

**CGIAR Science Forum 2013
Breakout Session 9**

**Farm Size, Urbanization and the
Links from Agriculture to Nutrition and Health**

Will Masters

Professor and Chair, Department of Food and Nutrition Policy
Friedman School of Nutrition, Tufts University

<http://nutrition.tufts.edu>
<http://sites.tufts.edu/willmasters>



24 September 2013



Components of the ISPC Foresight Study

- **Five commissioned background papers**
 - Asia: Tom Reardon
 - Africa: Thom Jayne
 - Livestock: Cees de Haan
 - Geography: **Agnes Andersson-Djurfeldt** & Magnus Jirström
 - Cross-cutting: Peter Hazell
- **Fifteen discussants in a 2-day workshop, Jan 25-26**
 - Awudu Abdulai, Deborah Balk, Derek Byerlee, Cheryl Doss, **Ken Giller**, Margaret McMillan, Clare Narrod, Jerry Nelson, Kei Otsuka, Carl Pray, Agnes Quisumbing, Bharat Ramaswami, Anita Regmi, Steve Staal, Steve Wiggins
- **Active participation of ISPC**
 - Ken Cassman, **Doug Gollin**, Tim Kelley & Rashid Hassan



Main Conclusions in One Slide

- Global agriculture is increasingly diverse, along two main axes:
 - **Commercialization: *dynamic vs. hinterland zones***
 - “Quiet revolution” from low transport cost to ports and cities, even as many farmers remain in hinterland areas,
 - big differences for input use and role of agribusiness
 - **Resource ownership: *farm size (area, animals, resources/hhld)***
 - “Farm size” is tailored to family enterprise for most crops, despite scale economies in processing & marketing
 - family-size farms vary in area/worker and mechanization demography drives trends in *average* area/worker
- === > *Research on agriculture to improve nutrition & health should be tailored to diversity and change in farm size and commercialization, as well as climate change etc.***



Implications of Farm Size for Nutrition and Health

- **Targeting of Agricultural R&D and Extension**

- Level of productivity and farm income
- Level of commercialization and sales
- Mix of foods and nutrients
- Mix of activities and child care

Strong link with farm size
+ access to markets

Weaker link
with size &
mkt. access

Gender, demography,
and wealth have
strong link to all four

==> Need to focus on the poorest end-users, who are most at risk while non-ag interventions needed for other hhlds

- **Design and Evaluation of Agricultural Interventions**

- Need realistic objectives/results/outcomes
 - Anticipate trends & differences in confounders (eg farm size)
 - Anticipate behavioral responses (substitution, diversification)
- Need appropriate evaluation methods

External validity

Internal validity

== > Need interventions and studies tailored to agri-health as opposed to pharmaceutical and health care services



Main Conclusions: Commercialization

- ***In “dynamic” zones along transport routes***
 - productivity growth relies on local agribusinesses even as farm size remains tailored to family enterprise
 - => CGIAR research should aim to equip competing input suppliers and product marketers with increasingly productive innovations
- ***In “hinterland” zones facing high transport costs***
 - productivity can grow but from a low base, initially few inputs
 - => CGIAR research should aim to accelerate growth with public domain technologies adapted to farmers’ needs
- ***Watch out for exceptions and transitions as dynamism spreads***
 - it is difficult to predict the path of commercialization
 - => CGIAR can and should drive productivity growth in both dynamic and hinterland areas to achieve poverty reduction, nutrition improvement and environmental sustainability.



Main Conclusions: Resource Ownership

- ***Most crops need family-size farms, whether small or large***
 - Farm size is tailored to family enterprise for most crops, because cost of supervising workers offsets scale economies in machinery and management
 - => Average farm size = land area / number of farm families, even as families diversify and then migrate as fast as possible
 - => Heterogeneity arises from land quality and family assets
- ***Many investor-owned farms fail, but they sometimes succeed***
 - Large enough scale economies in machinery and management usually only in on-farm processing (e.g. tea, sugar, oil palm) or packaging for transport (e.g. cut flowers, high-value veg.) or easy supervision (e.g. livestock exc. dairy, some crops)
 - => Innovations can expand investor-owned farming (e.g. with GPS on variable-rate equipment) but is very difficult to do.



