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Policy Issues Facing the Food, Agriculture and Rural Sectors and Implications for Agricultural Statistics

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Introduction

Food, agriculture and rural policy issues occupy a central place for national governments and international organizations. Their importance is illustrated by headlines in newspapers and internet discussions as well as political events including the first meeting of Ministers of Agriculture of the G8 in April 2009 to discuss the global food crisis and the content of the Millennium Development Goals (MDGs). The policy issues encompass not just food production, but the rural economy, household incomes and environmental issues such as water quality, water availability, and climate change.

Coincident with the visibility of agricultural issues, has been higher levels of accountability and initiatives to measure impact with quantitative indicators. The MDGs provide one example. This confluence of policy importance and the desire for quantitative indicators has brought scrutiny to basic data on food production, rural incomes, and land use. Beyond providing indicators, economists and other social scientists have research underway to assess the causal factors and responses to policies. The goal of our paper is to discuss the key issues and research approaches that shape the kinds of data required.

As a preview to the conclusions, two themes emerge. One is the importance of indicators that capture the distribution of the population. Experience in the U.S. shows that the average or mean of many indicators mask differences that matter. For example, of the 70 thousand farms with milk cows in 2007, the average dairy farm has 133 cows, but 2.3 percent of farms with 1000 cows or more produced 42 percent of all dairy product sales. Similarly, in Brazil, 40 percent of the largest farms (with 26 hectares or more) account for over three-quarters of total grain, oilseed, and meat production. Ignoring the distribution of economic activity can lead to unintended consequences for a policy to provide assistance to small farms and fails to provide information about the extent of the farm population in poverty. A second is the need to understand individual decisions. For example, what factors influence farmers' decisions about adoption of new technologies? What determines whether farmers transform tropical forests to agricultural lands or, vice versa, plant trees on crop or pasture land? How will farmers respond to policy incentives which subsidize input use?

A final point that we would like to discuss is working closely with data users to ensure that the investments made in strengthening food and agriculture data pay dividends in the long run.

Key policy issues

The MDGs highlight the issues driving the demand for high quality data for agriculture and rural areas. For each goal, indicators have been developed to track progress and guidance is given that, "All indicators should be disaggregated by sex and urban/rural as far as possible." Two of the goals, their targets, and indicators illustrate the policy issues driving the demand for high quality statistics. Two key aspects of these and other indicators are a focus on poverty and income and on natural resources such as land and water. These translate directly into demand for high quality agricultural statistics as the sector is a major source of employment, income, and food for people in developing countries. In most countries, more land and water resources are devoted to agriculture than any other use.

Goal	**Selected target**	**Selected indicator**
1: Eradicate Extreme Poverty & Hunger	Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day	Proportion of population below $1 (PPP) per day
	Halve, between 1990 and 2015, the proportion of people who suffer from hunger	Proportion of population below minimum level of dietary energy consumption
7: Ensure Environmental Sustainability	Immediate action is needed to contain rising greenhouse gas emissions	Proportion of land area covered by forest
	Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss	Proportion of total water resources used

A global consensus has emerged that meeting these and other MDG's requires investments in agriculture and the rural sector. These points are made by diverse organizations including The World Bank, Oxfam International, and African Union. For example, the World Bank's *World Development Report 2008* makes a case for the importance of rural areas and agriculture based on where people live and the location of resources.

> Three out of four poor people in developing countries—883 million people—lived in rural areas in 2002. Most depend on agriculture for their livelihoods, directly or indirectly. (page 26) … It is a major user of scarce natural resources (85 percent of the developing world's fresh water withdrawal and 42 percent of its land) and a largely unrecognized provider of environmental services (sequestering carbon, managing watersheds, and reducing deforestation). (page 28)

In 2007, 64 percent of the population in Sub-Saharan Africa resided in rural areas, compared to less than one-quarter of the population in more developed countries. Moreover, between 2007 and 2025, it is projected that the rural population worldwide will increase by 1.5 percent, but in Sub-Saharan Africa, the rural population will increase by 26.4 percent (see Figure 1). Research findings published in the *World Development Report* go further and link investment in rural and agriculture to higher rates of overall economic growth.

