economic and other conditions that reduce average annual growth to 2% per capita in real terms.

Equitable Growth (EG) assumes that African governments adopt policy and public investment approaches that drive broader distribution of income gains across rural and urban areas. Specifically, we assume that growth remains (a) inequality neutral across income classes within urban and rural, and (b) *urban bias neutral*, with rural and urban areas enjoying the same average annual percentage income growth. Due to the factors cited above that tend to drive higher income growth in urban than in rural areas (World Bank, 2009), we believe that a negative urban bias – higher percentage income growth in rural than in urban areas – is unlikely to prevail for the time being even under policies that promote equitable growth. Finally, we assume in this scenario that average income growth under EG is slightly higher than in BaU – 6% vs. 5% - based on research that suggests that policies and public investments that promote more equitable growth and asset distribution can also drive higher average growth (Barro 2000; Ravallion and Chen 2007; Timmer 2004).

3. RESULTS

3.1. Current Status of the Middle Class

Estimation of population, total food expenditure, cash food expenditure, and non-food expenditure by income class suggests several key patterns (Table 4). First, poverty ($0-$2) is concentrated in rural areas: 80% of all rural residents (0.62/0.78) fall into this category while only 49% of urban residents do, and rural households account for 85% of all the poor (0.62/0.73). Second, the middle class ($2 - $20) already dominates the food and non-food economy of the region: nationally it accounts for 27% of population but 53% of total food expenditure, 63% of cash food expenditure, and 74% of non-food expenditure. Third, the urban

[8] Ethiopia (7.99%), Mozambique (4.77%), Sudan (4.68%), Uganda (4.63%), Rwanda (4.46%), and Malawi (4.18%) all saw growth above 4% per year from 2006 to 2010.

middle class is not at this time dramatically different in income level from the rural middle class: the floating class accounts for two-thirds of the middle class population overall, for 69% in rural areas, and for 62% in urban areas.

Fourth, the *urban* middle class is the key driver of market demand in the region. Urban households of all income categories account for 22% of the region-wide population but 42% of the middle class population, 29% of total food expenditure, 50% of cash (marketed) food expenditure, and 45% of non-food expenditure. The urban middle class is only 11% of the population but accounts for 40% of both marketed food and non-food demand. Finally, excluding the "floating class" ($2-$4), the urban lower- and upper-middle class is only 4% of the population but accounts for 23% of market expenditure on food and 28% on non-food. The key result, then, is that the urban population, even in this least urbanized area of Africa[9], already accounts for half of the food market, and the urban middle class accounts for 80% of these urban households' share.

Several patterns of interest emerge when examining food consumption patterns (total budget shares for food) broken by processing content (Table 5). First, the urban middle class already spends between 50% and 68% of its income on non-food, compared to only 37% for the urban poor. Second, within food and still focusing on urban households, the main distinction between spending patterns of the urban middle class and other urban households relates to processed foods: the urban middle class spends between 3% and 5% of its total budget (6% to 15% of its food budget) on highly processed food items from industrial processing plants, compared to only 2% (over much lower total expenditure) spent on these items by the urban poor (3% of their food budget); total budget shares rise with income for this group, implying extremely rapid rises in total demand for this type of food. In contrast, shares for minimally processed foods fall with income, with the urban middle spending 17% to 26% of its budget on these items, compared to 33% for the urban poor. Third, these same patterns apply for the rural middle class but the range of budget shares is not as wide.

The key result from Table 5, then, is that the total budget share for highly processed food more than doubles when moving from the urban poor to the urban upper middle class (from 2.1% to 4.7%), while the share for non-food almost doubles (from 36.6% to 68%). When combined with sharply rising total expenditures, these two patterns will drive major changes in the structure of the food system as incomes rise and as urbanization proceeds.

Examining results by food group (Table 6), we find that total budget shares for cereals, roots & tubers, and pulses fall sharply with income in both rural and urban areas (more sharply in

[9] UN data indicate that urban population shares in the rest of Africa are 44% in West Africa, 41% in Middle Africa, and 59% in its definition of Southern Africa (South Africa, Swaziland, Lesotho, Namibia, and Botswana).

the latter)[10]. Fresh produce total budget shares fall by less than half overall, and greater disaggregation of this category would show rising or steady shares for fruit and some vegetables, and sharply falling shares for staple vegetables (tomato, onion, green leafies, and cabbage in this area of the world) and some others. Total budget shares for protein first rise with income before falling off (slightly) in the top region-wide expenditure class; in rural areas they rise monotonically though modestly, while falling monotonically and slightly in urban areas. Shares for beverages and prepared foods consumed away from home remain steady across income classes in urban areas while falling slightly in rural areas, reflecting the urban predilection for (a) processed foods and (b) convenience.

Disaggregating the cereals, roots & tubers category in Table 6, we find that total budget shares fall sharply with income for maize, other coarse grains, and roots & tubers, but fall only slightly for wheat (3.5% among the poor to 2.8% among the upper class), rice (3.1% to 2.3%) and oils and oil crops (1.8% to 1.4%; these are found in the Other Foods category in Table 6). Combined with sharply rising incomes, these modest falls in total budget shares imply sharp rises in total expenditure on these foods.

One key question about the rise of the middle class is whether it will drive large increases in demand for imported food. We examined two sets of data to triangulate likely import shares of different foods, then used our detailed breakdown of budget shares by income class for 23 food groups to compute estimated import shares by income class, rural and urban. The two approaches were:

1. FAOSTAT data on import and export value, adjusted by the share of each country's population included in our combined three FSZs (see above). Net imports from this approach were compared to the expenditure figures explained above. Since the expenditure figures are at retail and imports at CIF, we assumed an average 50% marketing margin to compare the two. The simple ratio of adjusted import value to estimated expenditure is an estimate of import share. This approach highlighted wheat, oil crops and vegetable oils, and rice as having the highest import shares – the same food groups that show only slight declines in total budget shares as incomes rise, and thus sharp increases in total expenditure. We therefore further investigated these figures with the next approach;
2. FAOSTATA commodity balance data for individual ESA countries for wheat, rice, oilcrops, and vegetable oil, adjusted by the share of each country included in our combined three FSZs, and with an assumed average 20% oil yield on oilcrops. These data result in weighted average estimated net import shares in the region of 45% for vegetable oil (compared to 67% in the first approach above), 46% for rice (compared to

[10] We have aggregated our 23 food groups into the seven found in Table 6 for the main body of the report. Full results for the 23 can be found in Annex A. We make selected use of these more disaggregated results in the discussion.

21%), and 52% for wheat (compared to 89%). Note that Ethiopia has the lowest wheat import share from this approach (28%) and the largest population, and thus has a heavy influence on the estimated import share for the region.

Table 7 reports results from these approaches by income class and rural/urban residence, using net imports and gross imports. Key patterns from this table are as follows. First, net import shares are four- to eight times higher in urban than in rural areas, but this ratio is less than 2:1 for gross imports. Second, and perhaps surprisingly, net and gross import shares in urban areas both *decline* with income, meaning that the urban middle class has lower import shares than the urban poor. This pattern is driven by substitution away from wheat and rice towards meat and other products that at least currently have lower import shares. Note that households substitute away from maize and coarse grains more strongly with rising income than they do from wheat and rice, but it is the latter two that have high import shares (maize import shares in the region are about 4% net and 5% gross). Fourth, because rural population shares are high and import shares rise with income in those rural areas, the middle class overall has a higher import share than the poor. Yet these shares are low (about 3% to 6% on a net basis, 10% to 15% gross) and, given the income dynamic identified in point two, may not necessarily rise sharply as incomes rise and urbanization proceeds. We will return to the issue of rising imports in more detail in the final section of this paper.

3.2. Projecting Consumer Food Demand to 2040

We present results in this section on the four scenarios outlined in section 2.4: Business as Usual (BaU), BaU with unfavorable environment, Equitable Growth (EG), and EG w/ unfavorable environment. For each, we focus on the size of the middle class, its location (urban/rural), and its spending power (share of total market) and patterns (shares across the elements in our two food item classifications – by processing level and commodity type).

Size of middle class: Total population in the region is projected by the UN to nearly double from 2010 to 2040 (from 227m to 442m), while we project the size of the middle class (floating, lower, and upper) to increase by nearly six times on average across the four scenarios, with a range of over four to nearly seven[11] (Table 8 and Figure 2). Currently, the middle class accounts for 27% of the total population but by 2040 its share will range from 59% to 91%, with a mean of 82%.

A key concern about the current middle class, highlighted in AfDB (2011) and also shown here, is the current numerical dominance of the floating class, given that this class is more subject than others to slipping back into poverty in the face of bad growing seasons (in rural areas), economic downturns, or personal setbacks such as illness, death of an economically active adult family member, or loss of job. The projection scenarios show that economic growth

[11] In each case, BaU w/ unfavorable environment delivers the least growth and least poverty reduction, while EG delivers the highest.

will as expected reduce the relative size of this group. Yet under all but the most optimistic scenario –EG with 6% real growth favoring rural areas – this class will remain well over 30% of the total population. Note, however, that its continued large size results from the poor rising out of poverty, as the share of poor falls from the current 73% to a range of only 1% to 41%

Within the middle class, the floating class will be outnumbered by the lower middle class in all but one scenario (BaU/Unfavorable). On average across the scenarios, the floating class will triple in size while the lower middle and upper middle will increase by 8.5 and 24 times, respectively. The floating, lower, and upper middle classes will on average account for 35%, 47%, and 18% of the middle class by 2040.

Location of middle class: Urban areas currently account for 22% of total population but 42% of the middle class. Under all but one scenario (BaU/unfavorable) the share of urban households in the middle class will fall, to an average of 38% across all scenarios. This decline is driven by two fundamental facts: (a) the current poor population in rural areas is six times the size of the poor in urban areas, and many of these will move into the middle class with income growth, and (b) nearly 3 million urban residents currently reside in the upper middle class, while a nearly unobservable number of rural residents are in this class; income growth will life more urban than rural households out of the middle class into the upper class.

This result – that the share of urban households in the middle class will in all likelihood fall over coming decades, despite rapid urbanization (recall that our projection model uses projected UN populations that reflect this rapid urbanization) and likely greater income growth in urban areas - may not be widely appreciated. Its implications, however, will become clear only after we explore spending power and patterns in the next sub-section.

The Middle Class's spending power and patterns: Examining food expenditure levels, we find that total food expenditure (purchased plus consumed own production) will increase on average by more than five times to 2040, that the total value of expenditure will remain larger in rural areas under all except BaU (Table 9 and Figure 3), but that the total value of cash food expenditure (purchases in markets, thus the "size of the market") will shift decisively to urban areas (Table 10 and Figure 4). The urban share of purchased food will rise from its current 50% to a narrow range of 62% under EG (with the low figure here due to strong rural growth in this scenario) to 72% under BaU (the high figure due to urban bias in the distribution of growth).

So we find a decisive (and robust across scenarios) shift towards urban areas in the share of the purchased food market despite the fact that the population share of rural areas in the middle class will *rise* under three- of the four scenarios. This pattern is driven by two factors. First, incomes remain much lower in rural areas, resulting in (a) a higher share of the floating class in the rural middle class than in the urban middle class (as high as 77% of the rural middle class under BaU/Unfavorable compared to a high of only 40% in the urban middle class under the same scenario) and (b) much greater shares of urban households in the upper middle and

upper classes compared to rural areas (21% and 22% under EG and BaU compared to only 10% and 4% in rural areas under the same scenarios).