Main Conclusions: Resource Ownership

- ***In Asia, family-size farms are growing (from very small now!)***
 - Slowdown in total population growth + continued urbanization leads to negative rural population growth, rising land/farmer
 - => In dynamic zones, output per farmer can rise very fast; in hinterlands, farmers must mechanize or migrate
- ***In Africa, family-size farms are getting smaller***
 - Slow fall in total population growth + recent urbanization leads to slowing but still rapid rural population growth
 - => In some regions, cropped area can still expand but most farmers experience falling land/farmer

====> Most Asian farmers seek labor-saving innovations, whereas most African farmers seek to *increase* labor/hectare



Main Conclusions: Next steps

- **“Big data” projects with high spatial resolution and rich data structures are needed for both targeting and evaluation**
 - Need to measure commercialization and resource ownership as well as agroecological conditions
 - Need to capture rapid expansion of dynamic zones , technological innovation as well as climate change
- **Heterogeneity and rapid change create new opportunities**
 - The world’s remaining hinterland, resource-poor farmers need the CGIAR more than ever
 - The growing areas of dynamic but still low-income farmers can use the CGIAR more effectively than ever
 - With new measurement tools, both targeting effectiveness and impact measurement can continue to improve



Data and methods behind our conclusions

*Average farm sizes are starting to grow in Asia,
but will continue to shrink in Africa*

Table 1: Trends in rural population, 1970 to 2050, Asia and Africa

	<u>Average annual rate of change (%)</u>		
	1970-2011	2011-2030	2030-2050
Asia	+0.85	-0.35	-0.83
Africa	+1.97	+1.35	+0.63

Source: Hazell 2013, from UN data.

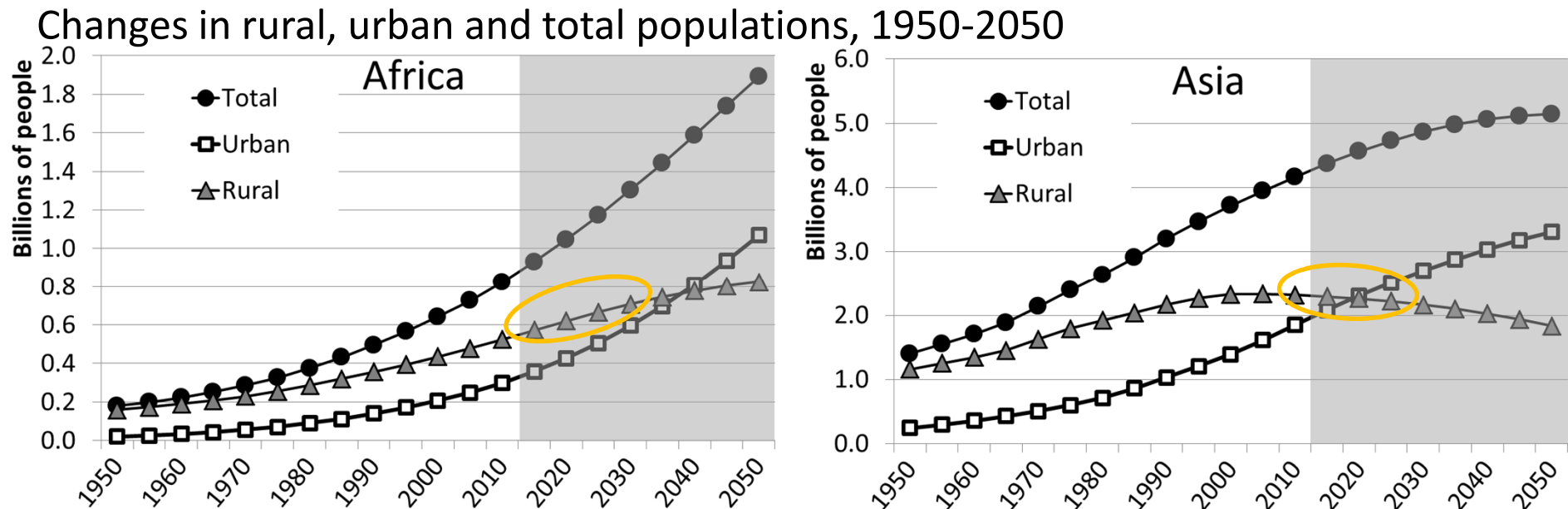
How accurate is this forecast?