A report by Oxfam International points to the importance of investments in smallholder agriculture. "The recent sharp increase in food prices should have benefited millions of poor people who make their living from agriculture. … To help farmers get out of poverty while protecting poor consumers, developing country governments should invest now into smallholder agriculture and social protection."

Here in Maputo in July 2003, at the Second Ordinary Assembly of the African Union, African Heads of State and Governments endorsed the "Maputo Declaration on Agriculture and Food Security in Africa" (Assembly/AU/Decl. 7(II)). The Declaration contained several important decisions regarding agriculture but prominent among them was the "commitment to the allocation of at least 10 percent of national budgetary resources to agriculture and rural development policy implementation within five years". Earlier this year, at a meeting of experts organized by the African Union, the final report emphasized the importance of building productivity and resilience in agricultural systems given the fact that climate variability and change is critical to the agricultural development agenda.

Agricultural statistics key to making smart investments

The current consensus marks a reversal from the recent past where agriculture and rural areas were low priorities for investments. Policy makers had questioned the value of investments in these sectors as the historical record shows that agriculture and rural decline in importance in the process of economic growth. The new attention and funding for investments has given rise to questions about the best ways to spur gains in productivity and reductions in poverty. Do the best opportunities lie with public sector agricultural research, infrastructure, human capital or other alternatives? We have the luxury in this paper to only raise, and not answer, questions that would inform investments.

- What are the determinants of agricultural productivity growth? What factors influence producer adoption of new technologies or management practices? What is the role of gender?
- What is the future of small farms in the developing world? What investments support small farms and what investments have unintended consequences of limiting opportunities for small farms?
- How do subsidies to raise prices and/or subsidies to lower input prices such as fertilizer subsidies affect production, prices, and incomes?

- How do investments in alternative energy, including biofuels, affect land and resource use and farm incomes?
- How do future changes in climate affect the value and optimal choice of research investments?

The rest of this paper covers the types and dimensions of agricultural statistics that are required for research that informs these questions. As researchers and economists, we are greedy consumers of data and want to know as much as possible about individuals (demographics and geo-coded data) and how the data aggregate into a national and international picture. The data required covers not just quantities of commodities produced, but also information about the resources used, incomes of producers, and similar information about rural residents.

Figure 2 provides a schematic of these linkages where farm households form a subset of all households and farm businesses are both associated directly with households and also organized as independent operations with multiple owners. Farm businesses produce crops, livestock, and increasingly inputs into energy production. Connected to these households and businesses are the resources, communities, and inputs. The importance of having a broad set of data is consistent with the importance of data integration in the strategic plan. These linkages, and hence the appropriate type and degree of integration, vary by country where one can contrast the U.S. with less than 2 percent of the population residing on farms versus much larger shares for many developing countries.

Distribution, not just mean, inform policy issues

Measurement of individual, household, sector and national income represent critical indicators to track economic activity and underpin many of the MDGs. To provide consistent measures, the U.N. System of National Accounts and related national accounts for individual countries are typically developed as aggregate indicators. For example, gross domestic product (GDP) is a commonly reported aggregate economic indicator for the U.S. economy and net farm income is an aggregate indicator commonly reported to--and commonly used by--U.S. policy makers concerned about the agricultural sector. Current levels of aggregate indicators are useful in the context of previous or forecasted levels to provide a gross indicator of how the economy is faring compared to the past situation or expectations for the current period. Current indications of an indicator like net farm income lead analysts and policy makers to subsequent questions about its components. Are changes in levels (from past levels or current expectations) the result of changes in commodity prices, production levels, input prices, pest pressure, weather, government policies—domestically or internationally? Each of the costs and returns which comprise an income statement in a system of national accounts are typically developed at the aggregate level, such as the value of wheat production or the expense for fertilizer. This system allows an analyst or policy maker to develop an understanding of changes in net farm income through changes in the value of commodity production and the cost of production inputs at the sector level. In the U.S., economists in the Economic Research Service (ERS) of U.S. Department of Agriculture (USDA) develop aggregate

indicators of net farm income using a variety of statistics, mostly with origins in the statistical programs of the National Agricultural Statistics Service (NASS), USDA.

