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GLOBAL STRATEGY TO IMPROVE AGRICULTURAL AND RURAL STATISTICS

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United Nations

1818 H Street, NW
Washington, DC 20433
Telephone 202-473-1000
Internet www.worldbank.org/rural
E-mail ard@worldbank.org

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ACRONYMS AND ABBREVIATIONS

AQUASTAT	FAO Information System on Water and Aquaculture
COFOG	Classification of Functions of Government
CPC	Central Product Classification
Eurostat	Statistical Office of the European Union
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
GPS	Global Positioning System
ICAS-V	Fifth International Conference on Agricultural Statistics
IDA	International Development Association
IMF	International Monetary Fund
ISI	International Statistical Institute
ISIC	International Standard Industrial Classification of Economic Activities
LCCS	Land Cover Classification System
MDG	Millennium Development Goals
MPPS	Multiple Probability Proportional to Size
NASS	National Agricultural Statistics Service
NSDS	National Strategy for the Development of Statistics
OECD	Organization of Economic Cooperation and Development
PARIS21	Partnership in Statistics for Development in the 21st Century
PDA	Personal Digital Assistant
PPPs	Purchasing Power Parities
SEEA	System of Integrated Environmental and Economic Accounting
SNA	System of National Accounts
TFSCB	Trust Fund for Statistical Capacity Building
UNEP	United Nations Environment Programme
UNSC	United Nations Statistical Commission
UNSD	United Nations Statistics Division
USDA	United States Department of Agriculture

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PREFACE

The Global Strategy to Improve Agricultural and Rural Statistics presented in this document is based on input from a large number of stakeholders, including national statistical institutes and ministries of agriculture, and a number of regional and international organizations.

One of the outcomes of the 2007 International Statistical Institute Conference on Agricultural Statistics was a consensus regarding the challenges of applying statistics to issues in agricultural development. Not only is there a lack of direction regarding agricultural data requirements posed by the Millennium Development Goals (MDG) and other emerging issues such as the use of food for biofuels, and the environment and food security; there is also a general decline in the overall quality and availability of agricultural statistics.

These concerns were discussed during the 2008 meeting of the United Nations Statistical Commission (UNSC). The discussion led to the formation of a working group assigned to draft a strategic plan to improve agricultural statistics. The working group, under the guidance of the United Nations Statistics Division (UNSD), included the World Bank, the United Nations Food and Agriculture Organization (FAO), Statistical Office of the European Union (Eurostat), the United States Department of Agriculture (USDA), and the International Statistical Institute (ISI).

Using input from the working group and other stakeholders, the World Bank prepared a paper entitled "Framework to Develop a Strategic Plan to Improve National and International Agricultural Statistics." The paper was the basis for the Expert Meeting on Agricultural Statistics held in Washington, DC, on October 22–23, 2008. The Expert Meeting was attended by heads and representatives of national statistical offices and ministries of agriculture from 27 countries. The FAO, the World Bank, International Monetary Fund (IMF), Eurostat, Organization of Economic Cooperation and Development (OECD), and the USDA also attended. The outcomes of the Meeting formed the basis for a paper discussed at the 2009 meeting of the UNSC, which concluded that a global strategy was needed to improve agricultural statistics.

The UNSC recommended that a Friends of Chair Working Group be formed to develop the global strategy for review and approval at the 41st Meeting of the Commission in 2010. The Working Group is led by Brazil (Mr. Eduardo Pereira Nunes) and includes Australia, Brazil, China, Cuba, Ethiopia, Italy, Morocco, the Philippines, the Russian Federation, Trinidad and Tobago, Uganda, the United States, the FAO, and the UNSD, serving both as observer and secretariat, and Eurostat and the World Bank as observers.

With input from the Friends of Chair Working Group and other stakeholders, the World Bank developed a draft "Global Strategy to Improve Agricultural Statistics" in collaboration with the FAO. The draft provided the basis for the International Statistical Institute Satellite Meeting on Agricultural Statistics that took place in Maputo, Mozambique, in August 2009. The Meeting was organized around the chapters of the draft Global Strategy, and was attended by more than 200 participants from over 45 countries as well as from regional and international organizations. Funding agencies such as the Bill & Melinda Gates Foundation also showed their interest by sending delegates to the meeting to discuss possibilities and modalities for participating in this global initiative. Based on discussions at the Maputo Meeting, the Friends of Chair formed four working groups to provide more details about components of the paper through consultations within the network of statisticians.

At the International Statistical Institute Conference in Durban, South Africa, that followed the Maputo Meeting later that month, a wide variety of papers on agricultural and rural statistics was presented and discussed. The papers covered topics relating to the Global Strategy such as censuses of agriculture, survey methods, and economic-environmental accounting for agriculture. A review of agricultural statistics by the United Nations Economic Commission for Europe again underscored the need for improved statistics in developing countries.

The FAO included the Global Strategy as a main item on the agenda of its Biannual Conference in November of 2009—an event at which ministers of agriculture of all member countries were gathered. The Strategy was also discussed at sessions of the Regional Commissions on Agricultural Statistics attended by national directors of agriculture statistics.

The PARIS21 Consortium meeting in Dakar in November 2009 provided another opportunity to further discuss the Global Strategy with a variety of stakeholders, donors, governments, private businesses, intermediate organizations, and statisticians. A seminar on the Global Strategy attracted around 100 participants and contributed significantly to the further recognition of its importance. A peer review by experts from the World Bank, International Food Policy Research Institute (IFPRI), and USDA also provided input to the Global Strategy.

Efforts to expand access to the development of the Global Strategy to all ministries of agriculture and national statistical offices included the development of a Wikipedia Web page: *wiki.asfoc.ibge.gov.br.* This global consultation helped the Friends of Chair Working Group to improve the document and to widely publicize the initiative.

The technical content and strategic directions of the Global Strategy were endorsed by the 41st session of the UNSC. It is the result of a wide process of consultation with national and international statistical organisations as well as with agricultural ministries and other governmental organisations represented in FAO governing bodies.

ACKNOWLEDGMENTS

The Global Strategy to Improve Agricultural and Rural Statistics was prepared by the World Bank in collaboration with the FAO and Friends of the Chair working groups of the UNSC, and through extensive consultations with stakeholders.

The World Bank team was led by Sanjiva Cooke and included Nwanze Okidegbe and Fred Vogel (principal author). The team is grateful for comments received from the following peer reviewers: Gero Carletto, Robert Townsend (World Bank), Gerald Nelson (International Food Policy Research Institute), and Mary Ahearn (United States Department of Agriculture). The team thanks Juergen Voegele, Mark Cackler, and Misha Belkindas for their support and inputs. The FAO team was led by Pietro Gennari and included Naman Keita, Hiek Som, and Greg Gong. The Friends of the Chair on Agricultural Statistics was led by Eduardo Pereira Nunes (Brazil) and included representatives from Australia, China, Cuba, Ethiopia, Italy, Morocco, Philippines, Russian Federation, Trinidad and Tobago, Uganda, United States, FAO, the United Nations Statistics Division (UNSD), the Statistical Office of the European Union (Eurostat), and the World Bank. World Bank staff Gunnar Larson edited and Sonia Madhvani managed the production and design of the publication.

The National Statistical Institute in Mozambique, which hosted the International Statistical Institute Satellite Meeting on Agricultural Statistics, warrants special recognition. The meeting was organized in cooperation with the African Development Bank, Eurostat, the FAO, the Partnership in Statistics for Development in the 21st Century (PARIS21), the United Nations Statistics Division, the United States Department of Agriculture, and the World Bank. The African Development Bank, the World Bank, and the U. S. Department of Agriculture are also recognized for the financial support provided during the nearly two year period to develop the Global Strategy. The International Statistical Institute's support of the global initiative to improve agricultural statistics has been greatly appreciated.

The preparation of the Global Strategy was supported by the Trust Fund for Statistical Capacity Building (TFSCB), a multi-donor trust fund financed by Canada, the Netherlands, the United Kingdom, and administered by the Development Data Group of the World Bank.

EXECUTIVE SUMMARY

Policy makers and development practitioners who are responsible for developing investment strategies to promote economic growth find many challenges in the changing face of agriculture in the twenty-first century. In addition to its productive role of providing food, clothing, fuel, and housing for a growing world population, agriculture assumes other roles, the importance of which has more recently been recognized. In addition to its essential role in food security, agricultural development is now seen as a vital and high-impact source of poverty reduction. It is also seen as a source of environmental problems and a contributor to global warming, water scarcity and pollution, and land degradation. At the same time its potential as a source of environmental services needs to be defined, monitored, and evaluated. Many of the issues facing the sector transcend national boundaries.

The Global Strategy is the result of an extensive consultation process with national and international statistical organizations as well as with agriculture ministries and other governmental institutions represented in FAO governing bodies. Considerable input came from the United Nations Statistical Commission Friends of Chair working group and the 2009 meetings of the International Statistical Institute in Maputo and Durban. Other collaboration involved the FAO Biannual Conference and discussions at the Regional Commissions on Agricultural Statistics attended by national directors of agricultural statistics, the World Bank peer review process, and the development of a Wikipedia Web page to collect inputs from the statistical community (wiki.asfoc.ibge.gov.br).

The purpose of the Global Strategy is to provide a framework for national and international statistical systems that enables them to produce and to apply the basic data and information needed to guide decision making in the twenty-first century. This Strategy is based on three pillars.

- The first pillar is the establishment of a minimum set of core data that countries will collect to meet current and emerging demands.
- The second pillar is the integration of agriculture into national statistical systems in order to satisfy the demands of policy makers and other users who rely on comparable data across locations and over time. The integration will be achieved by implementing a set of methodologies that includes the development of a master sample frame for agriculture, the implementation of an integrated survey framework, and with results available in a data management system.
- The third pillar is the foundation that will provide the sustainability of the agricultural statistics system through governance and statistical capacity building.

The Strategy is based on an assessment of the data that users need and that are currently available. The assessment, which is described in chapter 1, not only found a serious decline in the quantity and quality of agricultural statistics, but one that is occurring at the same time that many new data requirements are emerging. Among these emerging data requirements are those relating to global warming, land and water use, and the increasing use of food and feed commodities to produce biofuels—in addition to a number of requirements that relate to poverty and food security.

The assessment of data that users need led to the formulation of a conceptual framework that relates the economic, social, and environmental dimensions of agriculture. This framework incorporates forestry, fisheries, and land and water use in

addition to the narrower, more conventional treatment of agricultural production. It recognizes linkages between rural households, agricultural holdings, and the land and other natural resources that they use and that they impact.