- UN population projections are imperfect, but their biases probably understate the Asia-Africa difference;
- Places and people vary around regional trends, but regional rural population growth does drive change in average labor-to-land ratios and hence farm size



Data and methods behind our conclusions

*Average farm sizes are starting to grow in Asia,
but will continue to shrink in Africa*



Source: Adapted from Jayne, 2013 from United Nations (2012), World Urbanization Prospects: The 2011 Revision, online at <http://esa.un.org/unup>.)

Data and methods behind our conclusions

Farmers diversify and migrate as fast as possible to nonfarm work, but opportunities are limited

Migration between major administrative regions, 2002

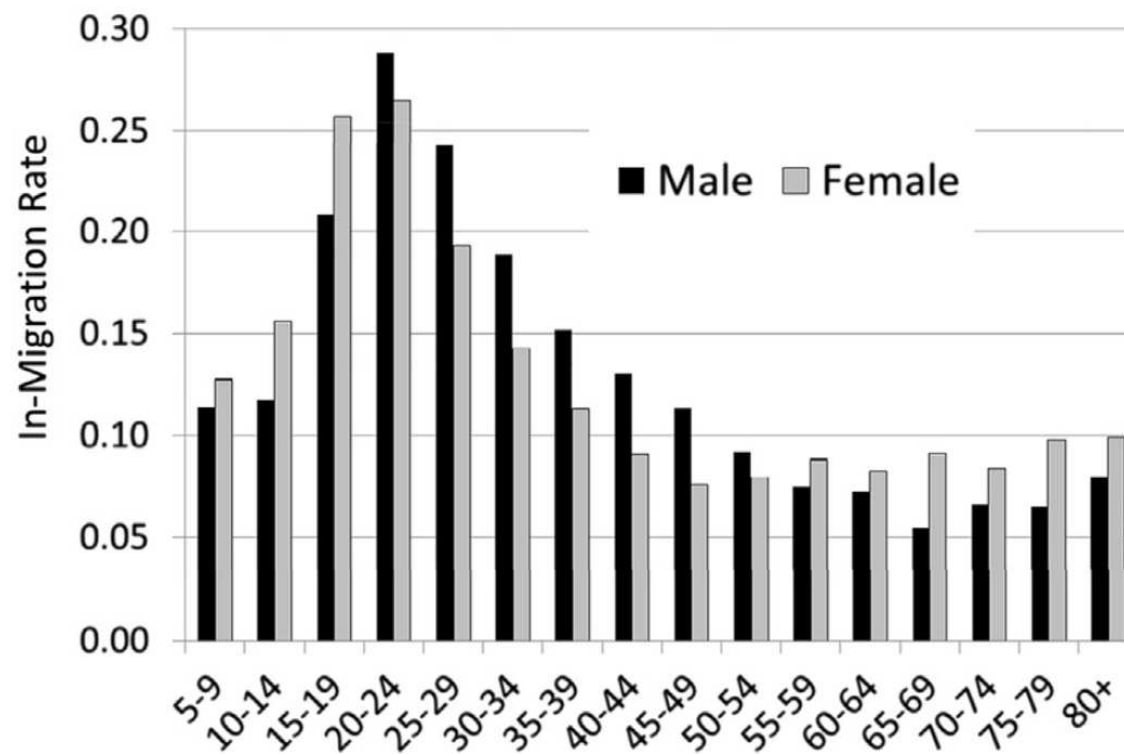


Fig. 2. Urban in-migration rate by age and gender in Uganda.
Source: Balk (2013), from Uganda census data.