The second that market demand for food will shift strongly to urban areas despite a rise in the rural share of the middle class is that income elasticities of demand for consumed own production remain exceptionally high in rural areas. These high elasticities reflect the depth of poverty currently found in rural Africa; poor farmers consume more and better food out of their own consumption as their production and incomes rise. Across the three FSZs, this consumed own production expenditure elasticity averages 1.36 in the lowest rural expenditure tercile, falling only to 0.93 in the upper tercile. In all cases, only highly processed food shows a higher elasticity, and its budget share is far lower. Thus even as incomes rise, the share of consumed own production in total food expenditure remains remarkably high: currently 65% in rural areas, it falls no lower than 58% by 2040, under both BaU and BaU/Unfavorable (Table 11).

Table 5 in section 3.1 presented current expenditure shares by income class and rural/urban location. Key results from that table were that the urban middle class is already the key driver of market demand for food in the region, and that the total budget shares for highly processed food and non-food each about double when moving from the urban poor to the urban upper middle class. The growth of an urban middle, then, as projected in this paper, can be expected drive major changes in the structure of the food system of the region. Tables 12 and 13 focus on this issue by presenting projected overall food budget shares and total food demand in 2040 under the four scenarios, by processing level and commodity grouping. These results speak directly to the profound changes in processing, packaging, wholesaling, and retailing that need to take place in response to urbanization and the rise of the middle class.

The first major pattern seen in 2040 is that the decline in the overall food budget share is robust across scenarios but not dramatic. Even in BaU and its 5% growth, and EG and its 6% growth, the share of food in total expenditures falls only from 58% to 40% and 39%, respectively. These are meaningful declines but, as seen below, population and income growth drive very large increases in total demand. The differences between the BaU and EG scenarios are not large at this level of aggregation.

The second important pattern is that consumed own production share falls in every scenario and is made-up almost entirely by increases in the budget shares of processing. Consumed own production falls much less under EG than under BaU, because EG delivers more income growth for those in rural areas, who have higher elasticities of demand for consumed own production than do the more wealthy and urban. Among processed items, Processed Low with the lesser value added predominates but grows less in percentage terms; the more highly processed items in Processed High see their budget shares rise from about 4% to 10%-11% under BaU and EG, and to 7%-8% in each of these scenarios under unfavorable conditions that deliver less total income growth.

Finally, both sets of scenarios drive large declines in food budget shares of maize, root crops (especially cassava and yams), and plantains, slight shifts within food staples towards wheat and rice, large increases in beef and prepared food consumed away from home, increases also in fruit and beverages, and relatively modest changes in all other items. Note that the budget share on poultry remains essentially flat from 2010 in all four scenarios. This result stems from sharp increases in quantities consumed paired with sharp declines in price; the world over, poultry production is the first meat production to industrialize as food systems transform, resulting in much higher productivity and lower prices. Consumers eat more poultry as their incomes rise but they pay much lower prices for it.

Perhaps the most noteworthy result on food budget shares is that they are not much different in our two sets of scenarios. In each case, lower growth results in less change, but the pattern of change across processing levels and food groups is similar.

Unlike expenditure patterns, total expenditure outcomes differ dramatically across scenarios. Due primarily to the way that the EG scenarios deliver more growth than BaU to rural households, and because these tend to be poorer and have higher elasticities of demand for food than richer and more urban households, total demand for food grows much more rapidly under the two EG scenarios. Including consumed own production, total food demand in the region rises six times (from $253 million per day to $1,493 million per day) under BaU but eight times under EG (up to $1,949 million per day). Demand for food through markets –i.e. excluding consumed own production – rises by 7.2 times and 8.5 times, respectively. Rises in demand are far less but still very substantial under unfavorable environments that deliver less growth: total demand rises 3.2 times under BaU and 5.1 times under EG, while market demand jumps by 3.7 times and 5.7 times. On average over all scenarios, demand for food through markets rises over six times. These results are comparable to those of Byerlee et al (2013) who project a quadrupling of the size of urban food markets through 2030 (our projections go to 2040).

The rise in demand is seen most sharply in the most highly processed food items, demand for which rise nearly 15 times under BaU and 19 times under EG under favorable environments for growth. Even under an unfavorable environment, EG delivers more than a 10-fold increase in demand for Processed High food items, due to the distribution of growth more heavily toward rural households compared to BaU. Unprocessed foods and Processed Low foods grow similarly, each increasing between about four times and 7-9 times depending on the scenario.

Among the food groups, the biggest winners in percentage terms are prepared foods consumed away from home, beef, and fruit. These grow under the EG (BaU) scenario with favorable conditions by 17 (11) times, 15 (11) times, and 14 (10) times, respectively. Wheat and wheat products, beverages (alcoholic and non-alcoholic), fruit, and eggs are also big winners. In all cases the increase in total demand is much more pronounced under the two EG scenarios than under the two BaU scenarios, for the reasons explained above.

Summarizing, the key results from this analysis are as follows:

- Under all scenarios, changing patterns of demand (captured by budget shares) are most evident for maize and overall own production (large declines), and for food away from home, beef, fruit, and high value added processed items (large increases). Wheat and wheat products, beverages (alcoholic and non-alcoholic), fruit, and eggs are also big winners;
- Differences among growth strategies (continuation of current policies producing urban-biased growth) are minor in this measure of transformation;
- Differences among strategies are very large in their impact on growth in demand; the two EG scenarios deliver much higher multiples of growth than the two BaU scenarios;
- In any case, urbanization combined with even modest economic growth will drive very large increases in overall demand for food; these increases range from 3.1 times under the least favorable scenario (BaU with unfavorable conditions) and nearly eight times in the most favorable (EG with favorable conditions).

To meet this increased demand, and to produce the new foods and more value added foods that this analysis shows consumers will demand, local food systems will have to profoundly increase their investment and productivity at all levels, from farm through all the midstream and downstream segments.

3.3. Anticipating Qualitative Changes in Demand

Rapid urbanization and the rise of a middle class lead, in addition to explosive quantitative growth and major shifts towards more highly processed foods and fresh perishable foods, to transformative *qualitative* changes in consumer demand for food over time. One such change is rapid rises in demand for value, much of it closely linked to convenience. Urbanization leads to less free time for most people, especially for women, who become more likely to work outside the home, giving them less time and energy to focus on home-prepared foods. Greater packaging, semi-prepared (e.g., sliced- and diced vegetables and fruit) and prepared foods, canned and frozen goods, and fast foods become more common.

The second major qualitative change is that consumers become more concerned about food quality and safety and their conception of what safety means evolves as their incomes and education rise. From simple visual inspection of freshness and cleanliness, consumers eventually come to expect much more sanitary shopping environments and to rely on third-party certifications and formal food safety standards to back-up their confidence in the food supply. As Unnevehr and Hirschhorn (2000) state, "food safety interventions build from basic investments and simple interventions to more complex regulatory systems as economies develop." Currently, most African countries have severely limited abilities to design, maintain, and properly adapt over time these types of complex regulatory structures. Doing so will require far more trained personnel in nutrition, food safety and toxicology, food processing, and the

economics of regulation. To be of real use, these trained people will need to be employed in organizational and managerial structures that value knowledge-driven service to the public; promoting such an attitude is a major challenge in any country, and is particularly so at this point in most African countries.

It is all but certain that these two qualitative changes will occur to a meaningful extent in Africa over the next 30 years. The difficult question is the rate at which they will occur. Properly anticipating this rate of change is important so that the needed new regulatory structures can keep pace with, and even promote and shape these changes, without getting so far ahead that they become irrelevant or even counter-productive. As one example, insisting that farmers and traders follow sophisticated process standards and meet quantitative requirements for maximum pesticide residues in fresh produce can be counter-productive when well over 90% of the produce comes from farmers with low literacy, moves through badly under-developed traditional marketing structures, and is consumed by very low income consumers who may not even understand such regulations.

Key variables that will drive the rate of change in these qualitative dimensions of demand are per capita income and its distribution, educational levels, and growth of urban relative to rural populations: higher income growth, more equal distribution of that growth, higher levels of education, and greater urbanization will drive more rapid and broad-based increases in demand for the range of quality characteristics we discuss above. Nutrition and food safety awareness campaigns can also influence the rate of change in consumer demand for food quality and safety. Yet the current income levels found in ESA need to be kept firmly in mind. Growing at 5% in real terms per year (BaU from our model), mean incomes in ESA will rise by 2040 to levels equivalent only to El Salvador in 2010, one of the poorest countries Latin America[12]. In addition, UN projections call for the urban population share in ESA in 2040, despite the very rapid urbanization forecast for this period, to remain much lower than it is at present in Central America. Thus, while the next 30 years will bring substantial change to the structure and quality of demand for food in the region, one needs to remain anchored in the reality of the region's very low starting point and in patterns observed over time elsewhere in the world, to avoid overestimating the degree of change and designing policies and programs with low or even negative returns.

4. Implications for Africa's Development Trajectory

We address three questions in this final section. First, what does the rise of the middle class imply about the growth of the "modern" food marketing system? Second and closely linked to the first question, what opportunities exist for smallholder farmers in these changing markets?

[12] Based on World Bank per capita GNP data. We exclude Botswana and South Africa from this computation. Somalia, South Sudan, and Zimbabwe are not included due to lack of data.

Third we ask if the rise of the middle class lead to a surge in food imports? Finally, who will capture the vastly growing market for processed food?

4.1.Anticipating future growth and impacts of modern retail

Future growth in supermarkets in Africa will be driven by evolution of demand by consumers for supermarket services and supply of these services by firms (Reardon, Barrrett, Timmer, and Berdegue 2003). Key drivers on the supply side are policies regarding foreign direct investment (FDI), and policy and investment factors that determine the general cost of doing business in the country. Policies that hinder or promote private investment whether foreign or domestic will hinder or promote food system transformation, including the rise of supermarkets. Opening to FDI in Latin America was a key policy change that allowed international food retailing companies to target the urban populations of the continent and spurred the rapid growth of modern retail in that region. Economic liberalization in SSA in the mid-1990s was a necessary trigger for what supermarket expansion there has been to date on the continent, and we noted above the very rapid growth in FDI on the continent since 1998. The reduction of bureaucratic impediments to doing business can be important to attract more local and foreign investment. Public infrastructural investment in water, sanitation, transport, and electricity also are needed if supermarkets are to be able to reduce their costs and provide superior quality of service at prices that most consumers can afford.

Several demand side factors need to come together to see rapid supermarket expansion. One is urbanization, which has been occurring at generally high rates in the region for several decades. When urbanization and income growth occur together – as has been happening since the late 1990s – they drive major changes in consumer behavior that favor supermarket development. Among these changes is an increase in the perceived opportunity cost of time, especially for women. Convenience thus becomes of greater value to urban residents. This can work in the favor of supermarkets for households that have the ability to buy larger quantities of food at less frequent intervals, which is associated with ownership of vehicles (or at least access to good public transport) and refrigeration. For poorer households without access to vehicles and refrigeration, however, shopping in diffuse informal outlets of the traditional marketing system can be far more convenient (see below for results from Zambia on locational convenience). Public investment in the electricity grid, road infrastructure, and public transport thus also affect the demand for supermarket services. The distribution of growth – in particular growth strategies that raise incomes for the poorest – can also lead to more rapid growth of a broad market for supermarket services. Finally, urban consumers with growing incomes tend to become more educated, raising awareness of the need for sanitation and a preference to shop in the clean environment that most supermarkets provide.