Applying this conceptual framework, an evaluation of national agricultural statistical systems points to an urgent need to improve their capacity to systematically collect and report reliable data. The evaluation also found a need to improve the coordination between national statistical organizations and the other national agencies that produce agricultural statistics.

In 2008, the Global Donor Platform for Rural Development, with support from the United Nations Food and Agriculture Organization (FAO) and the World Bank, published a sourcebook of indicators for monitoring and evaluating results in agriculture and rural development. This set of indicators was used as the starting point to develop a full menu of indicators that meets both current and emerging information requirements. From this menu of indicators, a set of core data or statistics is defined that will provide the input to estimate the indicators. The minimum set of core data is intended to be used as a starting point in building agricultural statistics systems for the twenty-first century. A strategy to determine the content, coverage, and frequency of the national system that goes beyond the core set of data is also provided. The emerging data requirements, the conceptual framework, the assessment of the national agricultural statistics systems, and the choice of a core set of indicators all point to the need to integrate agriculture into the national statistical systems.

The Strategy identifies the main elements with which the integration will be achieved. The integration of agriculture into a country's national statistical system will begin with the development of a master sample frame for agriculture. This will be the foundation for all data collection based on sample surveys or censuses. The master sample frame is to be constructed based on the requirements to include both households and farms as statistical units. It provides a link between the census framework and land use. An integrated survey framework will be established to provide data measured consistently across time and comparable across countries using an annual survey of selected core items and periodic data from a set of rotating panels covering economic and environmental issues. The concept of a master sample frame will be extended to include a data management system for all official statistics related to agriculture.

All data collection is to be based on sample units selected from the master sample frame and integrated into the survey framework. The survey framework also takes into account the additional data sources that need to be included in the integrated statistical system, including administrative data, agribusiness and market information systems, community surveys, remote sensing, and consistent input from expert data collections. The official statistics that are gathered are to reside in a data management system. These are the basic principles of the Strategy. Their implementation will require improved governance across the national statistical system.

The integration of agriculture into national statistical systems will also affect the roles and the divisions of responsibility between national statistical offices, ministries of agriculture, and institutions that govern other sectors. The Strategy suggests that each country establish a national statistical council to coordinate the integration of agriculture when the country designs its National Strategy for the Development of Statistics (NSDS). However, the Strategy leaves the respective roles of the organizations to the countries themselves to decide.

The steps to implement the strategic plan will depend upon the statistical capacity of each country. Those needing to reform their statistical systems will begin with the core data items and build the rest over time. In countries in which national strategies for the development of statistics are being undertaken, they should be reviewed in light of the Global Strategy and revised accordingly. Many countries that have already developed statistical systems, but that have not integrated agricultural statistics into those systems will need to develop a master sample frame for agriculture and an integrated database.

The Strategy is a long-term effort, with its implementation proceeding in stages that depend on each country's initial statistical capacity. Given the dynamic nature of agriculture and its accompanying issues, the Strategy should be considered a living document to be updated when needed to reflect current situations. It will be followed by an implementation plan based on

input from the national and international partners as well as additional contributors. The implementation plans will be flexible enough to consider the specific country situations.

This paper presents the overall Strategy. It provides a ground-breaking effort to improve agricultural statistics that has implications for other sectors in the national statistical system. While it took many years for agriculture statistics to deteriorate to their current state, the implementation of the Strategy provides a fresh start.

Chapter 1: INTRODUCTION

THE AVAILABILITY AND QUALITY OF AGRICULTURAL STATISTICS HAS DECLINED, JUST AT THE WRONG TIME

Three out of four poor people in developing countries live in rural areas. Most rely directly or indirectly on agriculture for their livelihoods. Agricultural development is vital to achieving the Millennium Development Goals, particularly those related to poverty and food security and to environmental sustainability. Agriculture contributes to development as an economic activity, as a source of livelihoods, and as a provider of environmental services—roles that were spelled out in substantial detail in the 2008 World Development Report "Agriculture for Development" (World Bank 2008a) Recognition of its importance has led to renewed commitment to agriculture within the international development community. This commitment has assumed mounting urgency in a global context of skyrocketing food prices and lowered food reserves. Globally, food prices doubled between 2006 and mid-2008, a trend driven in part by droughts in grain-producing regions, increased oil prices, and sales of corn to produce biofuels. Future food prices are expected to remain higher than they were in the 1990s and to be more volatile. The role of agriculture as a source of greenhouse gas emissions and other environmental problems has also assumed prominence, given the need to raise production, but with little latitude to expand production into new areas. The need to measure agricultural performance and the results of agricultural investment has therefore become an increasingly pressing priority.[1]

Decisions about aid and investments that are intended to foster agricultural growth need to be based on sound information about land use, factors of agricultural production, the prevailing economic and social situations that producers face, and the interaction of these with issues concerning climate change. The impacts of these factors can only be effectively measured and evaluated with appropriate statistics. However, at present there is a serious paucity of statistical data on which to base marketing, investment, or policy decisions, or with which to assess the efficacy of current commitments or policies.

Many countries, especially in the developing world, lack the capacity to produce and report even the minimum set of agricultural data necessary to monitor national trends or inform the international development debate. The *Independent External Evaluation of the Food and Agriculture Organization* (FAO2006) argued that "the time has come for a total re-examination of the statistical needs for the 21st century and how they can best be met." The evaluation report concluded that "the quantity and quality of data coming from national official sources has been on a steady decline since the early 1980s, particularly in Africa." It also found that "official data submissions from countries in Africa are at their lowest level since before 1961, with only one in four African countries reporting basic crop production data." The evaluation also recognized the increasing demands for new statistics and the need to integrate data on agriculture, fisheries, and forestry to understand their effects on the environment and climate change and on the use of biofuels to deal effectively with policy issues.

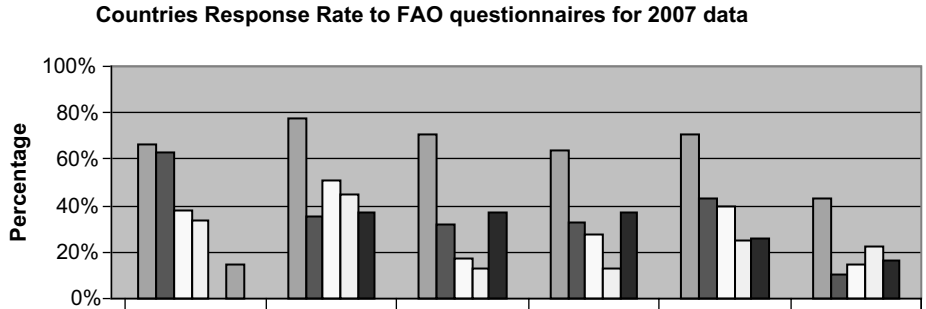
Low response rates to the United Nations Food and Agricultural Organization (FAO) questionnaires limit the availability of data. Figure 1 presents the response rates by data domain (production, land use, agricultural machinery, trade, fertilizer, and pesticides) and by region. Response rates from the Pacific, Africa (except for trade and pesticides data), and the Middle East are the lowest, while Europe has the highest rates. Response rates from Latin America for basic data on production, land use, machinery, and pesticides are also very low.

Factors contributing to the decline

A number of likely reasons are attributable for the decline in the quantity and the quality of statistics pertaining to

1 See "The Comprehensive African Agriculture Development Program" www.nepad-caad.net; "Joint Donor Principles for Agriculture and Rural Development Programs" (*The Global Donor Platform for Rural Development* 2009; "World Development Report, Agriculture for Development," (World Bank 2008) for a detailed discussion of these issues.

FIGURE 1: Country responses to the FAO, 2007



	Production	Trade	Land Use	Machinery and Equipment	Fertilizers	Pesticides
Europe	66%	78%	71%	64%	71%	43%
Asia and Pacific	63%	35%	32%	33%	43%	10%
Americas	38%	51%	17%	28%	40%	15%
Africa	34%	45%	13%	13%	25%	22%
Near East		37%	37%	37%	26%	16%
Oceania	15%					

Regions

agriculture and rural development. One obvious reason is the lack of country-level capacity at public statistical agencies. An evaluation of FAO in 2008 argued that the most pressing need in national statistical systems is to improve the capacity for agricultural statistics, which the evaluation described as a "re-emerging" need. The decline in the priority and in the resources that national agricultural systems assign to collecting and reporting reliable agricultural statistics is paralleled by a general lack in donor interest. The need to quantify such matters as the impacts of agricultural production on the environment and the impacts of biofuel production on food prices entails the development of new conceptual frameworks that go well beyond traditional domains of agricultural statistics. It also makes this an exceptionally inopportune time for the collection of even those traditional domains to be assigned lower priority than they have in the past.

Not unrelated to the lack of capacity is the lack of financial resources to collect data. The dilemma is that agricultural statistics are often outside the national statistical system, with ministries of agriculture and other organizations responsible for sectors such as land, water use, fisheries, and forestry also failing to keep up with the increasing demand for data.

In many countries, the lack of integration into the national statistical system is a major reason for the weakness of agricultural statistics. In countries with decentralized statistical systems, coordination between the national statistical office and the ministry of agriculture is often lacking. Nor do many national strategies for the development of statistics adequately cover the agriculture sector.

A recent review by the Partnership in Statistics for Development in 21st Century (PARIS21) found that, of a total of 78 International Development Association (IDA) countries, 43 (55 percent) have a national strategy for the development of statistics in which agriculture is or is supposed to be included. Among these 43 IDA countries, only 4 to 10 countries (therefore only around 10 percent of all IDA countries in the world) have included agriculture more or less appropriately in the National Strategy for the Development of Statistics (NSDS) process (PARIS21 2009).

A number of problems are common to many developing countries:

- Limited staff and capacity of the units that are responsible for collection, compilation, analysis, and dissemination of agricultural statistics.
- Lack of adequate technical tools, statistical methodology, and survey framework to support data-production efforts.
- Insufficient funding allocated for agricultural statistics from development partners and national budgets.

- Lack of institutional coordination, which results in the lack of harmonized and integrated data sources.
- Lack of capacity to analyze data in a policy perspective, which results in a significant waste of resources as large amounts of raw data are not properly used.
- Difficulty for data users in accessing existing data with no metadata or indication of quality.

A systematic assessment is needed, using a standard international framework, to provide a detailed diagnosis and analysis of the current statistical capabilities by country. The assessment should cover all principal data domains, including data gaps, data quality, and related institutional and methodological limitations with regards to priority data needs. The information available suggests that Africa, the Middle East, the Pacific, and Latin America have the largest number of countries with weak agricultural statistics systems. Countries in these regions require a comprehensive capacity-development effort to enable them to provide the minimum data requirements.