The value of national accounts for a variety of purposes cannot be disputed. One of the ways that national accounts are utilized is to examine how value added is distributed to the factors of production: land, labor, capital, and the entrepreneurship of management. Furthermore, in the U.S., returns to management are further distributed to farm operators and contractors (Figure 3). While informative about structure and organization of a country's agriculture, this type of distributional information provides little information about the well-being of different types of farmers and ranchers.

A major thesis of this paper is to emphasize the importance of indicators that provide policy-relevant information about the economic well-being of farm people in a manner that captures information about their actual or expected economic behaviors. Traditional aggregate indicators fail to provide this information. In particular, traditional indicators (1) do not adequately measure the well-being of farm people, and (2) fail to measure how performance varies within a country. An ideal national accounting system would have a micro-level (farm and household) basis that would permit flexible distributional analysis. Micro-level statistics provide the basis to answer questions about the distribution of sources of income and the variation across types and sizes of operations. Current policy issues include:

- What are the sources of farm and off-farm household income?
- How is farm income distributed across stakeholders including land owners and contractors?
- What are the natural resource (including climate) and human capital endowments of the farm or farm household?
- What was the source of and price paid for purchased inputs including fertilizer?
- How were products transported to markets and what is the proximity of other infrastructure?

Many of the answers to these questions vary systematically according to farm size. The size distribution of farms varies considerably within and across countries. In figure 4a, we show the size distribution of farms for the US and the EU-15 in 2007. Even within these two regions, farm structure varies considerable, for example, size figure 4b shows the distribution of farms by size class for The Netherlands and Italy. The size distribution of farms in a country is associated with other characterizations of the country's agriculture that is relevant to our shared goals, including the extent to which production is concentrated on the largest farms and the extent to which farm households rely on farm and off-farm sources of income. In the U.S., a well understood dynamic is the increasing concentration of production on the largest farms. In 2007, 1.5 percent of all farms accounted for 50 percent of the value of sales. Consistent with this trend, is the significantly different household income levels and sources of income for those farm households that operate large farms, compared to other farm households. Participation in off-farm labor markets—a significant source of income for farm households in developed countries—varies significantly across countries (figure 5).

Micro-level data on farm and household costs and returns have only been available in the U.S. since the mid-1980s. A major impetus for collecting micro-level data was the inability of analysts to understand the financial crisis of that time for policy purposes. Farms were affected in significantly different ways, not all of them negatively. The aggregate accounts were not able to provide a satisfactory understanding of the distributional impacts of the crisis for those responsible for targeting assistance.

It is informative to note that, before that time, ERS constructed statistics of the economic well-being of farm people and returns by size of farm based on the annual aggregate indicators, a variety of tangentially related indicators, and many heroic assumptions about distributional relationships. For example, ERS maintained a series beginning in 1910 on the per capita disposable income of farm and nonfarm people that projected a much different profile of the well-being of farm people than the series based on statistically reliable micro data since 1988 (figure 6a and 6b).

Understanding decision-making

Data are needed to understand how farmers, ranchers, and rural residents make decisions. Survey data with information on individual characteristics is often necessary for research to understand why individuals make decisions about issues such as adopting new technologies or strategies to manage risk from weather or market shocks. Policy makers must understand farmer decision making in order to institute policies that promote the farmer behaviors they are interested in encouraging. The close interaction of farm production and household decision-making is well understood in the developing world. In the developed country context, economic research has sometimes ignored these interactions and assumed separability between business and household decision-making. Increasingly, economic models have recognized the jointness and often draw on the seminal work by development economists to model decision-making (e.g., Strauss, 1986; de Janvry, Fafchamps, and Sadoulet, 1991).

Technology adoption

The rapid growth in the productivity of agriculture over the 20th Century in the United States and other developed countries stemmed from the adoption of new technologies including modern seeds, mechanization, and manufactured chemicals. Farmers choose technologies based on a variety of factors including profits, ease of implementation, and farm characteristics. Recent studies of technology adoption by farmers using only farm business statistics produced several puzzles. One is the rapid and widespread adoption of herbicide resistant soybeans which grew 70 percent in just 5 years after being introduced in 1996 despite no evidence of higher farm profits than using conventional seeds. Another is the slow pace of adoption of precision agriculture which has been shown to reduce input costs through use of intensive management.