Two demand side analyses of shopping in supermarkets are Tschirley et al (2010) and Neven et al (2005). Tschirley et al analyze the data from four cities of Zambia described above, plus similar data from Nairobi, Kenya. Neven et al focus more broadly on urban Kenya.

Tschirley et al show in both countries that income, owning a car, owning a refrigerator, and having a more educated household head all positively influence the likelihood of shopping in a supermarket chain. Overall, their results agree with those of Neven et al (2005) in Kenya, highlighting the importance of income, education, and the ability to shop less frequently in driving the use of supermarkets.[13] This analysis also strengthens findings from earlier research by showing (in Zambia) that, for a given food category and controlling for other factors such as the household's income, processed items are more likely than unprocessed to be purchased in a supermarket.

Two additional results for Zambia from Tschirley et al (2010) are noteworthy. First, supermarket chains may have more difficulty gaining market share in large urban centers than in smaller towns; conversely, supermarket expansion may be more rapid in the rapidly growing segment of smaller cities and towns (Tschirley et al 2013) than has already been seen in large capital cities. Second, distance to various retail outlets in Zambia has an important influence on choice of outlet. This puts supermarkets at a disadvantage compared to the traditional sector in competing for the low income consumer, one which they are trying to address by investing in greater numbers of smaller-format stores.

These results, together with the changes in consumer demand patterns projected in the previous section, clearly suggest that an economically growing and urbanizing SSA that remains open to private investment, will see continued growth of supermarkets. Recent investments on the continent by Walmart and Carrefour show that large international corporations have Africa in their strategic plans. Carrefour in 2013 entered a joint venture with the trading and distribution company CFAO to open eight retail outlets in countries of West and Central Africa, where supermarkets so far are barely perceptible. In a much bigger move, Walmart in 2011 purchased South African retailer Massmart and its 377 outlets in 12 African countries (including South Africa).

The key question is the rate at which supermarkets will take over market share. Dihel (2011) reports that supermarket sales in East Africa are forecast to grow at 10% to 11% per year over the next five years, after growing between 7% per year (in Kenya) and 15% per year (in Rwanda) over the previous five years. If current total food market shares of supermarkets in the region are, as we suggest, around 10%, and if they are able to sustain growth rates of 10% per year over the next 30 years, then they will reach a 30% market share at that time[14]. Currently in South Africa, supermarkets hold a 50% share in the national food market[15]. It thus seems reasonable to expect that by the end of our projection period, and assuming continued openness of countries to

[13] Neven finds car ownership insignificant.

[14] We assume 5% growth in per capita income, a 2.5% rate of growth of urban population, and 0.7 elasticity of demand for food, yielding a 6% annual growth rate in in total demand for food. Supermarkets need to grow more rapidly than this to increase their market share.

[15] Author's calculations from 2010 South Africa Income and Expenditure Survey (IES) data.

private sector activity together with economic growth, supermarket shares in ESA will lie somewhere between these two levels.

As supermarket shares grow, they will increasingly have five system-wide and inter-related effects (this is likely to happen sooner in places like Kenya and Zambia than in countries of West and Central Africa, or in Ethiopia for example). First, through their operational efficiencies, they can potentially drive lower price levels throughout the food system, to the benefit of consumers. This is especially likely for the processed and semi-processed goods such as maize meals, wheat flour, bread, oils, meat, fish, and dairy, that typically make-up 85% of these stores' sales.

Three potential effects derive from this efficiency and price effect. Supermarkets can drive consolidation and increased scale of operation in the processing and wholesaling sectors in their push to "squeeze costs out of the system". Supermarkets can also reduce the number of smaller independent shops and drive them towards niche markets as they (the small shops) attempt to earn higher profits on declining volumes. In this way, supermarkets can drive peripheral diversification in the food system as existing small retailers search out new markets to serve in an attempt to remain in business. Booz-Allen Hamilton (2003) and Farina and Nunez (2005) both highlight this dynamic and argue that food systems at retail in Latin America – where supermarket penetration is far higher than in SSA - are maintaining a diverse set of outlets in spite of the expansion of supermarkets. Finally, robust evidence indicates that smallholders are largely excluded from the supermarket procurement system, despite much talk of Corporate Social Responsibility and real attempts to include them. Concern about this exclusion is most acute in fresh produce, where supermarkets attempt to procure produce only from their "preferred suppliers", and where robust evidence indicates that all but a tiny minority, whether independent or in farmer groups, are unable to remain on these preferred supplier lists on a sustained basis. Currently these programs carry a tiny fraction of the food trade in African countries and so cannot be considered a major policy issue. For example, in Kenya in 2009, this share was only about three-tenths of one percent of all food purchased in urban areas[16]. As supermarkets grow their share and succeed in reducing their use of wholesale markets, however, this is likely to become a more important issue.

The fifth and final systemic effect that supermarkets can eventually have in African food systems is reduction of food safety problems through the creation of more hygienic shopping environments and better ability to mainstream food safety practices throughout their supply chain by demanding higher standards from their suppliers. As this happens, traditional markets will

[16] Based on a 4% market share by supermarket chains in fresh produce, a 20% share of fresh produce in urban consumer food expenditure, and a 40% share of preferred supplier programs in supermarket chain fresh produce procurement (the rest being purchased in traditional wholesale markets; Neven and Reardon, 2004, for Kenya): 0.04*0.2*0.4 = .0032 = 0.32%

need to modify their own practices to avoid even more rapid loss of market share. In this way, competition among these two channels can drive improved practices throughout the system.

4.2.Will the rise of the middle class drive a surge in food imports?

Rakotoarisoa et al (2011) show that there has been a surge in the gross value of food imports on the African continent (including North Africa and South Africa), with data through 2007. Here we focus on developing SSA and update to 2011. We use FAOSTAT data on imports and exports to examine trends, and World Bank Development Indicators data to examine the drivers of food imports and how developing SSA compares to Asia in its import levels and trends.

Previous sections of this paper showed that overall net (gross) food import shares in the region were about 2% to 4% (9.5% to 12%) depending on method of calculation, that net (gross) food import shares among urban households currently are four- to eight times (two times) higher than in rural areas, but that the share in consumption of both net and gross imports falls with income in urban areas (while rising in rural areas; Table 7). A simple application of the current food import shares by income class shown in Table 7 to the projected population shares in each income class in 2040 (Table 8) suggests that, under any of the four scenarios, overall food import shares will rise only slightly, to about 3% to 5% net and 10% to 13% gross. This is not an alarming scenario.

Note also that this scenario is entirely consistent with a sharp rise in per capita food imports in the region. Since Table 9 showed that per capita food expenditures are slated to rise between 55% (under BaU/Unfavorable) and nearly four times (under EG), these slight rises in the import share of food consumption mean that per capita imports would rise by 66% and by over five times under the same two scenarios. Yet as a share of food consumption these imports would remain very small, and as a share of total expenditure (food + non-food) they would be even smaller, remaining under 2% in all scenarios.

This analysis however ignores the question of whether African production and marketing systems can keep up with the projected dramatic rise in volume and value-added of food demand in the region. This question is urgent in light of the stagnant agricultural productivity on the continent (though we noted above that there are some signs this has begun to reverse itself), the low current value added of food consumed (reflecting currently low processing content), and the fact that, according to UN projections, there will be fewer than two rural inhabitants per urban inhabitant in 2040, compared to a nearly 4:1 ratio now – each rural resident in 2040 will have to feed twice as many urban residents as they do now, and even this assumes no movement out of farming into the rural non-farm sector, which would make the change even larger. Productivity at farm and post-farm levels will have to increase dramatically to avoid an import surge that goes well beyond what we just discussed.

The possibility of such a surge can be seen in Figure 7. To generate the figure, we assembled, from FAOSTAT, annual data on per capita value of net food imports since 1980 from

all countries in Latin America, developing Asia (Asia minus Japan, Singapore, and South Korea), and Sub-Saharan Africa. We excluded island nations. We then assembled data from the World Bank WDIs for each country on structural characteristics that should influence the level of imports but not be (strongly or quickly) influenced by those imports. The question to be answered was "does SSA import more food than would be predicted from its observable structural characteristics, independent of behavioral / policy / agricultural investment factors?" Specific variables were:

- Real per capita Gross National Income, in purchasing power parity terms (base = 2010);
- The country's urban share in total population;
- The share of the largest city in total urban population, a measure of the centralization of urbanization;
- Hectares of arable land per person;
- Whether the country is landlocked or not (1=landlocked, 0=not);
- Year, to control for secular trends

We then regressed net per capita real food imports on these variables to generate predicted values for each country, aggregated these regionally, and compared predicted to actual imports. The regression left out variables that capture policy and programmatic decisions that influence the productivity of the countries' food systems and thus their ability to produce, process, and distribute the quantity and quality of food demanded by its populace. As a result, any difference between predicted and actual imports should reflect differences in performance on these variables; imports above (below) predicted levels would reflect inferior (superior) performance relative to the average within the overall sample of countries.

We included Latin America in the regression but exclude it from Figure 6 to highlight the difference in performance between developing Asia and developing SSA. Results are striking. They show that predicted per capita imports in developing SSA have risen slowly but steadily over the period (somewhat more rapidly since the mid- to late-1990s), driven by the temporal pattern of income gains, and that actual imports have risen at the same pace but have consistently exceeded predictions based on observed structural characteristics. This pattern is consistent with the continent's low productivity at farm level and throughout its food system. In contrast, Asia's predicted imports (driven by China) grew dramatically over the period and especially since 2000, driven by the region's exceptionally high income growth. Yet actual imports trended slowly *down* throughout the period, and were far and increasingly below the predicted levels through the 2000s, suggesting that some mix of policy, programmatic action, and private investment in the food system drove the system-wide productivity gains needed to avoid such an explosion in imports.

Whether Africa repeats Asia's experience or instead sees imports rise rapidly even as a share of consumption depends on whether it adopts the policies and public- and private investments that will drive increased productivity throughout its food system. A positive note is that total

investment in public agricultural R&D increased 20% between 2001 and 2008, after a long decline. Yet this growth was confined to a small number of countries (Lynam, Beintema, and Annor-Frempong 2012). Crucially, given the rise in demand for value added products documented in this paper, continued and large investments in agricultural R&D must be based on a "broader policy and strategic framework that encompasses agro-industrial and agribusiness services along with farming." (IFPRI 2011).

4.3. What opportunities exist for smallholder farmers in these transforming markets?

The ability of smallholder farmers to benefit from the increased demand foreseen in this paper depends on three factors. First, they must be able to increase their productivity of the traditional food and feed crops that will remain the base of the consumer's consumption basket (albeit in increasingly processed form), to keep pace with rising demand. Second, they must be able to move into the new crops that will emerge or that will grow very rapidly due to changing demand, such as soybeans (for animal feed and oil), other oilcrops, fruit, and vegetables beyond the staple vegetables of tomato, onion, cabbage, and green leafies. Finally, smallholders must be able to meet rising quality and safety standards.

The first two factors depend fundamentally on public investment in agricultural R&D, on rural roads linking to rapidly growing cities and towns, and on public marketing infrastructure (especially wholesale markets and related information systems) that facilitate rural-urban product flows, and on development of robust private input markets. The latter depends on these factors plus a policy environment that does not undermine private investment in input marketing as government tries to promote affordable input availability for smallholder farmers.