FILLING THE VOID: THE GLOBAL STRATEGY TO IMPROVE AGRICULTURAL AND RURAL STATISTICS

The Global Strategy provides a blueprint for a coordinated and long-term initiative to address the decline in agricultural statistics systems. Several efforts related to the goal to improve agricultural statistics provided valuable input to the development of the Global Strategy. These include *Tracking Results in Agriculture and Rural Development in Less than Ideal Conditions: A Sourcebook of Indicators for Monitoring and Evaluation* (World Bank 2008b), *The World Programme for the Census of Agriculture 2010* (FAO 2005b), *The Guide to Designing a National Strategy for the Development of Statistics* (PARIS21 2007), and the *Wye Group Handbook on Rural Households Livelihood and Well-Being* (United Nations 2007).

The Global Strategy is also based on extensive consultations with national statistical offices, ministries of agriculture, and other national institutes as well as with all international statistical organizations that have a stake in improving agricultural statistics. It takes into consideration the different stages of statistical development across countries and the technical developments that can contribute to the improvement of statistics. The Strategy should therefore be considered a long-range plan requiring an examination of governance at the national level, the establishment of statistical capacity building across the national statistical system, and the restoration of resources to carry it forward. The Global Strategy continues with the following chapters.

- **Chapter 2. A Conceptual Framework for the Collection of Agricultural Statistics.** A conceptual framework based on a thorough assessment of users' data needs was developed. It pointed to many emerging requirements from issues closely linked to agriculture such as poverty and hunger, the environment and climate change, the use of land and water, and the increasing use of food and feed commodities to produce biofuels. Based on these requirements, the conceptual framework broadens the scope and coverage of agricultural statistics to include aspects of fisheries, forestry, and rural households and provides a menu of indicators. The conceptual framework translates policy issues into statistical language by identifying the need for the survey framework to link the farm as an economic unit, the household as a social unit, and the land they occupy in the natural environment. The framework suggests that the fundamentals of the Global Strategy be based on three pillars: identifying a minimum set of core data; the integration of agriculture into the national statistical system; and the sustainability of the agricultural statistical system through governance and statistical capacity building.
- **Chapter 3. The First Pillar—Identifying a Minimum Set of Core Data and Determining National Priorities.** Because the complete set of data requirements identified in the conceptual framework exceeds the existing statistical capacity of many countries, a minimum set of core data is to be used as a starting point upon which to develop the Global Strategy. This core set of data will provide national and international policy makers necessary information that goes across national boundaries. The Global Strategy provides a framework for countries to add items of national interest to the set of core data and to determine the frequency with which they will be provided. The set of core data provides the beginning point for the improvement of agricultural and rural statistics.
- **Chapter 4. The Second Pillar—The Integration of Agriculture into National Statistical Systems.** Overlapping data requirements and the need to improve underlying statistics and methodology point directly to the need to integrate agriculture into the national statistical system. Incorporating agriculture into national statistical systems will facilitate the concentration of resources from multiple sources, and remove the duplication of efforts in producing statistics that is so

common in developing countries. The Strategy provides the framework to achieve the integration based on the development of a master frame for agriculture, its use in an integrated survey system, and the implementation of a data management system.

- **Chapter 5. The Third Pillar: The Sustainability of Agricultural Statistics by Governance and Statistical Capacity Building** The conceptual framework leading to the integration of agriculture into national statistical systems points to requirements for governance that bring together the efforts of the different stakeholders, especially the national statistical institutes and ministries of agriculture. While the Strategy provides the framework for integration, it leaves the implementation to each country to decide and suggests they do so by forming national statistics councils. Other issues addressed are the steps needed to implement the Strategy, including the inclusion of the fundamentals of the Strategy in the national strategies for the development of statistics.
- **Chapter 6. Summary of Recommendations and the Way Forward.** The Global Strategy concludes with a summary of major recommendations and the conclusions reached by the UNSC in its acceptance and endorsement of the Global Strategy and a summary of actions to be taken to develop an implementation plan.
- **Annex A** provides a menu of indicators, data sources, and technical notes. The core indicators provided in the *Sourcebook* (2008) and the emerging requirements described in the FAO evaluations were used as starting points to develop the menu. The menu of indicators also includes those needed to understand the issues involving the environment, climate change, and the introduction of biofuels. Because countries have varied and limited capabilities, it will be necessary for each country to establish priorities for the collection of the basic data in addition to a core set that are universally needed and are comparable across countries.
- **Annex B** provides an overview of sample frames used for agricultural statistics.

Chapter 2: A CONCEPTUAL FRAMEWORK FOR THE COLLECTION OF AGRICULTURAL STATISTICS

Statistics on agricultural and rural development are used by policy makers, donors, and private sector decision makers to inform their decisions regarding a variety of important issues. It is these priority issues that drive the choice of indicators to be developed and the core data to be collected.

A variety of attempts have been made to quantify the value of information to public and private sector decision makers. Case studies examined in literature reviews suggest that the benefits of having the information far outweigh the costs of providing the information. For example, Bruce Gardner reviewed literature that quantifies the value of agricultural market information to private and public decision makers regarding domestic U.S. policy reform, trade policy reforms, and investments in public research and development (Gardner 2004). In the same volume, George Norton and Jeffrey Alwang consider case studies on the value of information regarding deforestation in the Amazon and pesticide use in the Philippines. Both reviews found high net benefits to providing decision makers the information (Norton and Alwang 2004).

Many of today's critical issues are not new, but they have increased in importance, have come to be framed differently, or have been newly recognized. Many of the traditional indicators in use, therefore, remain relevant, while others need to be refocused or newly developed. The independent review of the United Nations Food and Agricultural Organization (FAO) statistics program included an effort to seek input on emerging data needs from major users and partners. One overall finding of the report was that there was a great deal of overlap in the issues identified among stakeholders, including national statistical centers, nongovernmental and donor organizations, research institutions, and a variety of other users. Multiple users expressed the need for new and improved indicators on prices, energy and biofuels, agricultural environments, climate change, trade, water, land, soils, household consumption, food security, socioeconomic data, economic accounts, management of natural disasters, and fisheries. Users also had high expectations for geospatial and remote sensing data and expressed the need for improved integration and for more accessible and searchable databases.

The most critical issues are not independent of each other, and much of the data are needed for more than one indicator. The goal of the Strategy is to capture the interrelationships of these emerging issues and to ensure that appropriate indicators are defined and underlying data provided. This points to a major problem with current agricultural and rural statistics. Many of the issues have been considered in isolation, and this does not allow the cross-cutting analysis that is most desperately needed.

DIMENSIONS OF DATA DEMAND

While agriculture is fundamentally an economic activity, in that its purpose is the production of food and other commodities, concern about its relationships to environmental and social issues has been increasing. These relationships have to be considered in a broader context, in which agriculture, the environment, and social factors are no longer treated as discrete disciplines. Institutions and enterprises affect all three through policies, regulations, taxes, and infrastructure such as transportation, education, markets, and processing facilities. The significance of the institutional framework applies at the local, national, and international levels. The international level warrants consideration owing to the globalization of markets and to the reality that some of the most important issues, such as global warming and many facets of poverty reduction, transcend national or regional boundaries. Many of the enterprises involved in this bigger picture are not directly engaged in agricultural production, but they provide services that connect production to markets and consumers.

The economic dimension of agriculture consists of the land, labor, and capital that enter into the production process and the outputs that result from it. The output of the production process takes many forms. Some are consumed by the household, some are retained for seed or feed to be used on the holding, and others enter supply chains that extend to markets. Some of the products require processing, such as

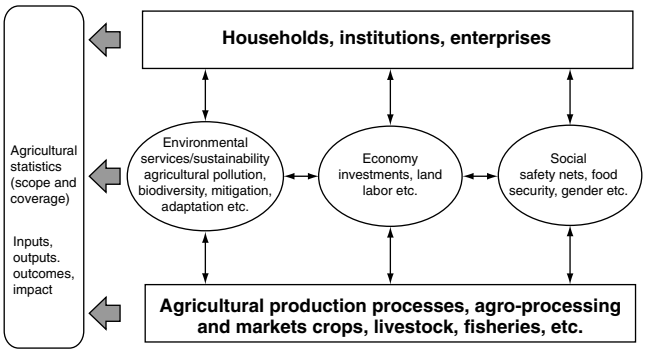
crushing soybeans for oil, ginning cotton, or the slaughter of livestock by nonagricultural enterprises. An emerging output is the use of agricultural commodities for the production of energy products. The outcome of the production process is income to the agricultural and nonagricultural enterprises, and to households—both agricultural and nonagricultural. The impact of the production process affects food security, poverty, and the performance of the economy.

The environmental dimension of agriculture consists of the sector's role as a user of natural resources—principally land and water—and as a provider of environmental services. In addition to its direct use of natural resources in production, its impacts also relate to the waste and emission byproducts generated by production. Agriculture can affect the condition of the resources it uses, and with important implications for climate change and biodiversity. Recognition of the negative and potentially positive impacts that agriculture has on global, regional, and local environments points to the need for statistics that enable informed analysis of the interactions between agriculture's roles in the economy and in the environment.

Data that relate to the social dimension of agriculture and rural development begin with households and household members—both farm and nonfarm. This represents a higher level of detail than was captured by much conventional data, which more often began with the farm enterprise as its basic unit. Including nonfarm rural households also serves to develop a broader and more complete picture of rural communities and the multitude of interdependencies that characterize them. Rural communities are far more than spatial clusterings of households located in sparsely populated areas. Understanding the interactions between rural households, businesses, and government agencies—and between communities—generates the need for extensive data. It is especially important that the combination of agricultural and nonagricultural income sources among households, farms, and nonfarm businesses be represented with data, given the significance of seasonality to food security among vulnerable households and individuals. The data are also very important in examining the relationships that exist between agriculture and other sectors in rural society. Finally, social data are needed to examine households and individuals not only in their roles as producers and consumers, but also as users of social services such as health and education programs.

The output of the agricultural process affects the income of both agricultural and nonagricultural households. Policy decisions that affect the choices made about different patterns of production have implications for the well-being of the households concerned. Environmental standards can have serious economic consequences for household income.