Using farm household data provides the answers to these puzzles by factoring in decisions about off-farm work and its relationship to the management intensity of specific

technologies. Reports in the agricultural press speculated about the importance of saving management time in explaining the rapid adoption of herbicide tolerant soybeans, but household data has allowed agricultural economists to test this hypothesis and quantify the effect. Fernandez-Cornejo (2006) reports on a series of studies that find a negative relationship between off-farm income and adoption of management intensive technologies (Figure 7). For herbicide tolerant soybeans, an increase of 16 percent in off-farm income results in a 10 percent increase in the probability of adoption of the management saving technology.

Studies of three other technologies confirm the relationship between management saving technology and higher off-farm income. A positive relationship was found for conservation tillage which also saves labor and has been shown to reduce soil erosion. The adoption of yield monitors is associated with precision agriculture and requires intensive management as supported by the finding that increases in off-farm income decrease the probability of adoption. An 8.4-percent decrease in off-farm household income is associated with a 10-percent increase in the probability of adopting yield monitors. The adoption of Bt corn did not show a significant relationship to off-farm household income. Fernandez-Cornejo explains that before the commercial introduction of Bt corn in 1996, most farmers accepted yield losses rather than incur the expense and uncertainty of chemical control. For those farmers, the use of Bt corn reportedly resulted in yield gains rather than pesticide savings, and savings in managerial time were small.

Policy implications of gender

Agriculture is an important source of employment for women in some countries. For example, in Pakistan two-thirds of women are employed in agriculture, although 43 percent of all employed are in agriculture. In developed countries, the share of both women and men employed in agriculture are quite low (figure 8). Research has shown the importance of considering the gender of farm people in efforts to understand and affect their behavior and improve the conditions of those in extreme poverty and hunger.

The key decision-making unit is a farm household, therefore, intrahousehold relationships, such as bargaining power, must be understood in some settings. In many countries, family roles, responsibilities, and rights are gender-related and extend beyond biological differences. In a seminar at IFPRI, Agnes Quisumbing (2003) provided examples of country-specific cases where gender roles were a significant factor in explaining behaviors of farm people. In particular, gender should be considered to be an important factor when there are significant gender differences in the following:

- Outcomes, such as yield differences, health and nutrition indicators, and poverty rates.
- Determinants, such as educational attainment, land ownership, and family headship.
- Processes, such as differences in motivations and preferences.

In her review of the literature, Quisumbing identified research that reported impressive results regarding the importance of considering gender, including:

- In Burkina Faso, equalizing resources held by women and men could increase yields by up to 20 percent.
- In Ghana, strengthening women's property rights could increase incentives to adopt agroforestry and improve environmental management.
- Increases in women's resources have a strong effect on education, health, and nutrition of the family.
- Women's social networks help families cope with income shocks.

Gender-specific information that can be included in national data collection efforts as proxies for bargaining power include education, shares of family income earned, unearned income, inherited assets, and assets at marriage.

Place matters and geo-coded data

The location agricultural producers and rural communities determines the effects of rising temperatures from climate change as well as the potential effects of policies. The U.S. legislative bodies are debating provisions for possible policies to limit Greenhouse Gas (GHG) emissions. The new policies provide both opportunities and challenges for farmers. The opportunities lie in the potential for farmers and forest owners to receive payments for reductions in GHG emissions or storage of carbon (known as offsets). The challenges come from higher energy prices that would results from restrictions on supply. At the heart of the debate is the fact that farmers and ranchers opportunities vary depending on their location and crops produced. To inform the debate, policy makers would like to understand the likelihood that farmers will respond to new payment opportunities by providing offsets. Answering these questions requires data on farm business decisions as well as the location of the farm to assess the potential for GHG reductions.

Policy makers and economists are asking these questions on a global basis. Any analysis requires information on land use or a related measure such as land cover. The Second Harvest initiative is producing public goods from existing data using consistent methods and high quality metadata. (Figure 8)

Research on farmer investment and savings decisions benefit from panel data

To more completely understand behavioral responses to policies and change—social, economic, and/or environmental—a strategic plan for agricultural and rural data should include a panel component. Human and organizational adjustments to change often occur slowly over time. This is especially true for adjustments involving long-term decisions, such as investment and savings choices. Hence, panel data are extremely useful for gaining an understanding of the returns from alternative investment options with long-term horizons. The World Bank's Living Standards Measurement Survey (LSMS) is an example of this type of survey instrument. In the U.S., the Panel Study of Income Dynamics (PSID) has been used to study the dynamics of U.S. households moving in and out of poverty over time—something that has not been possible with the traditional cross-sectional household surveys.