We do not review these issues here. Instead we focus on the third issue – rising standards for safety and quality – which our analysis can directly inform. Jaffee, Henson, and Diaz Rios (2011) outline six levels of regulatory and market requirements for safety and quality as they relate to the type of market. Level 1 is traditional retail markets and small stores, level two and three are small local supermarkets and local supermarket chains (high-end), respectively, while levels 4-6 are in developed countries, ranging from discount food retailers to high-end supermarkets. In Level 1, quality and safety requirements are assessed through visual inspection and quality and safety standards are the lowest and the least formalized. These are the markets that smallholders currently operate in. *The key result from this study in this regard is these traditional ("smallholder friendly") markets are likely to still hold 50% to 70% of the food market in ESA in 2040 (section 4.1).* We also note above (section 3.3) that, even with robust growth, mean incomes in ESA in 2040 will only match those of the poorest countries of Central America today, meaning that many consumers will continue to have limited willingness to pay for more abstract quality and safety guarantees.

Note also that the size of this traditional market will be far larger than it is today and will grow much more than rural population. Table 8 showed that rural populations in the region are

slated to grow by 57% from 2010 to 2040. Combining information from Table 13 on growth in market size for unprocessed and Processed Low products, with the share of traditional markets in overall food demand (estimated at 90% today, falling to 60% - the midpoint of our estimated range – in 2040), we calculate that the size of traditional (level 1) markets will grow an average of 258% (for unprocessed foods) and 292% (processed low) across the four scenarios during this time. Clearly, size of accessible market segments will not be a problem for smallholder farmers through this time. Indeed, the major challenge will be for smallholders and emerging and large farms to increase production enough to satisfy these markets.

Whether smallholders are able to enter higher value markets (local supermarket chains, non-traditional export markets, and quality processors such as beer and starch manufacturers) depends on their ability to meet the higher standards in these markets (local supermarket chains and export markets), and on well-known factors such as the productive resources (land, water, variable inputs, animal traction or mechanization) they can bring to bear in production, logistical costs of getting product to market, and on the ability to reduce the high transactions costs that buyers face in attempting to source from many spatially dispersed, small suppliers. To date, the evidence is clear: despite much development expenditure and trumpeted company efforts under CSR, the number of smallholder farmers supplying these markets is low (dwarfed by those operating in traditional markets), and turnover is very high (Jaffee, Henson, and Diaz Rios, 2011).

4.4. Might Supermarkets Penetrate Faster than our projections suggest based on these extrapolations?

Above, we made a projection based on various scenarios of growth, that ESA may reach a share of supermarkets in total food retail of 30-40% by 2040, approaching where South Africa is at 50% today. By comparison, ESA will have reached the stage of Southeast Asian supermarket penetration seen in the early 2000s. Keep in mind that the African supermarket penetration pace is about the same as it was in the US over the 1930s-1950s as supermarkets spread – and supermarkets in the US of course have dominated the food market for many years.

But there may be reasons to expect supermarket penetration to occur faster than these projections allow, controlling for a continuation of the fast rates of urbanization and income growth in the 2000s? Several points can be suggested from international experience; of course "only time will tell."

a) The rapid rise of small cities and towns (de-concentration of African urbanization) that has emerged especially in the 2000s may facilitate spread of small and medium supermarkets and convenience store chains as has occurred in Southeast Asia. Supermarkets were spreading faster in secondary cities and towns in of Zambia than in the largest cities.

b) The above point is closely linked to a second point: in the early stages of supermarket growth in all developing regions, supermarkets tend to be hard to access (there are few of them so consumers have to travel far), relatively expensive, and geared toward the middle- and upper class. But in all other regions, there was a "tipping point" where modern retail formats diversified, and became numerous and small, and undertook measures to reduce their costs and prices, and relatively suddenly became much more competitive against traditional retail. Then they moved from primarily focused on the rich and middle segments, to marketing food to the urban poor and small town consumers. Importantly, one finds this commonly among the second and first wave countries in supermarket diffusion – but it occurred in them after the first decade or two of growth that had been focused on the middle- and upper class and big cities. Interestingly, India is "precocious" in this trend as the leading supermarket chain is rapidly rolling out "KB Fair Price Shops", private versions of food ration shops with heavily discounted, mass marketed food for the poor in the cities and towns. This has already started to occur among the poor in rural townships in South Africa (d'Haese and van Huylenbroeck, 2005). This kind of change of format and marketing approach made for a "non-linear" penetration of consumer markets – foiling earlier projections of slow, sedate progress of supermarket penetration that did not figure that supermarket chains would turn to focus on the poor. This may be what Walmart has in mind for further stages in Africa, thus doing what it has done in the US, Mexico and other places.
c) Much discussion of limited expansion of supermarkets in Africa has focused on the very limited penetration of fresh produce retail. This point is of minor significance in judging the future trends in supermarkets in Africa; supermarkets did not even try to penetrate those markets in the US for the first 40 years of their existence; a similar relative lag was seen in Latin America and Asia. But fresh produce is only 15% of consumption baskets in these regions. More to the point, the great majority of food expenditure is in processed grains, edible oils, beverages, condiments, and so on, and in bulk cheap vegetables. Minten and Reardon (2011) found that in supermarket chains in 11 developing countries (with a Kenyan example included), supermarket prices for these "staples" were below the traditional shop prices, allowing for competitive gains quickly.
d) One should not discount the potential effect of retail FDI in the next two decades. Retail will become increasingly competitive in Asia and FDI will spill over into Africa. In the entry of Walmart and Carrefour, one sees an important sign that the usual "early entrants" are paving the way for this penetration, which could be far reaching indeed. Most important, where this penetration occurred, the "tipping point" in retail started, where chains penetrated well beyond the middle classes into the markets of the poor, lowering food costs.

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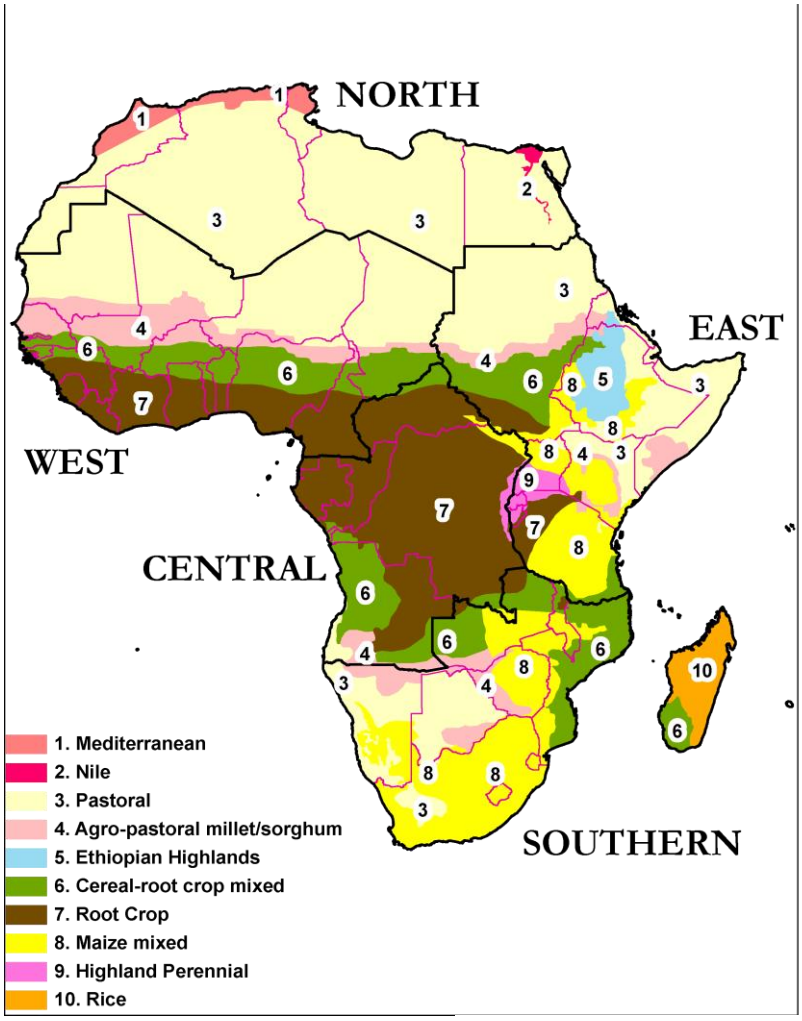
Figure 1. African Food Staple Zones



Source: Haggblade et al. 2012), adapted from FAO (2000; www.**fao.org**/docrep/x8200e/x8200e05.htm)

Figure 2. Population shares in ESA by income class under four scenarios, 2040

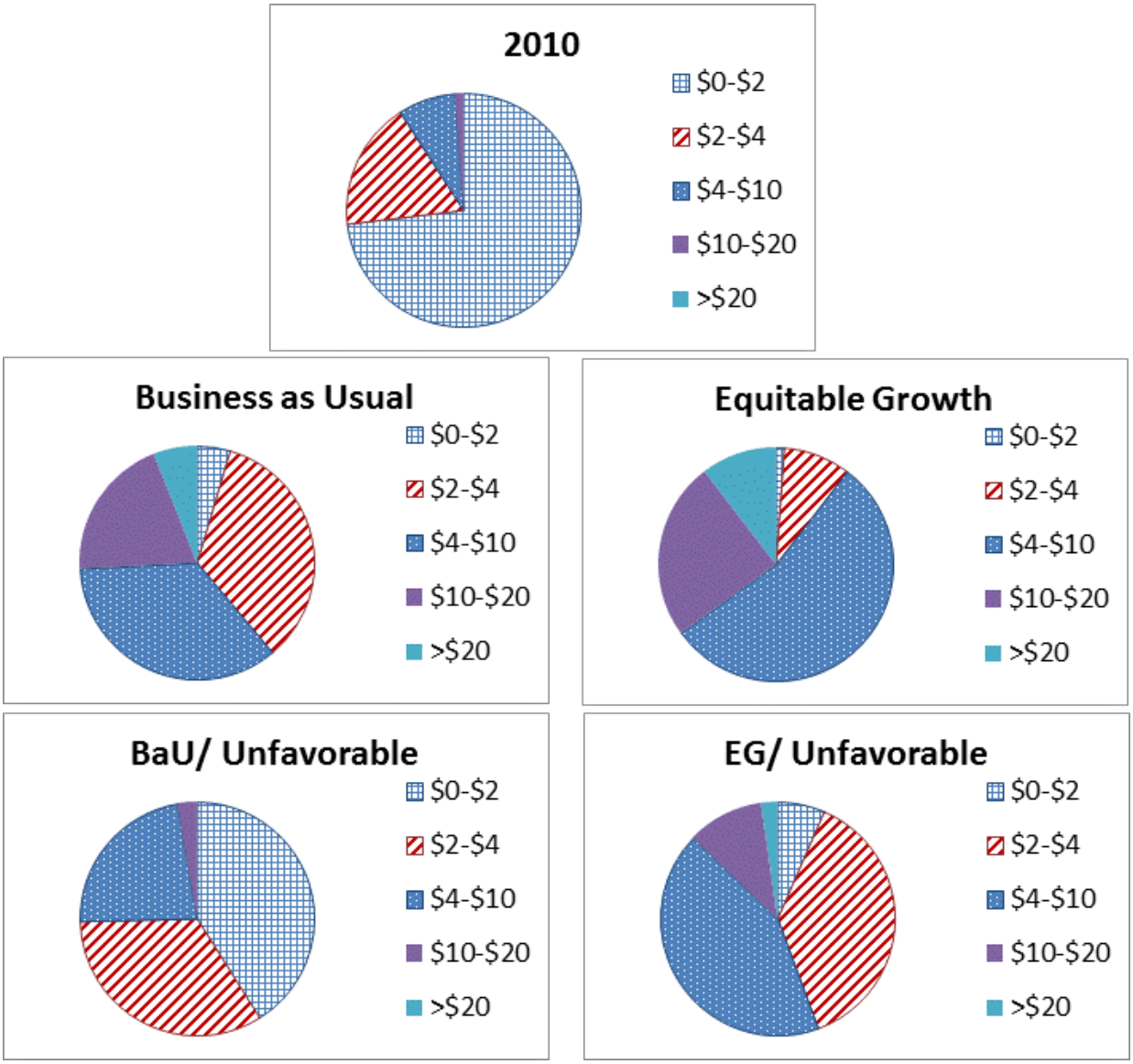


Figure 3. **Total food expenditure shares (purchased plus consumed own production) in ESA by income class under four scenarios, 2040**