FIGURE 2: The conceptual framework for agricultural statistics



THE CONCEPTUAL FRAMEWORK

The conceptual framework presented in figure 2 brings together the economic, environmental, and social dimensions of agriculture and the cause-and-effect relationships that connect them. These relate to agricultural production and extend to processing and markets as well as income distribution, accumulation, and consumption. The relationships are also a function of the prevailing institutional framework within which agriculture operates. Agricultural statistics are needed at each respective stage: inputs, outputs, outcomes, and ultimate impacts.

THE ECONOMIC DIMENSION

The economic dimension covers agricultural production, markets, and farm and nonfarm income.

Agricultural production. Data on agricultural productivity are important to decision and policy makers. Productivity rises when additional output is produced for the same level of inputs, or alternatively, the same amount of output is produced with fewer inputs. Data on the quantity and prices of outputs and inputs are therefore the starting points for measuring changes in agricultural productivity. Information is also required on capital stock that is used over multiple years of production in order to determine the equipment's rate of depreciation. Together this information can be used to develop a balance sheet.

While growth rates in agricultural productivity is a long-standing concern, the role of growth in reducing poverty and

hunger has more recently become a focus on monitoring and evaluation. The 2008 World Development Report *Agriculture for Development* (World Bank 2008a) relates evidence that growth in GDP that originates in agriculture is at least twice as effective in reducing poverty as growth originating in other sectors. The effectiveness of public and private agricultural investment has therefore become more closely monitored than it was in the past, whether that investment is in infrastructure, new technology, or physical or human capital.

Fish and other aquatic organisms are major sources of food and household income throughout much of the developing world. The subsector includes fish captured on the open-sea commons, in coastal zones within the territory of individual countries, in rivers and other freshwater sources, and through aquaculture. Countries are responsible for providing statistics on all fisheries and aquaculture within their national jurisdiction and on vessels that fly their flag. Regional fishery bodies have been formed to coordinate the collection of data and management of fishery resources. These data generally contain more detailed information on operational and biological aspects of capture fisheries, including the species composition of the catch. Small-scale and subsistence aquaculture and capture fisheries often provide an opportunity of last resort for earnings and food security for people without access to land. Small households that engage in aquaculture tend to combine fish production with other activities such as crop agriculture. The competition between aquaculture and agriculture for land and water use is intensifying and is likely to increase with the impacts of climate change.

Markets. Effective marketing systems depend on information about supply and demand and market prices, which is freely available to all participants in the system. The most essential information is timely forecasts and estimates of production. Timeliness is a critical factor. The lack of timely production data was one of the major factors leading to food shortages and spikes in consumer prices. The marketing system should be considered in the broader sense to include markets for inputs and those involved at every stage of the modern supply chain from production to final delivery to the consumer. (These indicators are also required to measure agricultural productivity.)

Farm and nonfarm income and survey data. Net farm income and GDP from agriculture are basic indicators of a country's agricultural performance. Tracking them for policy purposes can provide an understanding of the conditions facing producers as a group—and whether or not they are likely to have adequate resources for the next production cycle. One of the ways that national accounts are utilized is by examining how value added is distributed among the factors of production: land, labor, and capital, as well as to entrepreneurial management. While agricultural GDP is useful in measuring the overall performance of the sector over time, it is less informative about the well-being of different categories of producers and households. Many households engage in nonfarm work activities, and sometimes more than one household shares the returns of a farm holding. These complex resource allocations within and among households, along with an uneven distribution of income, mean that average GDP income is not a useful indicator of well-being. Because the ultimate goal of nearly all development projects is to reduce poverty, more detailed indicators are required to monitor progress, and in this capacity the use of household surveys has been prescribed. Using household surveys to collect data on agriculture, however, is very resource-intensive, to the point that the surveys are often not practical in many developing countries (although the Living Standards Measurement Survey-Integrated Surveys on Agriculture (Carletto 2009) represents an important recent success in this respect). The *Sourcebook* (World Bank 2008b) presents a number of alternatives to household surveys, including a service delivery survey to determine whether services are actually reaching the poor and vulnerable.

THE SOCIAL DIMENSION

The social dimension covers the need to reduce risk and vulnerability, including food security, and issues related to gender.

Reducing risk and vulnerability. National leaders and private decision makers in the marketplace will be better able to manage risk and vulnerability with information that enables them to recognize or forecast potential hazards. While natural disasters such as droughts and storms are relatively constant sources of risk, market factors can seriously compound that risk. For instance, a drought in a major producing region combined with large-scale transition from food to biofuel production in another major producing region can, as we have seen, seriously inflate global food prices. Effectively managing risks at this level requires excellent and timely data, and ensuring access to these data is a concern that has major ramifications for international food security.

Food security. Assessing food security at the national level requires information on commodity production, using a number of the indicators used to measure productivity and market efficiency. In addition, food security includes consideration of food trade and nonfood use (fuel, drug industry,

seed, feed, etc.). Information on consumption by agricultural and nonagricultural households is also required. The information on food demand collected in household surveys involves all households in the country, urban and rural, agricultural and nonagricultural. Food security also requires information to assess the food gap in terms of nutrients.

Gender. In many developing countries and in rural societies in particular, household roles, responsibilities, and rights are highly gendered. Income commanded by women has a disproportionately positive effect on the health, nutrition, and education of other members of their households. Women have also proven to be highly receptive adopters of technologies that raise yields and improve environmental management, such as agroforestry techniques—once their property rights have been secured. The Third Millennium Development Goal, to "promote gender equality and empower women," therefore, carries particular weight in the rural and agricultural development agenda, and the need to disaggregate pertinent data by gender is generally acknowledged.

THE ENVIRONMENTAL DIMENSION

The environmental dimension of agriculture generally applies to the sector's sustainability and to its provision of environmental services.

Agriculture and the environment. Policies and programs that seek to mitigate its environmental impacts or to capitalize on its potential as a source of environmental services require extensive information. Public officials and development practitioners who champion such policies or who promote such investments are often in a position of advocacy in which they must solicit the commitment of scarce resources. In this role they require the credibility that only reliable information can give them. Their ability to present informed estimations of the likely impacts of environmentally sustainable agricultural initiatives is essential, particularly given the politically sensitive contexts in which they often operate. The scale of agriculture's impacts on the environment remains indeterminate without sound data.

While more detailed data on agriculture's beneficial and adverse impacts on the environment are urgently needed, some broader facts point to the sector's general significance. The opportunity costs of foregoing its potential as a source of environmental services are likely very great. Environmentally sustainable agriculture can sequester large volumes of carbon from the atmosphere. It can also play a positive role in managing watersheds and in preserving agricultural biodiversity. Estimating the payoff of switching from less sustainable production systems to more sustainable ones requires disaggregated data in a number of areas, including data on agricultural inputs. For instance, the question of how much fertilizer is used and how much of it returns to the watershed as runoff is particularly important because more efficient fertilizer use can increase productivity even as it reduces the amount that becomes a source of water pollution.

Food and feed products for biofuels. Biofuels may reduce carbon emissions from burning fossil fuels and raise income for producers. The supply effects of converting food and feed crops to biofuel production can also raise food prices, quite possibly to a level that pushes consumers into poverty. For this reason the use of nonfood crops such as switchgrass and jatropha to produce biofuels has received increased attention. Switchgrass can be cultivated on marginal, highly erodible lands with little other agricultural potential, and converting its biomass to fuel requires less energy than the conversion of food crops. Jatropha is a small seed-producing tree whose seeds can be crushed to produce oil that can be used to produce biodiesel. The crop is being grown in South America, Africa, and Asia, and it is resistant to drought and pests. The production of these nonfood commodities could still raise food prices if they replace traditional crops and the input and marketing infrastructure that was developed around them. Output quantities and input prices relevant to biofuel issues are also relevant to the measurement of productivity. These, however, must be available in a disaggregated form in order to measure the relative costs and benefits of biofuel commodities and other agricultural commodities—particularly food crops.

Land cover and use, including forestry. Land is the foundation of agriculture and forestry. How the land is used determines its sustainability and productivity. The use of land can also have environmental consequences that range from pollution of waterways to global warming. Land cover is defined as "the observed physical cover including the vegetation (natural or planted) and human constructions that cover the earth's surface" (FAO 2005a). Agricultural expansion is the principal factor contributing to deforestation, which results in increasing levels of carbon dioxide in the atmosphere. Forests and woodlands absorb carbon dioxide (a major cause of global warming) from the atmosphere, thus mitigating the effect of carbon emissions from burning fossil fuels. It is necessary to monitor land cover over time to reveal changes resulting from deforestation, urbanization, desertification, and other measures related to not only agricultural productivity but also to the overall affect on the environment and global warming.

The System of Integrated Environmental and Economic Accounting (SEEA) uses two land classification systems. The *Land Cover Classification System* manual (FAO 2005a), jointly prepared by the FAO, the United Nations Environment Programme (UNEP), and Cooperazione, Italiana, provides an international standard with which to categorize land cover and how humans activities affect it. This establishes a direct link between land cover and the actions of people in their environment. For example, "grassland" is a land cover, while "rangeland" refers to its *use* to support livestock. The other classification is contributed by the FAO based on global statistical databases of agricultural and forestry land-use structures.

Water use. Like land, water is a critical integrating variable that cross cuts with agriculture, forestry, and fisheries, which, in combination, affect the environment, climate change, and food security. Water for irrigation is a major factor in improving land productivity and crop yields. According to AQUASTAT, FAO's global information system on water and agriculture, agriculture uses 70 percent of freshwater withdrawals globally and 85 percent in developing countries. Demand for water is increasing for both agricultural and nonagricultural uses. In some countries, this is leading to unsustainable extraction of groundwater. There is a lack of data concerning water use for agriculture, the distribution of irrigated land, and water use practices, including aquaculture.

AGRICULTURAL STATISTICS: SCOPE AND COVERAGE

Scope. The starting point in determining the scope of required agricultural statistics is the system of national accounts (SNA), which provides international standards for concepts, definitions, and classifications of economic activities. The conceptual framework also points to the need for a system of environmental accounts with which to monitor the effects of agriculture on the environment. The System of Integrated Environmental Economic Accounting (SEEA)—which is a satellite account of the SNA—should be the starting point for environmental statistics. While there is a framework for household decision making, there is no equivalent internationally accepted standard for social statistics. The guiding principle will be to follow the socioeconomic variables captured within the national accounts.