The importance of panel data for this purpose is true for understanding outcomes at both the individual farm household level and at the macro policy level. For example, at the micro level, panel data could be useful to examine adjustments within the context of community settings and migration patterns. How will changes in local nonfarm economic activities affect farm household consumption, farm investment, and savings? How do farm households who migrate to cities to seek nonfarm employment alternatives fare, compared to their counterparts who do not migrate, and what does that mean for the destination cities? At the macro level, panel data can be useful to examine the long-run returns to alternative development options by governmental and nongovernmental organizations.

Conclusions

The spotlight is on agriculture both as a critical sector for rural development, but also as the lynchpin for other high priority topics including climate and water quality and quantity. Policy makers and researchers working to support their decisions have asked for data ranging from basic indicators to micro or survey data to understand decision making. Other requirements for data include comparability across sectors within a country, compatibility with national accounts. Beyond links between sectors and countries, increasingly spatial information about the location and environmental characteristics of specific places is needed for issues such as climate policy.

Against these demands for data, resource constraints exist that hamper the production of statistics around the globe. Reasons for optimism exist including our gathering in Maputo in the first ever Satellite Meeting on Agricultural Statistics for the ISI and the development of the strategic plan by the United Nations Statistical Commission. Other positive development include multi-institution initiatives to strengthen and make data more accessible including Harvest Choice and the African Agricultural Data Rescue Initiative (AADRI) that is rescuing and making available on the internet historical files from surveys and census including some in spreadsheet format. The FAO and World Bank sourcebook of indicators for monitoring and evaluation provides guidance for using available data to produce meaningful indicators.

We are honored as data users to be invited to participate in this meeting and development of the strategic plan. We believe the importance of data on food, agriculture, rural and resources is not a temporary fad. However, the issues will evolve and close links with data users will ensure that not only is data used and valued, but also that it evolves to address the new technologies on the horizon and policy issues in capitals. There is a need to involve data users in the process of the development of statistics and we hope that the strategic plan recognizes the importance of developing institutional linkages with data users. This will ensure that the statistics are used, hence valued, and kept relevant. As two economists and intense data users, we can attest that users like to be asked and stand willing to help.

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Figure 1. Most of the population in developing countries lives in rural places, and the rural share of population declines with economic growth

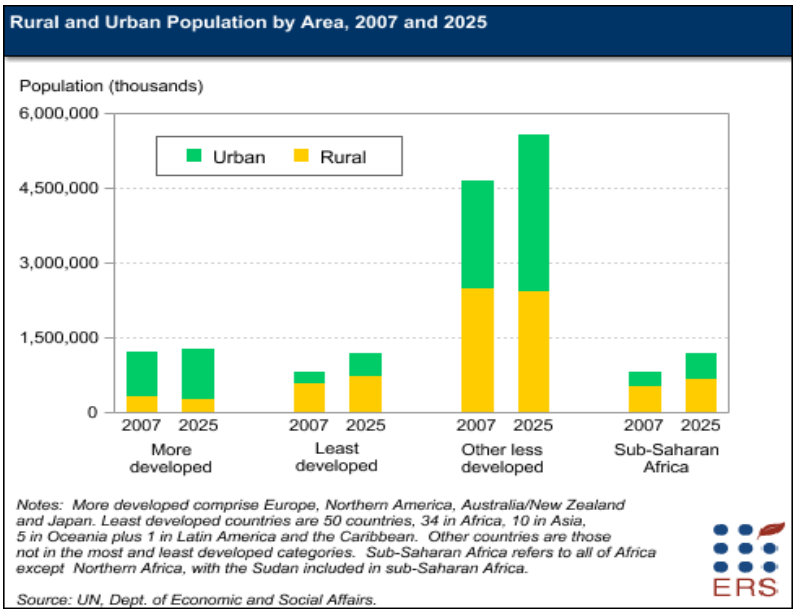


Figure 2.