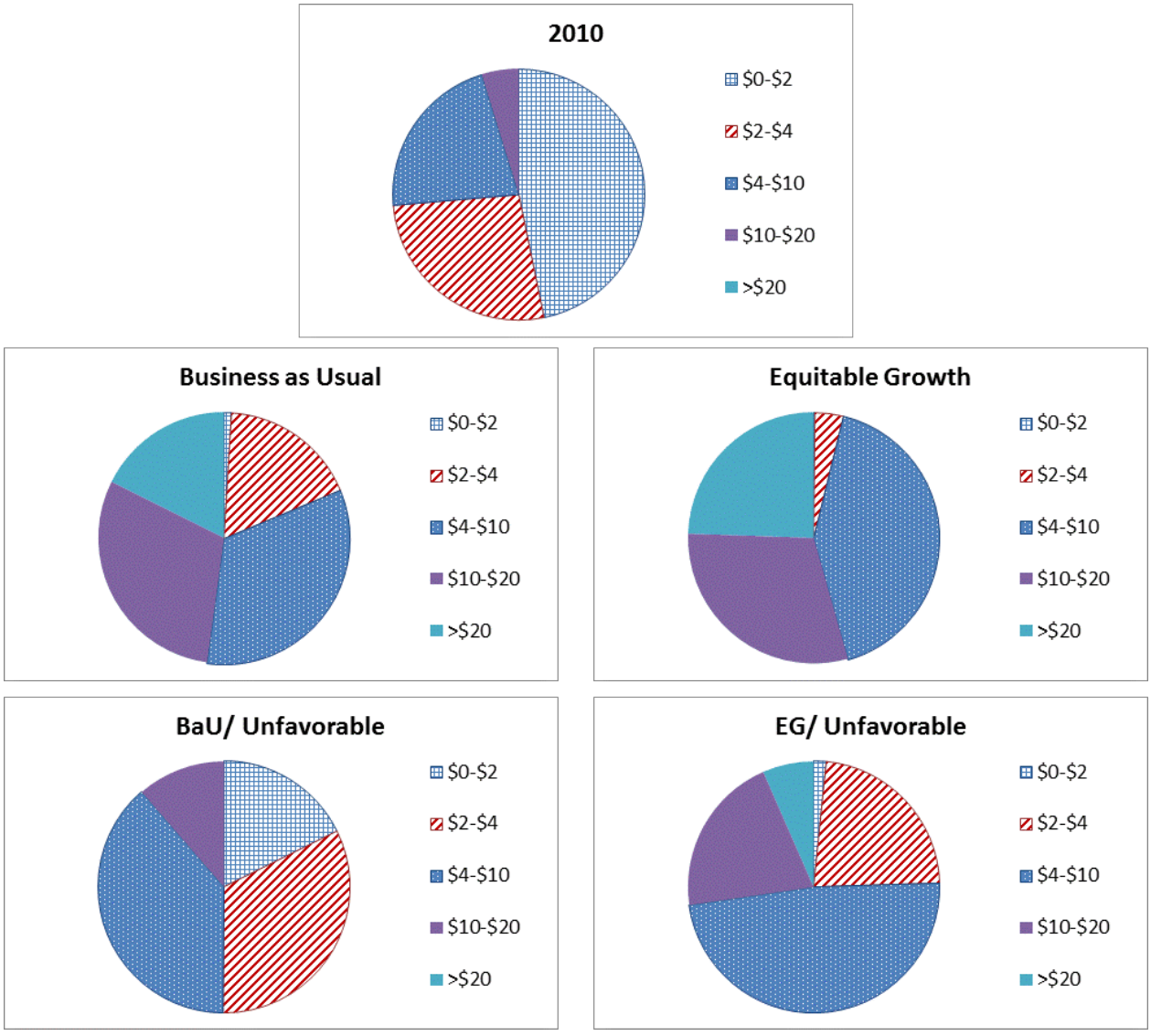


Figure 4. **Cash (marketed) food expenditure shares in ESA by income class under four scenarios, 2040**

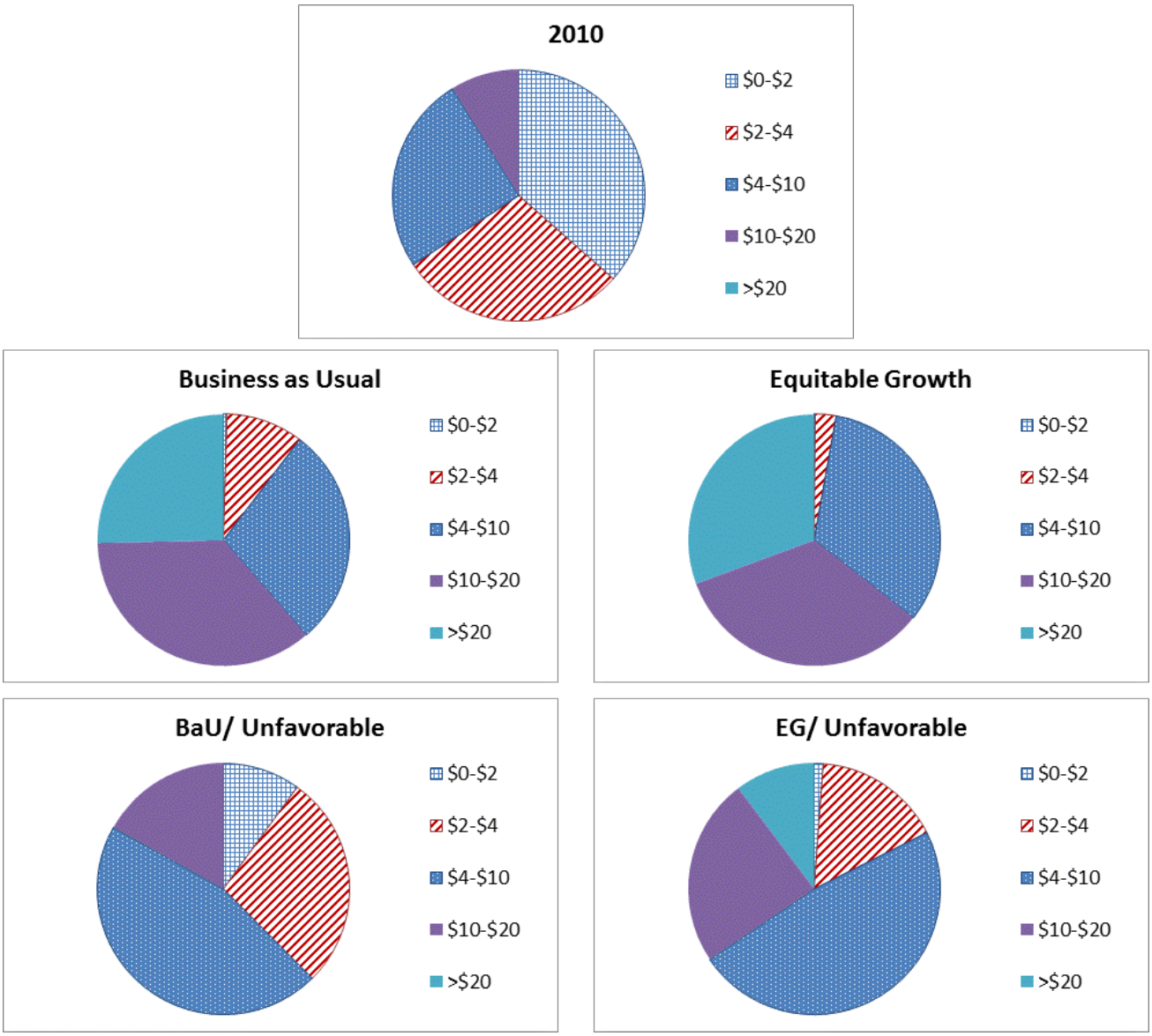
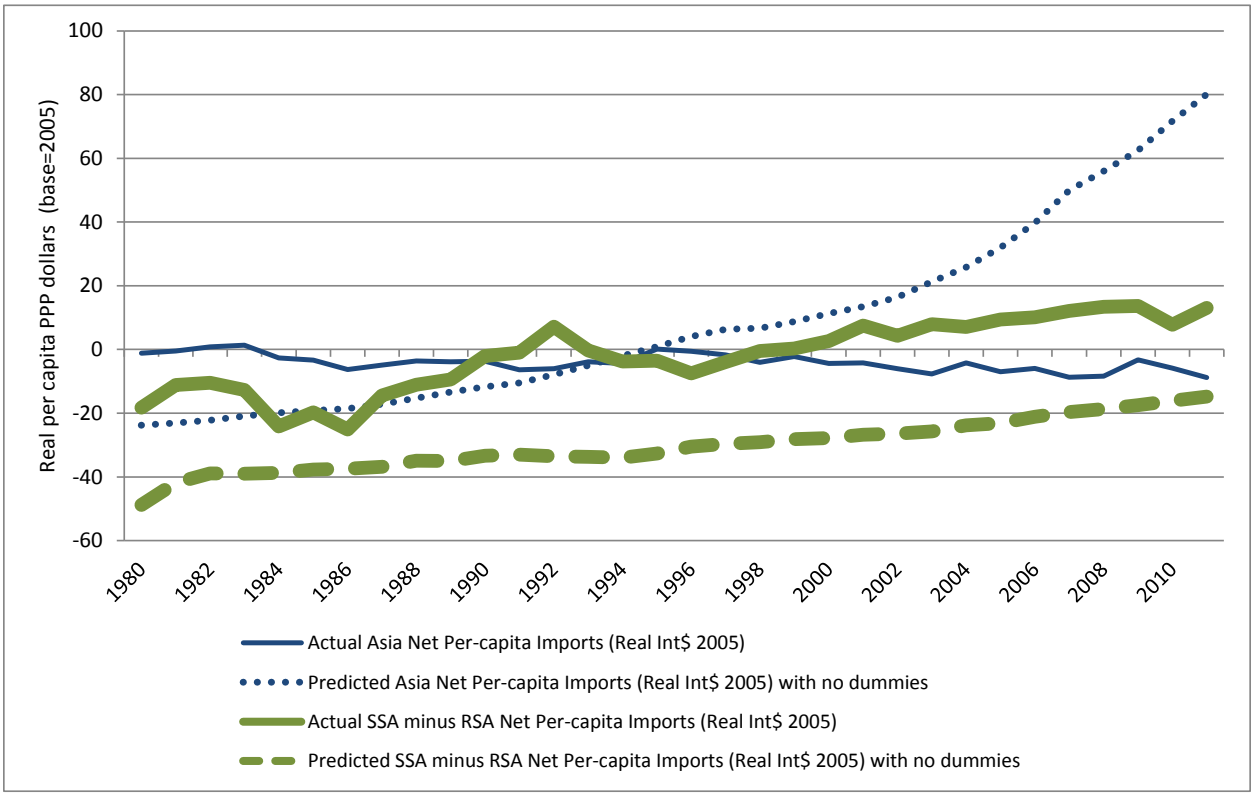