The International Standard Industrial Classification of Economic Activities (ISIC) divides agricultural production into three categories or groups. Group 011 encompasses the cultivation of crops, market gardening, and horticulture. Group 012 relates to "farming of animals," and group 013 to mixed crop and livestock production. The FAO uses this classification to determine the scope of the agricultural census as described in *The World Program for the Census of Agriculture 2010* (FAO 2005b). The Central Product Classification (CPC) provides an additional international standard. Its most recent revision, CPC 2.0, contains a number of important amendments and refinements in the area of agriculture, forestry, fisheries, and food. Items such as crops, livestock products, machinery and equipment, and fertilizers and pesticides that are included in *World Programme for the Census of Agriculture 2010* (FAO 2005b) are also classified in the CPC 2.0. Both ISIC and CPC provide important instruments for integrating agricultural statistics into national statistical systems.

Agroforestry and aquaculture are considered to be agricultural activities, although other activities related to forestry and fisheries are generally outside the scope of the agricultural census—unless they are carried out in association with production on an agricultural holding. In many countries these compete with agriculture for land and water and are often the object of land-and-water-use policies that have both economic and environmental consequences.

The scope of agricultural statistics based on the broader conceptual framework includes aspects of forestry, fisheries, and land and water use. This expanded purview is required to address the merging and often closely related economic, social, and environmental issues faced by policy makers.

Because of the fundamental relationship between agriculture and land, the geospatial aspects of land should be seen as an element of the scope of agricultural statistics. The geospatial scope for agricultural statistics should focus on the use of land for agriculture and forestry and take place within a broader scope of national land-use statistics.

Forestry and agroforestry relate both to the production of forest products and to the interface between forestry and agriculture as an area of environmental impact. Collecting and reporting the data required for forestry and woodlands outside of agriculture will be the responsibility of the conventional sources, which, from a governance standpoint, will become part of the national statistical system for coordination purposes.

Aquaculture and capture fisheries are important components of both food supply and security and household income. Aquaculture is defined by the FAO's *World Programme for the Census of Agriculture* (FAO 2005b) as the farming of aquatic organisms such as fish, crustaceans, mollusks,

aquatic plants, and other aquatic organisms. This implies feeding, regular stocking, protecting, and raising organisms through one or more life cycles. All aquaculture and capture production, employment, and food security information will be within the scope of agricultural statistics. *This does not mean the national statistical office undertakes the data collection if it is the responsibility of another governmental body*. However, the responsibility for oversight should reside with the national statistical system, which will use common standards, definitions, and coordination of the data that are published.

The scope of agricultural statistics will include use of water for agricultural purposes, including irrigation and other uses, the source of irrigation water, the land under irrigation, the irrigation method, and the resulting production. This will be done in collaboration with the FAO-AQUASTAT Programme, the global information system on water and agriculture.

The intersection of the connections between the dimensions of the conceptual framework points to the need for data described in systems of accounts such as supply utilization accounts, food balances, and income accounts for the household and agricultural enterprises. These accounts require data from many sources, including the government, households, agricultural holdings, and agricultural businesses. The following paragraphs define the coverage and statistical units to be included in the scope of agricultural statistics.

Coverage. The FAO's *World Program for the Census of Agriculture* (FAO 2005b) recommends that the 2010 round of the census consider the agricultural holding as the basic unit for economic statistics. However, the same report provides guidelines about the use of a population census and the collection of agricultural data for households that are not agricultural producers. The use of the population census to obtain basic information about agricultural and rural households provides a means of broadening the scope of the coverage required to meet the emerging data requirements of the conceptual framework. *The World Program for the Census of Agriculture* (FAO 2005b) and the *Sourcebook* (World Bank 2008b) also consider the rural community as a unit for social statistics. The basic unit for social statistics is the household; for environmental statistics it is the land parcel. The challenge will be to link these statistical units. In many cases, there will be one-to-one relationship between the agricultural holding, the household, and the land parcel. In these cases, it will be feasible to collect economic, social, and environmental information from one unit. If these units are georeferenced, then the three dimensions can also be associated with the overall land use.

In some cases, there will not be a one-to-one correspondence between the agricultural holding and the household. However, a goal should be to statistically establish the links between the economic, environmental, and social dimensions as described in the conceptual framework. Chapter 4 will discuss a strategy for establishing these links via an integrated statistical system.

Rural households fall within the scope of agricultural statistics. Agricultural development provides a pathway out of poverty and hunger for the rural poor. These pathways can include improving the income of small agricultural holders through wage employment in agriculture or the rural nonfarm economy, or through migration. The need for statistics for rural development led to the production of *The Wye Group Handbook on Rural Households Livelihood and Well-Being* (United Nations 2007). The necessary data underlying many of the indicators needed to monitor rural development and economic growth leading to poverty and hunger reduction are based on the rural household as a statistical unit.

Other statistical units required by the Global Strategy are enterprises that service agriculture such as input suppliers, processors, and transporters of agricultural goods. While these economic units are outside the conceptual framework for agriculture, they do provide information on prices and quantities that are important for economic and environmental accounts. Local communities are important sources of information on social services provided to agriculture holders and rural households.

The coverage of agricultural statistics should be as exhaustive and as comprehensive as possible, and any omission of units based on their size, importance, location, or other criteria should be avoided. Many countries apply such criteria to reduce the costs of collecting data. Some stipulate a minimum size that a holding must be in order to be included in a census or survey. Some concentrate data collection in major producing areas. This selective focus leaves smaller plots and remote parts of a country unrepresented in agricultural statistics, although these areas may account for a majority of the country's food insecurity and poverty. The omission of small-holder and household plots also deprives decision makers of information about local subsistence strategies or the amount of income households receive from selling produce from gardens and small plots. Because many small holdings are often the responsibility of women, the omission of this information overlooks a key source of gender-disaggregated data on well-being.

For the purposes of the Strategy, all agricultural units regardless of size and location should be included in the scope of

agricultural statistics. This would be made possible by the inclusion of some basic questions about agriculture in the population census. The inclusion of the small and geographically isolated household holdings in the annual statistical program will be considered in the following chapters on methodology. While size criteria and geographic coverage should be inclusive for the population and agricultural censuses, these can be different for the annual survey program, which more often covers commercial farms.

The agricultural statistician faces special problems. Agricultural production is seasonal and related to the biological life cycle of plants and animals. More than any other sector, it is dependent on the physical landscape (fertility and type of soil), weather, and climate. Agriculture must be self-sustaining; grain harvested provides the seed for next year's crop, and animal births represent the next generation. While agriculture feeds the world, certain amounts of its production need to be set aside for reproduction even in times of drought or famine. A complicating factor is that many items are perishable. These issues create fundamental requirements for current, timely, and accurate measures of production. The need for timeliness is a major factor underlying agricultural statistics—information about a bumper crop is worth little if it becomes available after the crop has rotted in storage because of lack of information about its availability. In order to provide information that generates an accurate picture of the activities of the agriculture sector, statisticians, therefore, require data that take into account seasonal variation and the heterogeneity of production patterns.

The data requirements and the conceptual framework for agriculture have been described. The next chapter builds on these topics to establish a minimum set of core data that can be used to derive many of the required indicators.

Chapter 3: THE FIRST PILLAR—IDENTIFYING A MINIMUM SET OF CORE DATA AND DETERMINING NATIONAL PRIORITIES

This chapter defines a minimum set of internationally comparable core data that countries should provide. The data requirements are shown as a menu of indicators in annex A. This menu of indicators includes those that are sector wide for agricultural and rural development as well as others for subsectors such as crop and livestock, indicators for climate change, land and the environment, and the rural economy. The menu shows data requirements to provide the indicators, data sources, and technical notes. Box 1 provides examples of indicators, data items, and variables. The selection of these core data is necessary because the total amount of data that would be required to meet all requirements exceeds what most developing countries can currently provide—until the capacity of their statistical systems has been substantially increased. A framework is presented for countries to identify other items in addition to this core set of data, to determine the frequency that data should be provided, and to establish the extent of the national coverage that is required. The core and national items and associated data will be used as starting points to implement the Global Strategy as it is defined in chapter 4.

The indicators in annex A reveal that basic statistics on crop production, livestock, aquaculture, fish captures, and timber removal from forests are major sources of information. The *World Program for the Census of Agriculture* (FAO 2005b) lists 149 crops, 28 livestock species, and about 1,400 fishery and aquaculture species. Not all are produced in every country, and they are not of equal importance everywhere they are produced. Data on inputs, production, and prices for all of those several hundred items are needed for indicators such as GDP growth from agriculture value added and a number of others. The United Nations Food and Agricultural Organization (FAO) sends annual questionnaires to countries requesting data on production, trade, land use, agricultural machinery and equipment, fertilizer, and pesticides. Producer price data are also requested. The problem is that these annual requests cover the population shown above. These data requirements exceed what any country can produce on an annual basis. Therefore, the first step is to select a minimum subset that countries will provide using common definitions and methodologies to ensure that measurements are internationally comparable. The goal is to determine the minimum subset of items for which data will be provided annually and the frequency with which the remaining data will be furnished.

BOX 1: Indicators, variables, and data items

A food production index is an indicator.

Maize is a data item that enters into the index.

Variables about maize include area harvested, yield, production, utilization, prices, etc.

The following paragraphs describe the process to establish an internationally agreed upon set of core data items that each country will provide. Because countries have varied and limited capabilities, it will be necessary for each of them to establish priorities on what to include in their national statistical system in addition to the core set.

Core data items are selected on the basis of their importance to agricultural production globally. For example, only about 10 crops and 4 livestock species account for over 95 percent of the world's production of cereals, meat, and fiber. A core item is one whose data enter into a multitude of indicators needed to monitor and evaluate development policies, food security, and progress toward meeting the Millennium Development Goals (MDG). Core data should provide inputs to the national accounts and global balances of supply and demand for food and other agricultural products. Core data items that are crops should account for a major proportion of land use, contribute significantly to farm and rural household well-being, and have an effect on the environment and climate. A core item should be the first to be included in the statistical system and the last to be removed as a result of budget shortfalls.

Core items and their related data are required by the global statistical system to monitor issues that go beyond national boundaries. The globalization of the world's economies means that an action in one part of the world affects the food supplies, the environment, and the climate in other areas.

The list of core items and associated data should establish the framework for the agricultural and rural components of the National Strategies for the Develop of Statistics (NSDS) when they are being implemented. The set of core data items will be the building block to establish methodology and to integrate agriculture and rural statistics into the national system.

The designation of core data starts with basic production statistics for the major crop items, livestock, aquaculture, fishery products, and forestry; and continues with agricultural inputs, socio-economic data, land cover, and public expenditure. These are presented in the following section, which is itself followed by a framework for countries to add their additional national requirements to the core list and to also determine the frequency for which both core and national data will be provided.