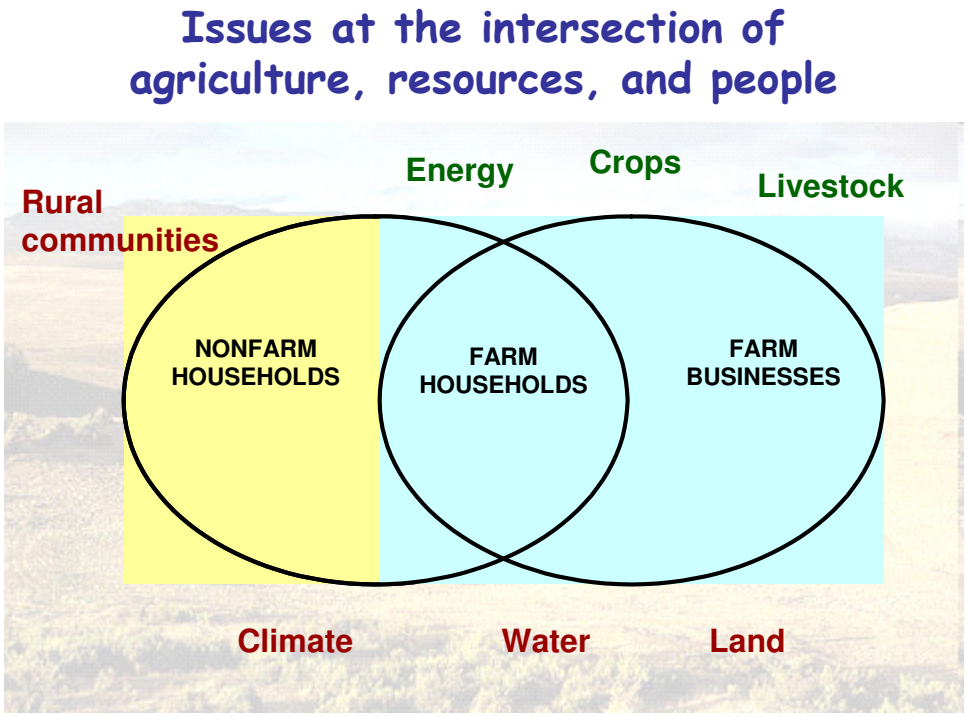


Figure 3. Linkages for US agriculture include multiple stakeholders

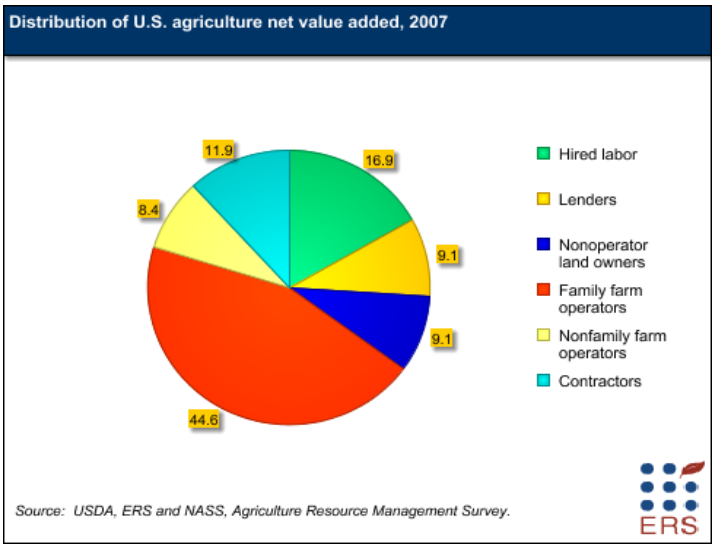
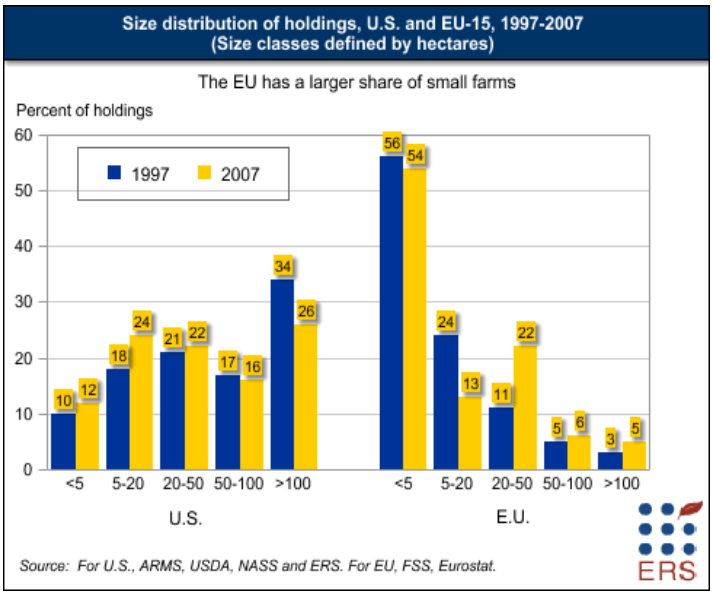