Data and methods behind our conclusions

The total number of farmers and total land area is largely fixed, so expanding some farms implies that others will shrink

Country (year of survey)	(a) Sample size	(b) Mean farm size (ha)	(c) Farm Size (hectares per capita)					(d) Gini Coefficients		
			Mean	Quartile				Land per household	Land per capita	Land per adult
				1	2	3	4			
Kenya, 1997	1146	2.28	0.41	0.08	0.17	0.31	1.10	0.55	0.56	0.54
Kenya, 2010	1146	1.86	0.32	0.07	0.12	0.25	1.12	0.57	0.59	0.56
Ethiopia, 1996	2658	1.17	0.24	0.03	0.12	0.22	0.58	0.55	0.55	0.55
Rwanda, 1984	2018	1.20	0.28	0.07	0.15	0.26	0.62	--	--	--
Rwanda, 1990	1181	0.94	0.17	0.05	0.10	0.16	0.39	0.43	0.43	0.41
Rwanda, 2000	1584	0.71	0.16	0.02	0.06	0.13	0.43	0.52	0.54	0.54
Malawi, 1998	5657	0.99	0.22	0.08	0.15	0.25	0.60	--	--	--
Zambia, 2001	6618	2.76	0.56	0.12	0.26	0.48	1.36	0.44	0.50	0.51
Mozambique, 1996	3851	2.10	0.48	0.1	0.23	0.4	1.16	0.45	0.51	0.48

Most farms got smaller... even as sometimes, the biggest get bigger

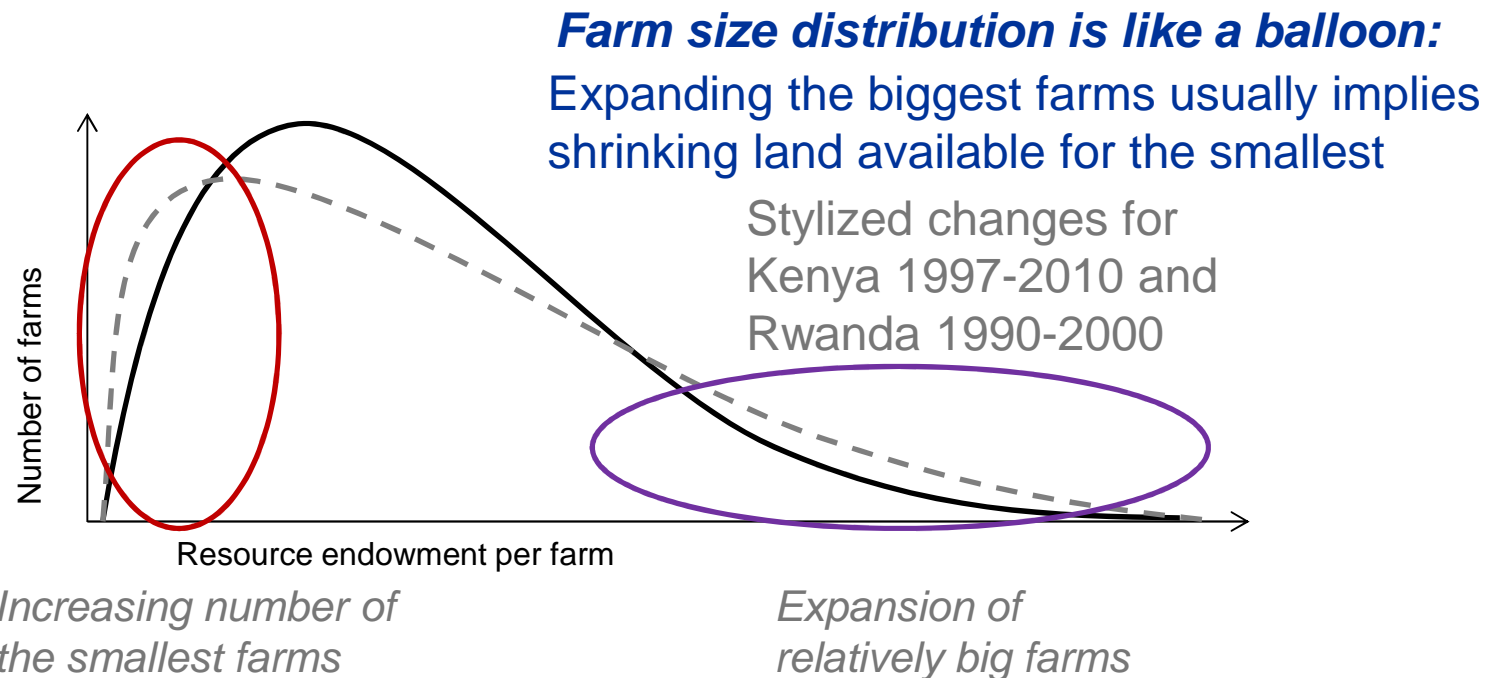
Source: Jayne 2013, from various household surveys. *and land distribution becomes more skewed*