SET OF CORE ITEMS AND ASSOCIATED DATA

Core crop items. Wheat, maize, barley, sorghum, rice, sugar cane, soybeans, and cotton are core crop items. These account for a major proportion of agricultural land use, of overall food supply, and of value added from agriculture. Their production can vary considerably from year to year. Because their products can be used for a variety of purposes, including bioenergy, decisions about which commodities to produce can have important implications for food supply. Data required for these core items include:

a. Area planted and harvested, yield, and production.
b. Amounts in storage at the beginning of harvest.
c. Area of cropland that is irrigated.
d. Producer and consumer prices.
e. Amounts utilized for own consumption, food, feed, seed, fiber, oil for food, bioenergy, and net trade or imports and exports.
f. Early warning indications such as precipitation, windshield surveys of crop conditions, and vegetative indices provided by satellite observations.

Core livestock items. These include cattle, sheep, pigs, goats, and poultry. These are major sources of food supply and agricultural income. Consumption increases as countries develop and incomes grow. Increased demand for livestock products leads directly to increased usage of feed grains, and can lead to situations in which feed production competes with food production, even though the feed is ultimately an input to food production. Livestock are also sources of methane emissions, water pollutants, and disease risk. All of these factors can be affected by policy decisions. Data required for these livestock items include:

a. Inventory and annual births.
b. Production of products such as meat, milk, eggs, and wool, and net trade or imports and exports.
c. Producer and consumer prices.

Core aquaculture and fisheries products. These contribute significantly to food supplies, and in the case of aquaculture, production entails the use of land as well as of water resources. Fisheries provide livelihoods for small-scale and inland holdings. Data required include:

a. Area cultured, production, prices, and net trade or imports and exports for aquaculture.
b. Quantity landed and discarded, number of days fished, amounts processed for food and nonfood uses, prices, and imports and exports.

Core forestry production. Forestry is a major land use, provides income, and has a significant role in understanding the forces affecting climate change. Data required include:

a. Area in woodlands and forests, quantities removed, and their prices for land associated with agricultural holdings.
b. Area in woodlands and forests, quantities removed, and their prices for products from nonagricultural holdings and respective utilizations.

Core agricultural inputs. Core inputs to agricultural production include labor, chemicals, water, energy, and capital stocks. Inputs are considered core because, in combination with data about outputs, they provide measures of agricultural productivity important to monitoring and evaluating steps to reduce poverty and hunger. Data required include:

a. Quantities of fertilizer and pesticides utilized.
b. Water and energy consumed.
c. Capital stocks such as machinery by purpose (i.e., tillage or harvesting).
d. Number of people of working age by sex.
e. Number of workers hired by agricultural holders.
f. Employment of household members on the agricultural holding.

Core socioeconomic data. The socioeconomic characteristics of agricultural and rural households include household income by source as a key measure of the economic well-being of rural households to guide policy decisions about developmental efforts to reduce poverty. Periodic data about the number of households, employment, population, age, gender, and education levels are also required.

Land cover. A fundamental way to evaluate agriculture's affect on the environment is to monitor changes in land cover and use. Land cover does not change rapidly and data are not, therefore, required on an annual basis. However, mapping products or digitized data from remote sensing should provide complete coverage for the entire land mass of a country with the following classifications:

a. Cropland
b. Forest land
c. Grassland
d. Wetlands
e. Settlements
f. Other land
g. Water

Public expenditures on subsidies, infrastructure, and health and education in rural areas are core items. This should include the availability of roads, transport services, communications, and extension services.

Table 1 below shows the core data items grouped by key variables in the economic, social, and environmental dimensions. Note that the basic production data items are required annually. The strategy to establish the frequency of the remaining core data items is described in the next section that elaborates on the steps to determine the national priorities. The frequency requirement is also considered in the design of the integrated survey framework presented in chapter 4.

DETERMINING NATIONAL PRIORITIES: CONTENT, SCOPE, AND FREQUENCY

Data for some core items will not be required every year either because they do not change much from year to year or because they are difficult and expensive to obtain annually. Countries will also have additional items to add to the list of core items to meet national data needs. *Teff,* for example, is a major crop and food source in Eritrea and Ethiopia, but not in other countries. Items such as rice, on the other hand, are major global food sources, but are not produced in every country.

Each country, therefore, needs to select which core items to include in its national system. It must add other items relevant to its economy and determine how frequently data will be provided and the scope of the national coverage required. For example, the core data do not include fruits and vegetables or other livestock items that contribute to a country's food supplies and household income. Each country should consider how these should be included in its national system.

Annual data are generally required for those items that, combined, account for more than three-fourths of a country's value of production. Items with production that can vary significantly from year to year should be included, particularly if the production fluctuations are a major source of risk for vulnerable households and food supplies. Items that account for a significant proportion of land used and that have short-term effects on land use and the environment should be represented as well. Including items that are produced by only a small number of households or holdings or that account for only a small share of the country's land has sample design and resource implications. For example, sampling theory shows that the relative variance of the estimated mean is approximated by the relative variance of the positive sample units plus the relative variance of the estimated proportion of positive population units.

$CV^2 (Y) = CV^2 (Y_p) + CV^2 (P)$ where Y_p is the mean of the positive responses and P is the proportion of the population that has the item

Assuming that only a third of the households or holdings have a particular item, the sample size will have to be four times larger than if three-fourths have the item in order to achieve the same level of precision. If only 10 percent of the households or holdings have the item, then sample sizes triple over what is needed if a third are positive and would be 12 times greater than if (P) > 0.75 for the same level of precision. The general conclusion of this exercise is that minor and relatively rare commodities should be confined to the 5 to 10 year agricultural census and omitted from more frequent surveys. The exception would be if the sample frame contains sufficient data that can be used in the survey design to target the rare items.

The next step is to review the rural development indicators for monitoring and development in the *Sourcebook* (2008) and include those relevant to the national situation. Then each country should determine the level of geographic coverage and detail to be provided for the core plus additional items added. The same issue raised above about the

TABLE 1: Minimum set of core data

GROUP OF VARIABLES	KEY VARIABLES	CORE DATA ITEMS	FREQUENCY[a]
ECONOMIC			
Output	Production	Core crops (e.g., wheat, rice, etc.) Core livestock (e.g., cattle, sheep, pigs, etc.) Core forestry products Core fishery and aquaculture products	Annual
	Area harvested and planted	Core crops (e.g., wheat, rice, etc.)	Annual
	Yield/births/productivity	Core crops, core livestock, core forestry, core fishery	Annual
Trade	Exports in quantity and value	Core crops, core livestock, core forestry, core fishery	Annual
	Imports in quantity and value	Core crops, core livestock, core forestry, core fishery	Annual
Stocks	Quantities in storage at beginning of harvest	Core crops	Annual
Stock of resources	Land cover and use	Land area	
	Economically active population	Number of people in working age by sex	
	Livestock	Number of live animals	
	Machinery	Number of tractors, harvesters, seeders, etc.	
Inputs	Water	Quantity of water withdrawn for agricultural irrigation	
	Fertilizers in quantity and value	Core fertilizers by core crops	
	Pesticides in quantity and value	Core pesticides (e.g., fungicides herbicides, insecticides, disinfectants) by core crops	
	Seeds in quantity and value	By core crops	
	Feed in quantity and value	By core crops	
Agro processing	Volume of core crops/livestock/fishery used in processing food	By industry	
	Value of output of processed food	By industry	
	Other uses (e.g., biofuels)		
Prices	Producer prices	Core crops, core livestock, core forestry, core fishery	
	Consumer prices	Core crops, core livestock, core forestry, core fishery	
Final expenditure	Government expenditure on agriculture and rural development	Public investments, subsidies, etc.	
	Private investments	Investment in machinery, in research and development, in infrastructure	
	Household consumption	Consumption of core crops/livestock/etc. in quantity and value	
Rural infrastructure (capital stock)	Irrigation/roads/railways/communications	Area equipped for irrigation/roads in km/railways in km/communications	
International transfer	ODA[b] for agriculture and rural development		
SOCIAL			
Demographics of urban and rural population	Sex		
	Age in completed years	By sex	

a The frequency for the items not specified will be established by the framework provided in the Global Strategy to determine the national priorities for content, scope, and frequency. The frequency requirement will also be considered in the establishment of the integrated survey framework where the data sources will be defined.

b ODA = Official Development Assistance

TABLE 1: Minimum set of core data

GROUP OF VARIABLES	KEY VARIABLES	CORE DATA ITEMS	FREQUENCY
	Country of birth	By sex	
	Highest level of education completed	One digit ISCED by sex	
	Labor status	Employed, unemployed, inactive by sex	
	Status in employment	Self employment and employee by sex	
	Economic sector in employment	International standard industrial classification by sex	
	Occupation in employment	International standard classification of occupations by sex	
	Total income of the household		
	Household composition	By sex	
	Number of family/hired workers on the holding	By sex	
	Housing conditions	Type of building, building character, main material, etc.	
ENVIRONMENTAL			
Land	Soil degradation	Variables will be based on above core items on land cover and use, water use, and other inputs to production.	
Water	Pollution due to agriculture		
Air	Emissions due to agriculture		
GEOGRAPHIC LOCATION			
GIS coordinates	Location of the statistical unit	Parcel, province, region, country	
Degree of urbanization	Urban/Rural area		

TABLE 2: Frequency of coverage by geographic and structural detail

	Level of geographic and structural detail			
DATA ITEM	**MAJOR PRODUCTION AREAS ONLY—PRODUCTION BY HOLDINGS**	**NATIONAL COVERAGE OF PRODUCTION BY HOLDINGS**	**WITHIN COUNTRY ADMINISTRATIVE AREAS—PRODUCTION BY HOLDINGS**	**INCLUSIVE OF HOUSEHOLDS AND HH PLOTS**
Crop A	Annual	Annual	Decennial census	Decennial census
Crop B	Biannual	Biannual	Decennial census	Decennial census
Crop C	Decennial			
Crop Z				
Livestock A				
Livestock B				
Livestock Y				
Aquaculture and fishery				
Forestry				
Inputs				
Household income				
Change in land cover				

Time and available resources result in a necessary compromise between frequency, level of geographic detail, and other breakdowns.
These categories need to be considered for each data item.

proportion of households or holdings that have the item will also determine the level of geographic detail or other breakdown that can be provided from the sample surveys. These have implications about the methodology to be used and the resources required. The annual collections of data will rely upon sample surveys that will limit the geographic detail that can be provided. Therefore, it may be only through an agricultural census that detailed geographic or size distribution data can be provided.

The question of what level of detail is required and how often data are required may be difficult to answer. Table 2 presents a decision matrix that is useful in many contexts. For example, it should be determined for each item whether the data will be provided for the entire country or only for the major producing areas.