Figure 4 (4a with US/EU and 4b with Italy/Netherlands)



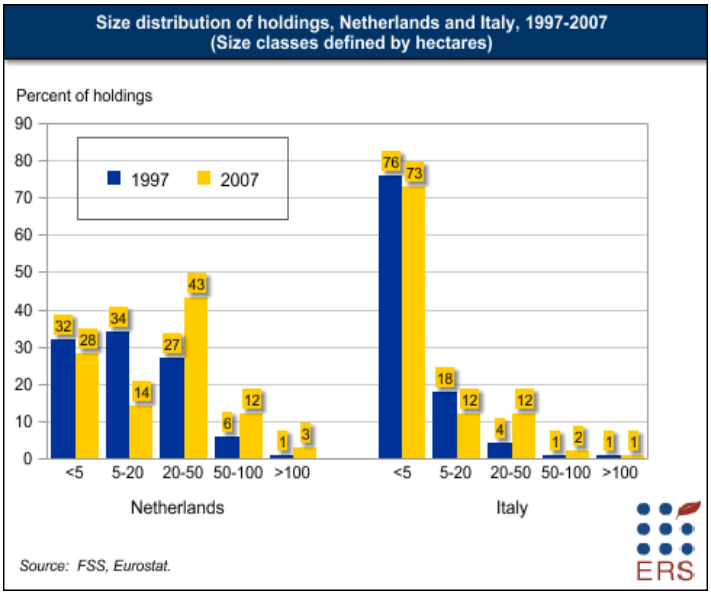


Figure 5

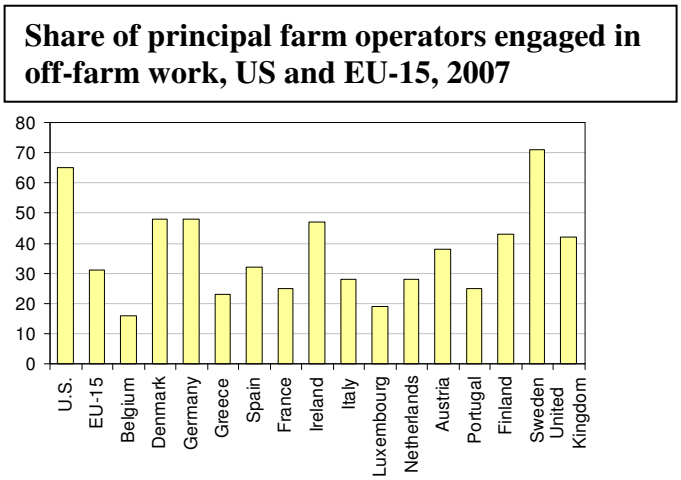


Figure 6a and 6b: Source of data critical to measurement of farm household income