Data and methods behind our conclusions

*The number of farmers is fixed by demography & off-farm opportunity
and available land area is fixed by nature & infrastructure*

Typical distribution of farm sizes (e.g. lognormal)

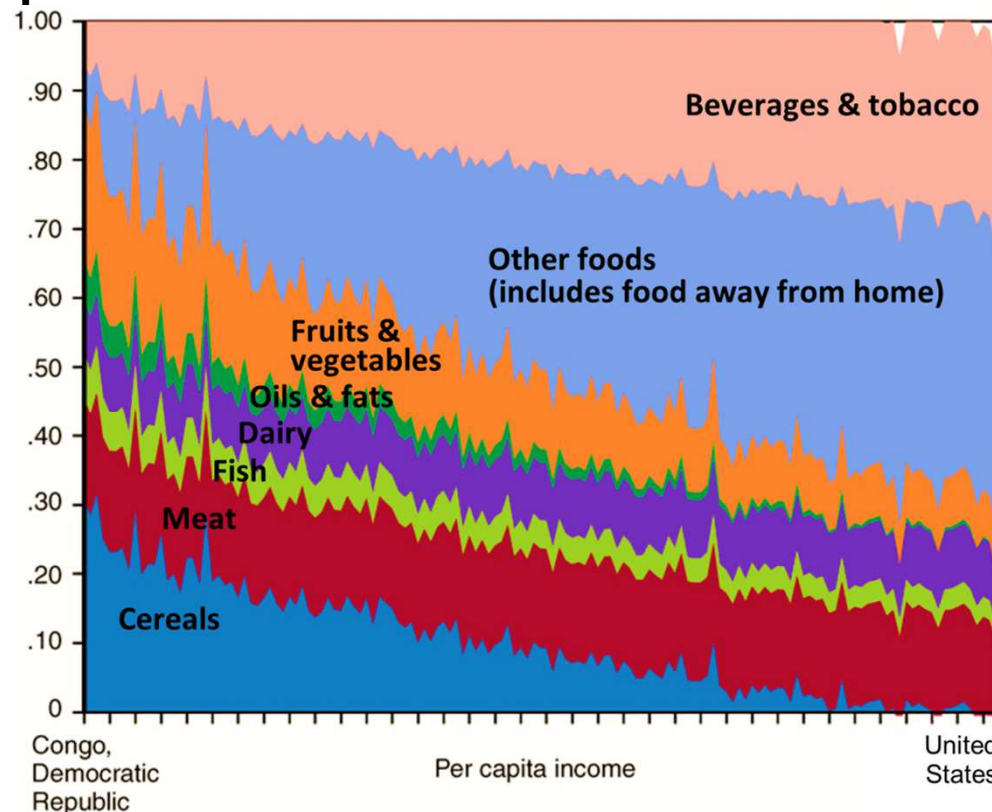


Source: Adapted from Giller (2013)