It is generally true that policy makers will want data for within country administrative areas such as provinces; if so, this should be included in the national framework.

At this stage, each country should have an overall picture of the content of its national statistical system for agriculture, including the rural, forestry, and fishery components and the coverage and frequency of the data provided. Input from policy makers and other data users should shape this final picture.

The data-user requirements, conceptual framework, and steps to determine the content of the national statistical programs have been defined. The following chapter provides the strategy and methodology to integrate agriculture into the national statistical system and improve agricultural statistics.

Chapter 4: THE SECOND PILLAR—INTEGRATING AGRICULTURE INTO NATIONAL STATISTICAL SYSTEMS

This chapter provides an overview of the statistical methodology to improve agricultural statistics that will meet the requirements of policy makers and other data users. The conceptual framework is used as a base. The statistical framework will provide the blueprint for the methodological requirements for agriculture in the national strategies for the development of statistics. The integration and underlying methodology described below considers the quality dimensions, which include relevance and completeness, accuracy, timeliness, accessibility, coherence, and comparability.

The process of improving agricultural statistics will begin with the integration of agriculture into the national statistical system. This integration will be accomplished by the development of a master sample frame for agriculture to ensure relevance and completeness; its use in implementing a coordinated data collection program to produce timely and accurate data that are coherent and comparable; and a strategy for data dissemination to ensure accessibility. This integration of agriculture into the national statistical system is needed for several reasons.

One of the shortcomings of current statistical systems in both industrialized and developing countries is that data are collected by sector, using different sampling frames and surveys. The division of data by sector leaves no opportunity to measure the impact of an action in one sector on another. Surveys are often conducted on an ad-hoc basis with no links to a master sampling frame or the use of georeferenced units for data collection. It is therefore difficult to integrate data from various surveys for in-depth analysis with cross tabulation of variables. Data on crop and livestock production are drawn from separate surveys, which are based on separate samples. The separate data provide no basis for analyzing the characteristics of farms that produce both crops and livestock, or for comparing them to farms that specialize in one or the other. Household surveys are often conducted in isolation from production surveys with no coordination or with sample sizes too small to disaggregate the data into the rural and farm sectors. The results generated from these surveys are also not integrated into a common database for access by data users.

BOX 2: Reminder:

The use of the word "agriculture" in the strategy is inclusive of the broader scope to include forestry, fisheries, and aquaculture as described in chapter 2.

More than one governmental organization is often involved in the collection and analysis of agricultural, fishery, and forestry data without coordination. While the National Statistical Office may produce the agricultural census, the annual production data could come from the ministry of agriculture, and the contribution of the fishery and aquaculture sectors may come from another authority and may be ignored or neglected by the National Statistical Office. In some cases, different organizations produce statistics for the same items, with different results, which confuse the data users and make it difficult to aggregate results across countries. This means that results then differ also at the international level if those organizations use different sources to populate their data bases.

Integrated statistical systems can resolve many of these problems by avoiding duplications of effort, preventing the release of conflicting statistics, and ensuring the best use of resources. Concepts, definitions, and classifications become standardized, allowing more systematic data collection across sources. These practical advantages of integrated data systems together with the increasing need for reliable and comparable data in a context of globalization and international concern about environmental issues point to the need for integrated national statistical systems. The World Program for the Census of Agriculture (FAO 2005b) argues forcefully for the development of such integrated systems.

In some countries, centralized organizational structures are already in place, and national statistical offices maintain the principal responsibility for agricultural statistics. However,

this centralized role may not always meet the needs of the line ministries such as the ministry of agriculture. For that reason, the statistical responsibilities in many countries are decentralized with the agricultural statistics produced by the ministries of agriculture. Both systems have advantages and disadvantages. National statistical offices have experience with statistical methodology and sample frames that other ministries do not have. However, the other ministries have more knowledge about agriculture, forestry, fisheries, and land use. The purpose of the Global Strategy is to propose a framework for integration that builds off the strengths of both systems.

The integration of agriculture into the national statistical system will be based on statistical methodology using tools that establish a closer link between results from different statistical processes and different statistical units. This can be achieved by the development of a master sampling frame, the adoption of sample designs such as overlapping samples, and the synchronization of questionnaire designs and surveys.

The master sample, sample designs, and the survey framework need to be considered together because there are choices to be made, such as whether to monitor the same farms and households, or to use different samples, and collect some of the same variables across surveys. It is also necessary that countries have some flexibility in how the master sample frame and resulting survey designs are implemented to consider their national requirements as well as statistical capabilities.

The statistical methodology to be used also needs to consider some basic data quality dimensions—timeliness, completeness, comparability, and accuracy. Measures for each quality dimension will be considered in the development of the strategy. The following sections provide the strategy to create a master sample frame followed by the sample and survey frameworks to achieve the integration.

The following strategy also builds on recent developments in agriculture statistics, including the use of satellite imagery for monitoring land use, estimating crop areas, and providing early warnings of changing growing conditions, to name a few examples. In addition, the development of global positioning systems (GPS) makes it possible to georeference observations and data collection to the land cover provided by the satellite imagery. The emergence of the Internet and other technology, such as the use of personal digital assistants (PDAs) equipped with GPS systems for data collection and their connection to databases, has tremendous potential for shortening the period between data collection and dissemination with improved data quality.

FRAMEWORK TO DEVELOP A MASTER SAMPLE FRAME FOR AGRICULTURE

The development of the master sample frame for agriculture starts by defining the population parameters, which are the physical land mass and natural environment of the country, the economic output of agriculture, and the well-being of the farm and rural populations. For data-collection purposes, the population needs to be defined in terms of the unit of measure or the statistical units. The statistical units defined in the conceptual framework include the farm or agricultural holding, the household, and the land parcels. The conceptual framework requires a link between the economic, environmental, and social dimensions and their statistical units. This entails the need for georeferencing the farms and households. All of these issues are considered in the development of the master sample frame.

Annex B provides an overview of the different approaches currently used by countries to establish sampling frames for agricultural statistics. Developing countries often use the enumeration or administrative areas established for the population census as the sample frame. Samples of farms are obtained by first selecting enumeration areas, screening them for farms or households, and then selecting a subsample for the surveys. Other countries prepare registers of farms for sampling purposes and must devote considerable resources to keep them up-to-date. A less used approach is an area sample frame, which is essentially the country's land mass divided into sampling units (Gallego 1995). Many of the requirements posed by the Global Strategy point to an increased use of area frame methodologies. A final approach is to use multiple frames (FAO 1998) to create a master frame that builds on the advantages of area frames and registers.

The master sample frame must provide the basis for the selection of probability-based samples of farms and households with the capability to link the farm characteristics with the household and then connect both to the land cover and use dimensions. The area sample frame meets this requirement. The methodology using the population census recommended for the *World Program for the Census of Agriculture* (FAO 2005) will also meet this requirement—if households from the population census are georeferenced and used as the frame for the agricultural census and linked to satellite images of land use. At this stage, only a limited number of countries have included agriculture in their population

census. According to information currently available to the FAO, only 71 countries out of a total of 189 member countries have plans to undertake an agricultural census during 2006–15. Given these constraints, it becomes important to provide alternative methods to develop the master sample frame for agriculture.

The strategy to follow starts with a long-term vision for how the master sample frame for agriculture should be developed. The strategy is mindful of differing levels of capacity between countries; therefore, alternative methods to develop the master sample frame are also provided.

The development of the master sample frame for agriculture begins with the need to link the economic and social dimensions of agriculture with those relating to land cover and other environmental issues. Because the master sample frame should be linked to land use, obtaining satellite imagery of the country's area is a useful starting point. The land cover as recorded by the satellite imagery should be classified into major categories such as cultivated land, woodlands, grasslands, idle land, and urban areas. Unless land use is changing rapidly, this imagery only needs to be updated periodically. This first step in creating the digitized land cover database should play a prominent role in efforts to build statistical capacity.

Once the land-use mapping is complete, the next step is to georeference (or digitize) the population and agricultural census enumeration areas to the satellite imagery. Countries, districts, townships, and villages should be georeferenced so that they are associated with the land-cover imagery. This enables monitoring of land use over time, and can be used to relate land use to local administrative structures. This information becomes an important component of the master sample frame for agriculture.

A number of strategies can be employed to create a master sample frame. The first method discussed below is used to establish a link between the agricultural master sample frame and the population census. Given the fact that the link cannot be made for many years because of the infrequent nature of population censuses, additional strategies are also offered for: countries with recent agricultural censuses; countries that use administrative data to construct a sample frame; and those that do not have recent agricultural censuses.

Coordinated population and agricultural census data collection. The basic information that should be obtained in the population census is whether the household is associated with a farm, and if so, what are the indicators of size, type, and the location of the land (census enumeration area or administrative unit)? This information can be used to create a register of households and farms with their land linked to georeferenced census enumeration areas or administrative units. In census enumeration areas in which agricultural data are collected, nonfarm households should be included in the register. This will provide a link between the agricultural data and all characteristics contained in the population register. While linking data from farm censuses and from population censuses provides a powerful tool for data analysis, several issues will need to be resolved. First, confidentiality rules may limit how the census data can be used to construct a master frame for agriculture. In addition, the register will need to be supplemented by a register of commercial farms not associated with households in order to provide a complete register for agricultural surveys. A more ideal approach would be to use the household or farm register as an input into the agricultural census. Then the master frame for agriculture would be the same as described below when a census of agriculture is the base.

Master sample frame with an agricultural census. The development of the master sample frame using the agricultural census includes the need to associate farms with households and both with land use. Historically, the reporting unit for the agricultural census is the farm. The first step is for data collection to not only define the farm along with obtaining production and economic information, but also to obtain information

BOX 3: The Brazilian Institute of Geography and Statistics integration of the agricultural census with the population counting

- Integration facilitated by the use of PDAs equipped with GPS for data collection.
- The list of 5.2 million agricultural holdings is referenced to the households listed in the population counting.
- Each agricultural holding can be visualized by means of Google Earth images combined with the grid of the agricultural census enumeration areas.
- The **list frame** of agricultural holdings with their respective coordinates and the set of enumeration areas surveyed by the agricultural census forms the **area frame and becomes the master sample frame.**

about the household(s) associated with the farm and the household characteristics. The coverage of the census should be inclusive of both commercial and small-scale farms plus subsistence farming households. The goal should be that the farms counted in the census be used to develop a register, and each farm should be associated with a household unless it is a corporate or institutional farm. A problem is that the point of data collection is the farm headquarters or household whose distance from the land holding poses difficulties for georeferencing each land holding to land use. Therefore, land associated with each farm and associated household needs to be linked to the appropriate georeferenced census enumeration areas or administrative units, or both. In this example, the master sample frame for agriculture will be a register of farms or households and commercial farm enterprises with their land georeferenced to enumeration areas or administrative units. Where the census is repeated at 10-year intervals, it will be necessary to update the register in the interim period using administrative information. An alternative procedure is to use two-stage sampling in which the first stage is census enumeration areas or administrative units. The first stage units could be screened annually for updating purposes.