Figure 5. Predicted and actual food imports in Africa and Asia, 1980 - 2010



Source: FAOSTAT and authors' calculations

Table 1. Country composition of "developing ESA" region used in this study

Country	Total Population		Population in 3 FSZs (Landscan only)	% of population captured by 3 FSZs	Share in population of defined region
	United Nations	Landscan			
Ethiopia	82,950	90,864	82,322	90.6%	35.0%
Kenya	40,513	41,858	34,523	82.5%	14.7%
Lesotho	2,171	1,893	1,893	100.0%	0.8%
Malawi	14,901	15,888	15,613	98.3%	6.6%
Mozambique	23,391	22,966	22,966	100.0%	9.8%
South Sudan	9,948	11,228	11,228	100.0%	4.8%
Swaziland	1,186	1,365	1,365	100.0%	0.6%
Uganda	33,425	34,591	15,518	44.9%	6.6%
Tanzania	44,841	41,518	27,801	67.0%	11.8%
Zambia	13,089	13,875	11,586	83.5%	4.9%
Zimbabwe	12,571	12,085	10,170	84.2%	4.3%
Namibia	2,283	2,141	109	5.1%	0.0%
Total	281,269	290,272	235,094	81.0%	100.0%

Note: Landscan data for South Sudan is population in the maize mixed and cereals-root crop mixed FSZs

Table 2. LSMS Data Sets as a Percent of Food Staple Zones

	Rest of Africa Maize Mixed			ESA Cereal-Root Crop			Ethiopian Highlands		
	National	Rural	Urban	National	Rural	Urban	National	Rural	Urban
Ethiopia	19.7%	24.0%	7.1%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
Mozambique	10.1%	5.9%	22.6%	83.5%	81.1%	93.6%	0.0%	0.0%	0.0%
Tanzania	45.8%	39.6%	64.2%	16.5%	18.9%	6.4%	0.0%	0.0%	0.0%
Uganda	24.4%	30.5%	6.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 3. Simulation Scenarios

Scenario	Mean Per Capita Income Growth	Inequality of Growth	Urban Bias
Business as Usual (BaU)	5%	Neutral	Positive
BaU with unfavorable environment	2%	Neutral	Positive
Equitable Growth	6%	Decreasing	Neutral
Equitable Growth with unfavorable environment	4%	Decreasing	Neutral

Table 4. Levels and shares of population and expenditure in total food, cash (marketed) food, and non-food, by income class (2010)

Income Class (PPP$ pc/day	Population		Total Food Expenditure		Cash Food Expenditure		Non-Food Expenditure	
	'000 People	Share	'000 USD/day	Share	'000 USD/day	Share	'000 USD/day	Share
ESA-wide	227,041	1.00	*245,289*	1.00	*123,897*	1.00	*195,450*	1.00
$0-$2	165,991	0.73	114,726	0.47	45,222	0.36	51,265	0.26
$2-$4	**40,333**	**0.18**	**65,920**	**0.27**	**36,263**	**0.29**	**55,080**	**0.28**
$4-$10	**18,091**	**0.08**	**52,925**	**0.22**	**31,472**	**0.25**	**64,177**	**0.33**
$10-$20	**2,626**	**0.01**	**11,718**	**0.05**	**10,939**	**0.09**	**24,928**	**0.13**
>$20								
Rural	176,939	0.78	*174,444*	0.71	*61,546*	0.50	*108,418*	0.55
$0-$2	141,314	0.62	99,080	0.40	32,043	0.26	42,233	0.22
$2-$4	**24,573**	**0.11**	**42,175**	**0.17**	**15,697**	**0.13**	**31,543**	**0.16**
$4-$10	**11,052**	**0.05**	**33,1889**	**0.14**	**13,807**	**0.11**	**34,641**	**0.18**
$10-$20								
>$20								
Urban	50,102	0.22	*70,845*	0.29	*62,351*	0.50	*87,033*	0.45
$0-$2	24,677	0.11	15,645	0.06	13,180	0.11	9,032	0.05
$2-$4	**15,761**	**0.07**	**23,745**	**0.10**	**20,566**	**0.17**	**23,537**	**0.12**
$4-$10	**7,039**	**0.03**	**19,736**	**0.08**	**17,666**	**0.14**	**29,536**	**0.15**
$10-$20	**2,626**	**0.01**	**11,718**	**0.05**	**10,939**	**0.09**	**24,928**	**0.13**
>$20								

Notes: (1) Expenditure figures are total daily expenditure in the region, thus an indicator of size of market. (2) Lack of entries in cells indicates that PovcalNet data allowed no estimation of incomes at that level

Table 5. Total budget shares for food and non-food by level of processing and income class (2010)

Income Class	Own Production	Purchased Food Categories: Unprocessed	Processed Low	Processed High	Total Food	Non-Food
ESA-wide	0.298	0.091	0.184	0.024	0.597	0.403
$0-$2	0.415	0.088	0.171	0.017	0.69	0.310
$2-$4	**0.238**	**0.089**	**0.188**	**0.028**	**0.543**	**0.457**
$4-$10	**0.178**	**0.069**	**0.167**	**0.034**	**0.451**	**0.549**
$10-$20	**0.02**	**0.081**	**0.172**	**0.049**	**0.322**	**0.678**
>$20						
Rural	0.424	0.062	0.139	0.020	0.645	0.355
$0-$2	0.474	0.070	0.141	0.017	0.701	0.299
$2-$4	**0.359**	**0.051**	**0.136**	**0.024**	**0.572**	**0.428**
$4-$10	**0.286**	**0.040**	**0.131**	**0.029**	**0.489**	**0.511**
$10-$20						
>$20						
Urban	0.068	0.144	0.262	0.032	0.506	0.494
$0-$2	0.100	0.188	0.326	0.021	0.634	0.366
$2-$4	**0.067**	**0.142**	**0.261**	**0.032**	**0.502**	**0.498**
$4-$10	**0.042**	**0.107**	**0.211**	**0.04**	**0.401**	**0.599**
$10-$20	**0.021**	**0.080**	**0.171**	**0.047**	**0.32**	**0.680**
>$20						

Table 6. Total budget shares for food in ESA by food category and income class (2010)

Income Class	Cereals, Roots, & Tubers	Pulses	Fresh Produce	Meat, Milk, Eggs, Fish	Beverages	Prepared Foods	Other Foods
ESA-wide	0.286	0.054	0.057	0.097	0.027	0.031	0.044
$0-$2	0.354	0.068	0.066	0.094	0.030	0.034	0.044
$2-$4	**0.248**	**0.046**	**0.051**	**0.100**	**0.026**	**0.029**	**0.044**
$4-$10	**0.188**	**0.033**	**0.041**	**0.099**	**0.024**	**0.028**	**0.039**
$10-$20	**0.100**	**0.019**	**0.035**	**0.089**	**0.023**	**0.025**	**0.032**
>$20							
Rural	0.329	0.062	0.059	0.092	0.029	0.034	0.040
$0-$2	0.368	0.070	0.066	0.090	0.031	0.036	0.041
$2-$4	**0.278**	**0.049**	**0.049**	**0.097**	**0.027**	**0.032**	**0.039**
$4-$10	**0.220**	**0.036**	**0.038**	**0.101**	**0.025**	**0.030**	**0.038**
$10-$20							
>$20							
Urban	0.208	0.041	0.055	0.105	0.024	0.024	0.051
$0-$2	0.282	0.056	0.069	0.115	0.024	0.024	0.065
$2-$4	**0.206**	**0.040**	**0.055**	**0.104**	**0.023**	**0.024**	**0.051**
$4-$10	**0.147**	**0.029**	**0.044**	**0.096**	**0.023**	**0.024**	**0.040**
$10-$20	**0.100**	**0.019**	**0.035**	**0.089**	**0.023**	**0.025**	**0.032**
>$20							

Table 7. Import share in total food expenditure in ESA, by income class (2010)

	Estimated Total Food Import Share Based on:			
	Net Imports		Gross Imports	
Income Class	#1	#2	#1	#2
Region-wide	3.72%	2.23%	11.98%	9.51%
$0-$2	2.51%	1.24%	10.58%	8.49%
$2-$4	4.67%	3.01%	13.03%	10.30%
$4-$10	5.14%	3.27%	13.47%	10.49%
$10-$20	5.88%	3.66%	14.62%	11.03%
>$20				
Rural	1.99%	0.74%	9.92%	7.93%
$0-$2	1.51%	0.36%	9.41%	7.56%
$2-$4	2.78%	1.35%	10.74%	8.51%
$4-$10	3.98%	2.25%	11.95%	9.31%
$10-$20				
>$20				
Urban	7.68%	5.64%	16.70%	13.15%
$0-$2	8.34%	6.36%	17.46%	13.91%
$2-$4	7.70%	5.68%	16.72%	13.19%
$4-$10	6.93%	4.86%	15.83%	12.31%
$10-$20	5.88%	3.66%	14.62%	11.03%
>$20				

Source: FAOSTAT data on imports, exports and commodity balances, together with budget shares computed by authors from LSMS data.