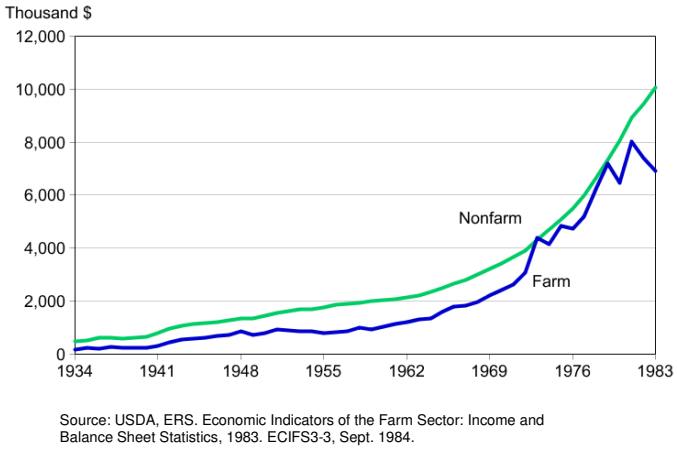


Figure 6a: Aggregate indicators show farm income falling relative to nonfarm

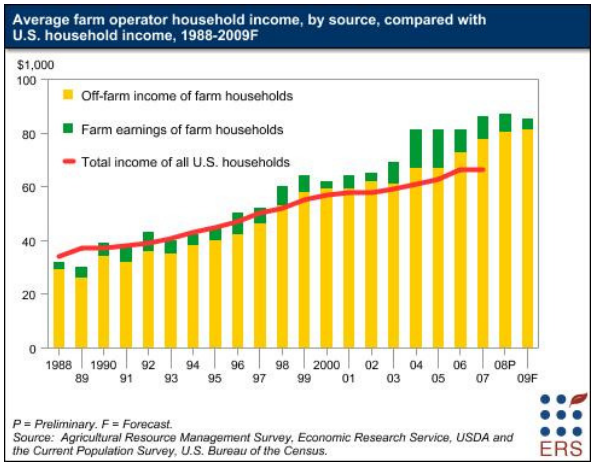


Figure 6b: Importance of off-farm income in rising average farm income

Figure 7. Managerially Intensive Technologies Are Associated With Lower Off-Farm Incomes

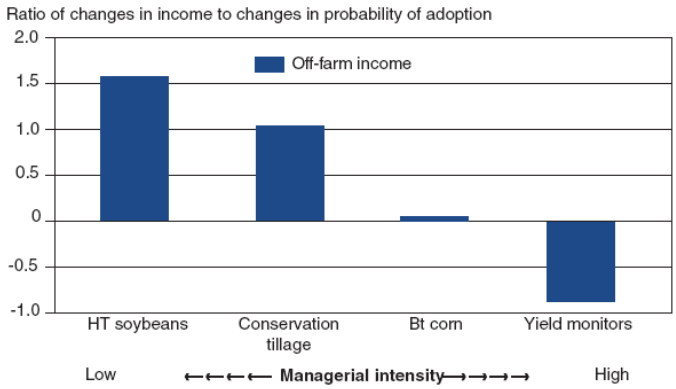


Figure 8. Importance of agricultural employment varies across countries as does the role of women

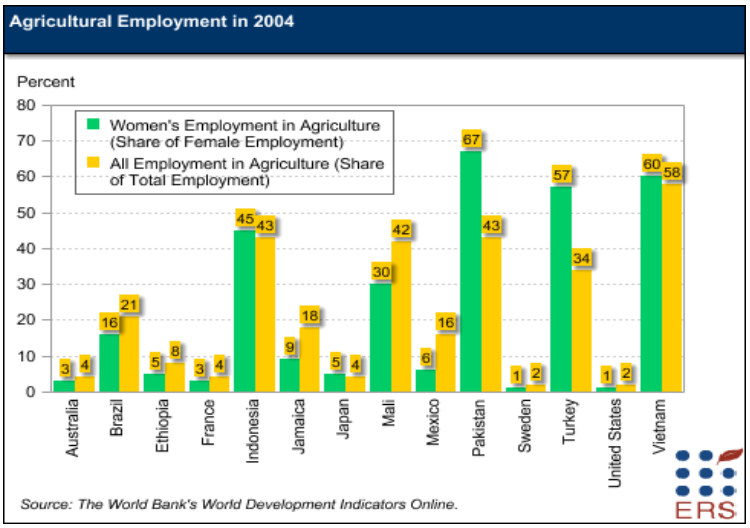


Figure 9. Global land cover data serves as input to analysis of climate impacts and policies