Data and methods behind our conclusions

*A dollar of income growth raises demand for starchy staples
& FFV more in poorer settings than in richer settings*

Composition of one additional dollar of food expenditure across 144 countries,
ranked by per-capita income

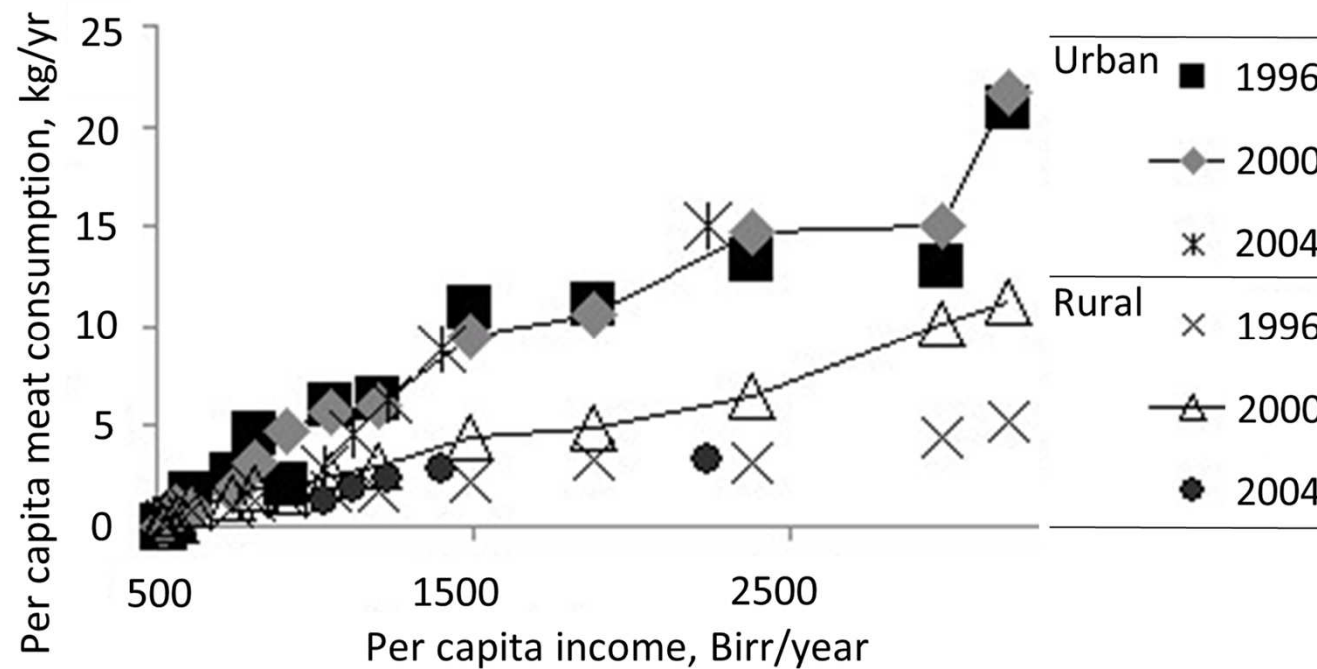


Source: Regmi (2013), from Muhammad et al. (2011)

Data and methods behind our conclusions

*Urbanization and income growth raises demand
for meat even in the poorest countries*