Table 8. Population by income class and rural/urban location in ESA, current (2010) and under four growth scenarios in (2040)

			2040							
	2010		BaU		BaU Unfavorable		EG		EG Unfavorable	
Income Class	'000	Share	'000	Share	'000	Share	'000	Share	'000	Share
ESA-wide	227,041	1.00	442,483	1.00	442,483	1.00	442,483	1.00	442,483	1.00
Poor ($0-$2)	165,991	0.73	20,058	0.05	181,728	0.41	4,930	0.01	28,701	0.06
Floating ($2-$4)	40,333	0.18	152,127	0.34	148,584	0.34	41,006	0.09	167,657	0.38
Lower middle ($4-)$10	18,091	0.08	156,024	0.35	100,154	0.23	241,789	0.55	189,339	0.43
Upper Middle ($10-$20)	2,626	0.01	87,810	0.20	12,017	0.03	108,716	0.25	46,892	0.11
Upper (>$20)			26,463				46,042		9,894	
Rural	176,939	0.78	278,562	0.63	278,562	0.63	278,562	0.63	278,562	0.63
Poor ($0-$2)	141,314	0.62	18,965	0.04	158,998	0.36	3,371	0.01	20,905	0.05
Floating ($2-$4)	24,573	0.11	144,348	0.33	92,059	0.21	32,137	0.07	135,725	0.31
Lower middle ($4-)$10	11,052	0.05	96,442	0.22	27,505	0.06	183,271	0.41	102,360	0.23
Upper Middle ($10-$20)		0.00	18,807	0.04		0.00	42,048	0.10	19,571	0.04
Upper (>$20)							17,736			
Urban	50,102	0.22	163,921	0.37	163,921	0.37	163,921	0.37	163,921	0.37
Poor ($0-$2)	24,677	0.11	1,093	0.00	22,730	0.05	1,559	0.00	7,796	0.02
Floating ($2-$4)	15,761	0.07	7,779	0.02	56,525	0.13	8,869	0.02	31,932	0.07
Lower middle ($4-)$10	7,039	0.03	59,582	0.13	72,649	0.16	58,518	0.13	86,978	0.20
Upper Middle ($10-$20)	2,626	0.01	69,003	0.16	12,017	0.03	66,669	0.15	27,321	0.06
Upper (>$20)		0.00	26,463	0.06		0.00	28,307	0.06	9,894	0.02

Table 9. Total food expenditure by income class in ESA, current (2010) and under four alternative growth scenarios (2040) ('000 USD/day)

		2040			
Income Class	2010	Business as Usual	BaU/ Unfavorable	Equitable Growth	EG/ Unfavorable
ESA-wide	*245,289*	1,412,585	741,448	1,873,044	1,201,831
Poor ($0-$2)	114,726	13,534	131,183	3,288	19,331
Floating ($2-$4)	**65,920**	250,981	240,441	68,318	275,410
Lower middle ($4-)$10	**52,925**	472,377	285,591	782,520	578,918
Upper Middle ($10-$20)	**11,718**	426,533	84,233	560,547	249,362
Upper (>$20)	0	249,160	0	458,371	78,810
Rural	*174,444*	673,198	377,395	1,114,603	688,358
Poor ($0-$2)	99,080	12,853	117,691	2,312	14,189
Floating ($2-$4)	**42,175**	239,477	161,361	55,121	225,621
Lower middle ($4-)$10	**33,1889**	308,397	98,343	620,427	328,178
Upper Middle ($10-$20)		112,471	0	255,025	120,369
Upper (>$20)		0	0	181,718	0
Urban	*70,845*	739,387	364,053	758,441	513,473
Poor ($0-$2)	15,645	680	13,492	976	5,142
Floating ($2-$4)	**23,745**	11,504	79,080	13,197	49,789
Lower middle ($4-)$10	**19,736**	163,981	187,248	162,093	250,740
Upper Middle ($10-$20)	**11,718**	314,062	84,233	305,522	128,993
Upper (>$20)		249,160	0	276,654	78,810

Table 10. Cash (marketed) food expenditure by income class in ESA, current (2010) and under four alternative growth scenarios (2040) ('000 USD/day)

		2040			
Income Class	2010	Business as Usual	BaU/ Unfavorable	Equitable Growth	EG/ Unfavorable
ESA-wide	*123,897*	959,142	474,370	1,143,456	744,853
Poor ($0-$2)	45,222	4,519	47,355	1,577	8,627
Floating ($2-$4)	**36,263**	94,589	130,725	30,605	122,521
Lower middle ($4-)$10	**31,472**	271,014	216,194	374,689	357,087
Upper Middle ($10-$20)	**10,939**	345,928	80,096	386,375	180,023
Upper (>$20)	0	243,092	0	350,211	76,594
Rural	*61,546*	268,049	149,244	432,522	275,991
Poor ($0-$2)	32,043	3,951	36,320	760	4,368
Floating ($2-$4)	**15,697**	84,706	63,483	19,250	79,875
Lower middle ($4-)$10	**13,807**	125,443	49,441	230,598	133,493
Upper Middle ($10-$20)		53,949	0	102,070	58,255
Upper (>$20)		0	0	79,844	0
Urban	*62,351*	691,092	325,127	710,935	468,862
Poor ($0-$2)	13,180	568	11,035	817	4,258
Floating ($2-$4)	**20,566**	9,882	67,242	11,355	42,647
Lower middle ($4-)$10	**17,666**	145,571	166,753	144,090	223,594
Upper Middle ($10-$20)	**10,939**	291,979	80,096	284,305	121,769
Upper (>$20)		243,092	0	270,367	76,594

Table 11. Share of consumed own production in total value of food consumption, 2010 and 2040 under four scenarios

		2040			
Income Class	2010	BaU	BaU Unfavorable	EG	Eg Unfavorable
National	*0.49*	*0.31*	*0.32*	*0.38*	*0.37*
$0-$2	*0.61*	*0.65*	*0.61*	*0.51*	*0.55*
$2-$4	***0.45***	***0.61***	***0.42***	***0.54***	***0.54***
$4-$10	***0.41***	***0.41***	***0.21***	***0.51***	***0.38***
$10-$20	***0.07***	***0.18***	***0.03***	***0.30***	***0.27***
>$20		0.02		0.23	0.02
Rural	*0.65*	*0.58*	*0.58*	*0.60*	*0.58*
$0-$2	*0.68*	*0.68*	*0.67*	*0.66*	*0.68*
$2-$4	***0.63***	***0.63***	***0.58***	***0.64***	***0.63***
$4-$10	***0.58***	***0.57***	***0.47***	***0.62***	***0.57***
$10-$20		***0.50***		***0.59***	***0.49***
>$20				0.55	
Urban	*0.12*	*0.06*	*0.09*	*0.06*	*0.08*
$0-$2	*0.16*	*0.16*	*0.17*	*0.16*	*0.16*
$2-$4	***0.13***	***0.13***	***0.13***	***0.13***	***0.13***
$4-$10	***0.10***	***0.10***	***0.09***	***0.11***	***0.10***
$10-$20	***0.07***	***0.06***	***0.03***	***0.06***	***0.05***
>$20		0.02		0.02	0.02

Table 12. Food budget shares by food item groupings, 2010 and 2040 under four scenarios

		2040			
	2010	Business as Usual (BaU)	BaU w/ Unfavorable Environment	Equitable Growth (EG)	EG w/ Unfavorable Environment
By processing level					
Own production	48.6%	36.8%	38.3%	42.8%	42.4%
Unprocessed	15.7%	16.5%	18.0%	14.0%	15.4%
Processed Low	31.5%	35.7%	36.9%	32.0%	33.6%
Processed High	4.2%	10.5%	6.8%	10.6%	8.4%
By commodity type					
Wheat products	5.4%	5.9%	6.1%	5.5%	5.9%
Maize & maize products	15.8%	9.9%	12.9%	9.2%	11.2%
Sorghum, millet & other cereals	10.6%	9.0%	9.1%	9.8%	9.6%
Rice (Milled Equivalent)	4.9%	5.7%	6.1%	5.4%	5.9%
Cassava	4.3%	1.5%	2.7%	1.2%	1.8%
Roots and tubers	4.4%	3.4%	3.8%	3.3%	3.7%
Plantains	2.4%	1.5%	1.9%	1.4%	1.7%
Sugar & sweets	2.9%	2.8%	3.1%	2.6%	2.8%
Pulses	8.8%	7.3%	8.3%	6.8%	7.7%
Oilcrops & vegetable oils	2.9%	3.2%	3.4%	2.9%	3.2%
Staple vegetables	5.0%	4.4%	5.3%	3.9%	4.5%
Other vegetables	3.1%	2.2%	2.5%	2.2%	2.3%
Fruit	2.1%	3.5%	2.6%	3.8%	3.1%
Non-alcoholic beverage	3.3%	3.9%	3.5%	3.8%	3.7%
Alcoholic beverages	1.4%	2.2%	1.6%	2.3%	1.9%
Beef	4.2%	8.1%	6.1%	8.1%	7.0%
Poultry	2.5%	2.7%	2.7%	2.8%	2.9%
Other meat	2.4%	3.4%	2.7%	4.0%	3.4%
Milk & animal fats	3.4%	3.9%	3.5%	4.0%	3.8%
Eggs	0.5%	0.7%	0.6%	0.7%	0.7%
Fish	3.7%	4.6%	4.4%	4.2%	4.2%
Prepared foods away from home	4.5%	8.4%	5.5%	10.2%	7.5%
Other foods	1.7%	1.7%	1.6%	1.8%	1.7%
By food/non-food	0.0%	0.0%	0.0%	0.0%	0.0%
Food	57.6%	40.1%	50.7%	39.4%	46.2%
Non-food	42.4%	59.9%	49.3%	60.6%	53.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Table 13. Total expenditure on food by food item groupings, 2010 and 2040 under four scenarios ('000'000 PPP USD, 2010)

		2040			
	2010	Business as Usual (BaU)	BaU w/ Unfavorable Environment	Equitable Growth (EG)	EG w/ Unfavorable Environment
By processing level					
Own production	$123.06	$549.37	$302.36	$834.46	$547.71
Unprocessed	$39.86	$246.69	$142.40	$273.50	$198.43
Processed Low	$79.88	$532.44	$291.15	$623.83	$433.67
Processed High	$10.64	$156.29	$53.51	$207.44	$108.33
By commodity type					
Wheat products	$13.76	$88.65	$48.49	$107.27	$75.89
Maize & maize products	$39.92	$147.90	$101.86	$178.50	$144.21
Sorghum, millet & other cereals	$26.79	$135.02	$71.51	$191.90	$123.38
Rice (Milled Equivalent)	$12.32	$85.79	$48.26	$105.83	$75.97
Cassava	$11.02	$22.93	$21.71	$22.44	$22.60
Roots and tubers	$11.24	$50.23	$30.16	$64.31	$47.48
Plantains	$6.13	$22.30	$14.84	$27.54	$21.94
Sugar & sweets	$7.39	$41.51	$24.69	$49.74	$36.61
Pulses	$22.23	$109.01	$65.29	$132.71	$99.07
Oilcrops & vegetable oils	$7.40	$47.32	$26.70	$56.73	$40.71
Staple vegetables	$12.56	$66.00	$41.63	$76.25	$58.22
Other vegetables	$7.74	$32.85	$19.48	$42.72	$29.14
Fruit	$5.28	$51.67	$20.31	$74.37	$40.13
Non-alcoholic beverage	$8.28	$58.89	$27.95	$74.92	$47.67
Alcoholic beverages	$3.48	$32.34	$12.61	$45.44	$24.70
Beef	$10.74	$120.21	$48.08	$157.78	$90.81
Poultry	$6.23	$40.70	$21.47	$55.50	$37.26
Other meat	$6.03	$51.48	$20.95	$78.20	$43.49
Milk & animal fats	$8.55	$57.76	$27.42	$77.06	$48.75
Eggs	$1.21	$10.81	$5.08	$14.46	$9.03
Fish	$9.40	$68.82	$35.08	$80.90	$54.83
Prepared foods away from home	$11.51	$124.67	$43.31	$199.32	$96.85
Other foods	$4.23	$25.75	$13.00	$35.33	$21.54
By food/non-food	$0.00	$0.00	$0.00	$0.00	$0.00
Food	$253.44	$1,492.64	$789.87	$1,949.23	$1,290.25
Non-food	$186.28	$2,233.50	$768.94	$3,002.04	$1,502.22
Total	$439.71	$3,726.14	$1,558.80	$4,951.26	$2,792.48

Appendix IV. South and South East Asia Workshop Debrief Presentation / USAID India

Debrief Document

Food Systems Innovation in South and South East Asia Workshop

Higher Education Solutions Network (HESN)

Global Center for Food Systems Innovation and The Energy and Resources Institute India