Meat consumption and income in Ethiopia by urban/rural residence, 1996-2004



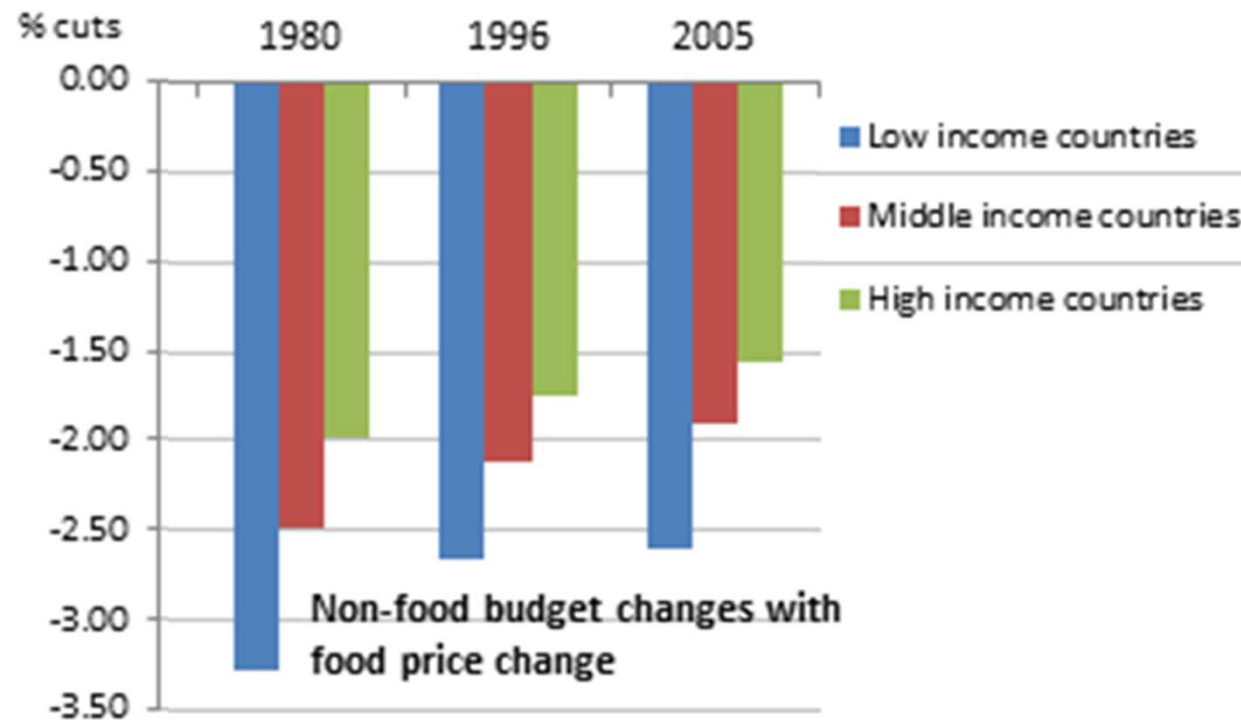
Source: De Haan (2013)



Data and methods behind our conclusions

Food productivity growth to lower food prices drives demand for non-food items and hence off-farm opportunities

Effect of a 10% rise in food prices on non-food expenditure



Source: Regmi (2013)

Data and methods behind our conclusions

Innovation and productivity growth drive diversification and migration to nonfarm work, as well as agricultural output growth

Transition matrix from small farm groups

Note: X = desired transition

Initial type of farm (Period t)	Desired Transition (Period t+1)		
	Commercial	Large Farm	Nonfarm
Subsistence	X		X
Commercial	X	X	X
Transitional			X

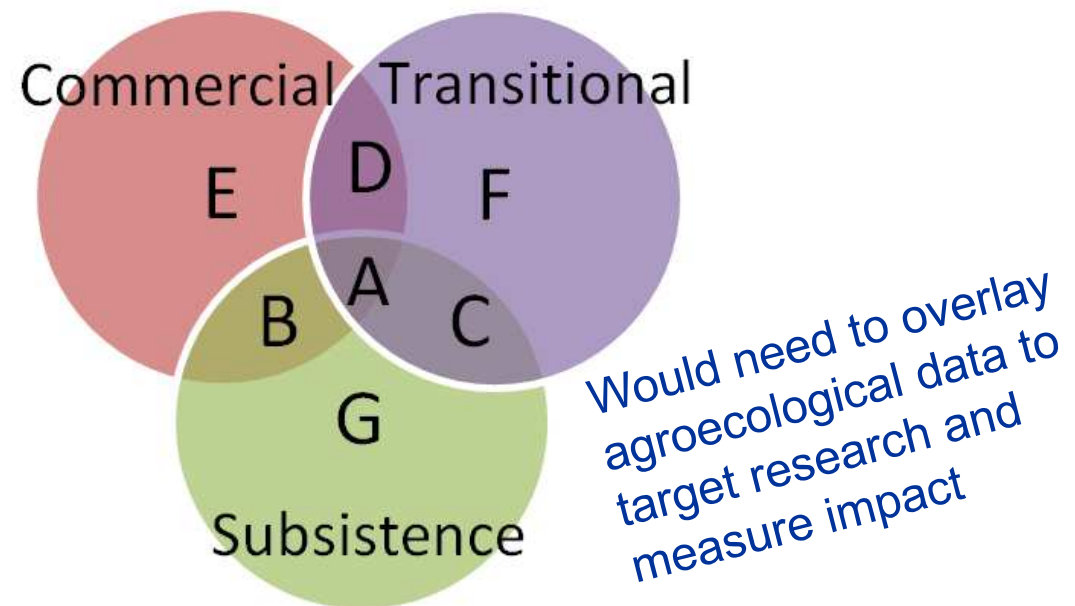
Source: Adapted from Hazell (2013)



Data and methods behind our conclusions

*Differences in commercialization and resource ownership
make for a patchwork of CGIAR research targets*

Targets for innovation by commercialization level



Source: Adapted from Hazell (2013)

Back to Main Conclusions: Next steps

- **“Big data” projects with high spatial resolution and rich data structures are needed for both targeting and evaluation**
 - Need to measure commercialization and resource ownership as well as agroecological conditions
 - Need to capture rapid expansion of dynamic zones , technological innovation as well as climate change
- **Heterogeneity and rapid change create new opportunities**
 - The world’s remaining hinterland, resource-poor farmers need the CGIAR more than ever
 - The growing areas of dynamic but still low-income farmers can use the CGIAR more effectively than ever
 - With new measurement tools, both targeting effectiveness and impact measurement can continue to improve



Publications to date:

All papers: www.sciencecouncil.cgiar.org/sections/strategy-trends

Synthesis paper: [Global Food Security](#) 2(3), September 2013

And now:

Presentations and discussion today

Agnes Andersson Djurfeldt, Lund University

Geographic and Demographic Perspectives

Doug Gollin, Oxford University and ISPC

Economic Perspectives

Ken Giller, Wageningen University

Farming Systems and Agronomic Perspectives

Plus your views

Reported back to plenary this evening



Implications of Farm Size for Nutrition and Health

- **Targeting of Agricultural R&D and Extension**

- Level of productivity and farm income
- Level of commercialization and sales
- Mix of foods and nutrients
- Mix of activities and child care

Strong link with farm size
+ access to markets

Weaker link
with size &
mkt. access

Gender, demography,
and wealth have
strong link to all four

==> Need to focus on the poorest end-users, who are most at risk while non-ag interventions needed for other hhlds

- **Design and Evaluation of Agricultural Interventions**

- Need realistic objectives/results/outcomes
- Anticipate trends & differences in confounders (eg farm size)
- Anticipate behavioral responses (substitution, diversification)
- Need appropriate evaluation methods

External validity

Internal validity

== > Need interventions and studies tailored to agri-health as opposed to pharmaceutical and health care services