New Delhi, India
December 20, 2013

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MICHIGAN STATE UNIVERSITY

The Global Center for Food Systems Innovation (GCFSI) a development lab of Michigan State University (MSU) part of the Higher Education Solutions Network (HESN), along with its partner The Energy and Resources Institute of India (TERI) conducted a 2 day workshop to discuss food systems innovation in the South and South East Asia Context

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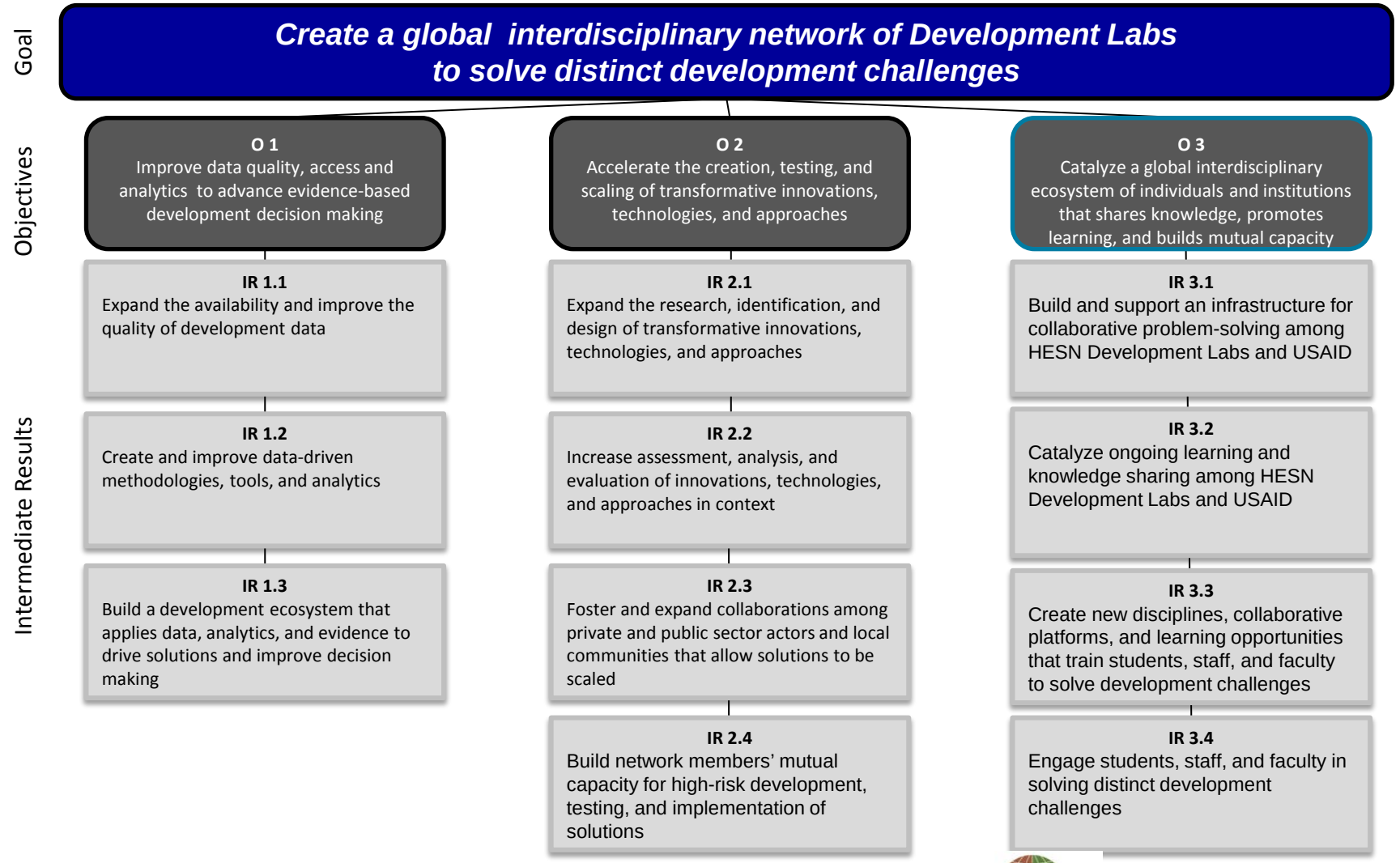
The Higher Education Solutions Network (HESN) was established in November 2012 to solve development challenges through innovation and collaboration



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The eight Development Labs in HESN in different sectors and at different points in the innovation pipeline

Summary of Development Labs

Lead Institution	Development Lab	Goal of Lab	Funds
College of William & Mary	AidData Center	Enable the international development community to improve **geographic** targeting, planning, and coordination of development programs.	$25 M
University of Cal. - Berkeley	Development Impact Lab	Design, evaluate and scale innovative **technological breakthroughs** in energy, health and information and communication technology	$25 M
Duke University	Social Entrepreneurship Accelerator at Duke	Identify and support successful innovations in achieving greater and more cost-effective **health care** and preventive services	$10
Makerere University	Resilient Africa Network	Innovate and accelerate science and technology based development tools to improve African resilience to stresses and strains	$25 M
Michigan State University	Global Center for Food Systems Innovation	Create, test, and enable scaling of solutions and evidence-based approaches to a defined set of future critical global trends impacting **food systems**	$25 M
MIT	Comprehensive Initiative on Technology Evaluation	Develop a methodology for evaluating technological solutions to challenges in the developing world	$15 M
MIT	International Development Innovation Network	Establish global network of **local innovators** who are using technology to address issues facing people living in poverty	$10 M
Texas A&M University	Center on Conflict & Development	Inform more deliberate development programs and policies for **fragile and conflict-affected** states	$6 M

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Year One Progress

- Launched AidData in Nepal (W&M)
- Piloted evaluation methodology on solar lanterns in Uganda (MIT - CITE)
- Held International Development Design Summit in Tanzania and Zambia (MIT - IDIN)
- Selected and engaged a pipeline of 13 global health innovator (Duke)
- Developed white papers on food system megatrends and issued RFAs for Innovation Grants (MSU)
- Established four Resilience Innovation Labs in Uganda, Ethiopia, Ghana, and South Africa (MU)
- Hosted a Conflict and Development workshop (TAMU)
- Held the Big Ideas conference (Berkeley

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There are numerous ways for missions to engage with HESN Development Labs

Potential engagement opportunities

- Buy-in to lab activities
- “Problem sets” to drive research efforts
- Ad-hoc guidance from labs and technical feedback to labs
- Fellowships with Development Labs
- Utilize tools developed by labs (e.g. DSI, AidData)

After one year of operations, the workshop was aimed at launching GCFSI second year operations in South and South East Asia

- GCFSI, one of eight development labs of the HESN, focused its first year of operations on conducting research in the area of food systems innovations in East Africa
- During December 17 and 18, GCFSI with its partner TERI, conducted a workshop to launch operations in South and South East Asia
- Guests included representatives from the food systems sector from Thailand, Nepal, Sri Lanka, Vietnam and India
- The team focused on presenting work to date and on engaging local and regional stakeholders to discuss local and regional needs
- During the 2 days of conversations, we were able to learn about local and regional priorities, establish solid links to regional stakeholders and identify common themes in the area of food systems in the region

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The goal of the climate change group is to gently nudge agricultural systems through applied science and innovation

- Climate models reliably predict temperature, but precipitation less so
- Future agricultural production demands will require intensification, and may, given climate change, require extensification
- There are many isolated investments in production (genetics, natural resource management and markets) but these are incremental solutions and, in isolation, tend to underperform
- In south and southeast Asia, most research has focused on rice agricultural systems and largely on intensification
- Land availability, tenure, and farm size remain important regional issues
- Climate change is now negatively impacting rice production in the Mekong river system and general food production in Nepal

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Technology has proven beneficial but not every initiative has had desired impact in the area of food systems innovation

- Almost everyone has a mobile and mobiles have penetrated into most communities
- Farmers' needs for information vary according to the different stages in the production cycle: from basic know-how when planning crop planting, to contextual information like weather information during crop growth, to market information during harvesting and selling
- Women face unequal access to ICTs and ICT-based services, which can have significant impacts on the food system because of the growing "feminization" of agriculture
- In addition, simply possessing a phone is just not enough to ensure that smallholder farmers will benefit from ICT-based services
- Two myths about technology are: (a) build and they will come; and (b) availability of market information leads to efficient markets and better prices.
- Some areas related to ICTs on which we should focus:
  - Better access to financial services, including microloans, insurance, and payments through mobile money
  - Ensuring investment in infrastructure to cater to the needs of smallholders in rural areas
  - Developing standards to better evaluate and improve smallholder output quality to improve the work of intermediaries and ease buyer-seller matching
  - Ensuring appropriate long term incentives for agricultural business stakeholders to encourage adoption and use of ICTs in ways that benefit smallholders as well as other participants

Structural changes and new linkages are needed in the workforce development systems to meet emerging food security needs

- Evolution of skills is not just related to higher education but it also includes, continuing education, vocational/ technical education, workforce development
- Need to understand the capacity of higher education to address food system challenges
- Continuing education needs to provide professional development and address a diverse number of issues such as feminization of agriculture
- Systems are not adequately preparing students with employable skills to help them enter into workforce
- There is a gradual shift of workforce to the private sector
- There is a shift from production to post production industry and therefore there is an emphasis on new skills that will be required, with a joint effort by multi-stakeholder… collaborative decision making

The region has a growing feminization of agriculture

- The percentage of women labor workforce is increasing specially in the south-east and South Asia. Women farmers account for 45-50 %
- In the past, there was a clear cut demarcation of work allocation but now women are increasingly taking more role and responsibility in the agriculture
- Women's work is not monetized, and women's role not recognized and counted
- Climate change adds pressure to traditional resources and this adds burden on women.
- Pressure on women as men migrate, leads to increase in food prices and girl child health affected
- Women have fewer resources, access to inputs and services, land rights, water rights, hold on livestock and technology, credit, etc.
- Farms headed by women are smaller, less likely to use purchased inputs and undefined water rights
- Women can be active agents of change
- Generally in policies, the gender differences are incorporated at a later stage. The issue of gender, food security, etc., all operate in separate silos and are separate areas of concern

Core and final findings of the workshop

- It is necessary to raise the skills of the people engaged in agriculture and in innovation in the food value chain
- Institutions, educational programs and their curriculums are important parts of this process
- There needs to be a re-evaluation and understanding of the access of women to resources, inputs, credits etc.
- We need a better understanding of how individuals respond to technology
- Understand policy issues- how they might unintentionally hinder the development of innovation
- Understand the incentives for youth to engage in the food system and agricultural production through training, education, employment etc.
- Better engagement of the private sector is necessary successful innovation
- Food security is a national level issue, thus there is a need to promote solutions at household level
- Important to understand and incorporate cultural considerations in innovations
- Need to keep focused on the scope of the work

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Questions?

Contacts

USAID

Kenneth Scheffler
Office of Science & Technology | USAID
Phone: (202) 712-4863
E-mail: kscheffler@usaid.gov

TERI

Dr. Nutan Kaushik
Senior Fellow and Area Convenor,
Phone: 91-11-24682100/ 24682111
Email: kaushikn@teri.res.in

Michigan State University / Global Center for Food Systems Innovation

Ajit Srivastava, Ph.D
Professor and Chair
Biosystems and Agricultural Engineering
Phone: (517) 353-7268
E-mail: srivasta@msu.edu

Reitu Mabokela, Ph.D
Assistant Dean, International Studies in Education
Department of Educational Administration
Phone: (517) 353-6676
E-mail: mabokela@msu.edu

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