The georeferencing of farms or households to the census enumeration or the administrative units that are part of the data layer in the satellite imagery in effect establishes an area sample frame—and becomes the master sample frame for agriculture.

Countries using administrative data to construct registers of farms. The procedures described above to develop a master sample using the census of agriculture should also be followed where administrative information such as tax records, licensing, or regulatory registers is available. However, additional steps may be required if the administrative data do not include small or subsistence farms. This could include selecting samples of administrative units or census enumeration areas, which would be screened for small and subsistence farms. Again, the georeferencing of the farms or households in the business register to either census enumeration or administrative areas in effect establishes an area sampling frame—which becomes the master sample frame for agriculture.

Master sample frame when there is not a recent agricultural census. The starting point should be the development of an area sample frame. The georeferenced satellite imagery by land-use category can also be used as the basis for an area sample frame as described by Gallego (1995). The land-use characteristics of the country should be used to select the sampling unit—segments with identifiable boundaries or a sample of points. Either method can be used with rules of association during data collection to assign both farms and related households to the segment or point that will be already georeferenced to land use. The data quality dimension of completeness is satisfied because the entire country is mapped and every farm, household, and parcel of land has a known probability of selection. It is also comparable because the same segments or points can be used for multiple surveys and over time. Once the country has established the area frame, it may begin creating a list register of large or specialized farms to use in a multiple frame context. Nevertheless, the area frame described above becomes the master sample frame for agriculture with the capability to directly link or georeference the farm or household to its associated land holding. This is an important advantage, as the households can be located in villages some distance from the land holding. The sample segments or points should also be associated with the census enumeration areas or administrative units. The link of the sample units with census enumeration areas also puts the master frame into the population census framework.

In summary, the master sample frame for agriculture can be established several ways. The common element for the three methods provided above is the georeferencing of census enumeration areas and administrative units to digitized satellite imagery classified by major land cover. The area frame sampling units can be directly associated with the land-cover classification. The land associated with the farms, households, and enterprises in the census or administrative registers is indirectly associated with land cover via the mapping to the census enumeration area or an administrative unit. A longer-term goal would be to georeference each parcel associated with an agricultural holding directly to the satellite imagery.

Once the master sample frame of farms and households has been established, the next and longer-term step is to create a register of agricultural enterprises that furnish inputs, provide

BOX 4: Master sample frame:

The underlying principle is that the master sample frame be the source for all samples for surveys of agricultural holdings, farm households, and rural nonfarm households. This means the samples can be designed so that data can be analyzed across surveys. Once the master sample frame has been developed, it should be possible for different institutions in the national statistical system to access the master sample for survey purposes with another guiding principle that the resulting data be available for analysis across other data collections.

transportation, and are the first-stage processors of crop and animal products.

The master sample frame enables the use of a rich assortment of sample designs including single- and multiple-stage sampling. If enumeration or administrative areas are the first stage of sampling, they can be selected with probabilities proportional to measures of size reported in the population or agricultural censuses. The use of enumeration or administrative areas provides a means of selecting farms, households, or a combination of them as the statistical unit.

Landing sites are the appropriate unit for surveying capture fishery production, while the master sample frame can be used to monitor other fishery-related units such as households, holdings, and enterprises. When utilizing landing sites as the sampling unit for data collection of capture production, the survey on the other aspects of the fishery sector will need to include questions about the landing sites used by each household, holding, and enterprise to allow integration of two different sampling schemes.

VISION FOR THE INTEGRATED SURVEY FRAMEWORK

This section presents a vision for the integrated survey framework. The complete survey framework includes the sample design, questionnaires, data-collection methods, analysis, and estimation. It also takes into consideration the data sources in addition to sample surveys that provide input into the survey framework. The overall strategy is presented. The technical and methodological elements will be part of the implementation plan.

The timing and frequency of data collection are major issues for agricultural statistics. Crops have different production cycles that are seasonal, while livestock production is determined not only by the respective reproductive cycles, but also the continuous production of commodities such as milk and eggs. Aquaculture has characteristics similar to livestock production. The rural labor force is also affected by the seasonal nature of agriculture, which affects opportunities for work and earnings. The timing of data collection affects the quality of the data, especially if a lengthy recall is required. As a result data collection should coincide with harvest periods. For example, if crop yields are determined by crop-cutting surveys, then these have to be measured shortly before harvest. Fish capture requires frequent sampling and surveys—for instance, twice a week or once every five days—in order for the data to reflect developments such as frequent and unpredictable changes in species composition.

The preparation of the integrated survey framework begins by first considering the set of core data requirements followed by the additional information needed by each country, as summarized in table 2 in chapter 3 showing by item the frequency of coverage, geographic detail, and inclusion of commercial agriculture versus small and subsistence farms.

The minimum set of core data includes statistics about the production of major crop, livestock, aquaculture and fisheries, and forestry products. The second requirement is for economic data on the agricultural holding, including inputs and outputs. The third requirement is to collect data on the use of fertilizers, chemicals, tillage methods, and other land-use activities to monitor how agricultural production affects the environment. The fourth requirement is to measure the social well-being of the farm and rural households. The traditional methodology is to select independent samples and conduct separate surveys for each of the categories. While the optimum sample design often leads to the selection of samples specific to crops, livestock, and the respective economic, environmental, and social surveys, it limits data analysis across the respective categories.

Single-purpose surveys generally make it easier to target the selected sample such as crops or livestock, especially where both are not present on most farms, or, when present, differ considerably in size. It is difficult to use stratified designs using many different measures of size. Recent developments in sampling theory provide an alternative using selection probabilities based on the measures of size for a number of different variables. This design is termed "Multiple Probability Proportional to Size" (MPPS) because the relative size of each farm (or enumeration area) is determined for more than one item of interest. The use of this method in China is described by Steiner (2007). It takes advantage of efficiencies of the Probability-Proportionate-to-Size sampling while adding the use of multiple measures of size. The use of MPPS is appropriate for multiple-purpose surveys in which the population sample units each only have a subset of the items of interest.

For the purposes of data analysis, it is desirable to select one large sample to provide all of the data for production,

BOX 5: China's integrated statistical system

MPPS sampling using multiple variables from the census of agriculture is used to support an expanded survey program and to integrate the statistical needs for different levels of government.

the economic situation of the holding, its environmental impact, and the social well-being of the household. It would also be desirable for the same sample to be used over time for longitudinal data analysis. While the MPPS sample design provides the basis to use a single sample, at the same time it requires lengthy and complex questionnaires to include all items of interest. For this reason, a strategy to collect data for some core items annually coupled with periodic data collection for other items is required to allow analysis across subjects.

STEPS TO IMPLEMENT AN INTEGRATED SURVEY FRAMEWORK

The integrated survey framework should be based on the minimum set of core and national data and the determination of how frequently they are required.

a. Determine the set of core items for which at least annual data are required. For those core items not needed annually, group them by category, including economic variables such as farm structure expenditures and income; environmental measures such as the use of fertilizers and chemicals and land and water use; social variables such as household income and well-being; and other items of national interest (minor crop or livestock items, for example). Data for these items will come from rotating panel surveys based on a subsample of the core survey.

b. Select a replicated sample for the annual core items using MPPS. In other words, instead of selecting one large sample, select several replicates. As shown in table 3, this allows a process to include some of the sample units in the survey across time for longitudinal analysis. Table 3 shows 12 replicates; 1 through 5 for year 1, 2 through 6 for year 2, etc. This provides longitudinal data, but also limits the number of times for respondent burden considerations.

c. Design a survey questionnaire to obtain the annual core data items. Each year the core questionnaire should contain supplemental questions regarding one of the subject matters described above. For example, in year 1 replicates 1 through 5 will be surveyed using the core questionnaire, which will also contain key questions about economic variables. The core questionnaire can either obtain all information required, or a subsample could be selected for the collection of the detailed data. In year 2, replicates 2 through 6 will be surveyed using the core questionnaire, which will also contain questions about

TABLE 3: Example of a replicated survey design with the use of an annual core questionnaire and rotating sets of supplemental questionnaires

YEAR \ REPLICATE	REP 1	REP 2	REP 3	REP 4	REP 5	REP 6	REP 7	REP 8	REP 9	REP 10	REP 11	REP 12
1	A	A	A	A	A							
2		B	B	B	B	B						
3			C	C	C	C	C					
4					D	D	D	D				
5					A	A	A	A	A			
6						B	B	B	B	B		
7							C	C	C	C	C	
8								D	D	D	D	D
9									A	A	A	A
10										B	B	B
11											C	C
12												D

Detailed Questionnaires for Rotating panel surveys

Every replicate receives the same core questionnaire every year for annual core data items plus obtains data for one following rotating panels:

A. Economic items including Farm structure, expenditures, income

B. Environmental items including inputs, chemicals, tillage, water use, land use

C. HH income, consumption, employment

D. Items of national interest

environmental issues. By year 4 all of the subject matters will have been included.

d. Each year, one of the sets of panel data will be linked to the annual core items. Also note that starting with year 4, at least one of the replicates will have been surveyed by all of the rotating panel questionnaires in addition to the core questions.

Table 3 provides an overview of a survey framework based on replicated samples that are surveyed each year for the annual core data items. In addition, each year the core questionnaire contains a set of supplemental questions for one of the subject matters that round out the minimum set of core data.

The above survey design provides a framework to collect data for core items—some annually, others on a 4-year rotating cycle. Each country will need to make its own decisions about the content of each of the components. Once the above design is in place, the next consideration is whether some of the data collections for the annual core items should take place more frequently during the year. One example would be to conduct a midyear survey to determine crop yields before harvest, another to obtain the final production and stocks.

The integrated survey framework also offers the opportunity to compare sample unit data across time, providing a major validation tool to improve data quality. The integrated framework also provides the opportunity to use alternative estimators. While the direct unbiased estimators based on the sample design form the foundation, they can be supplemented using ratio and regression estimators, or model-based estimators using census results. The use of multiple estimators can improve data accuracy and reliability.

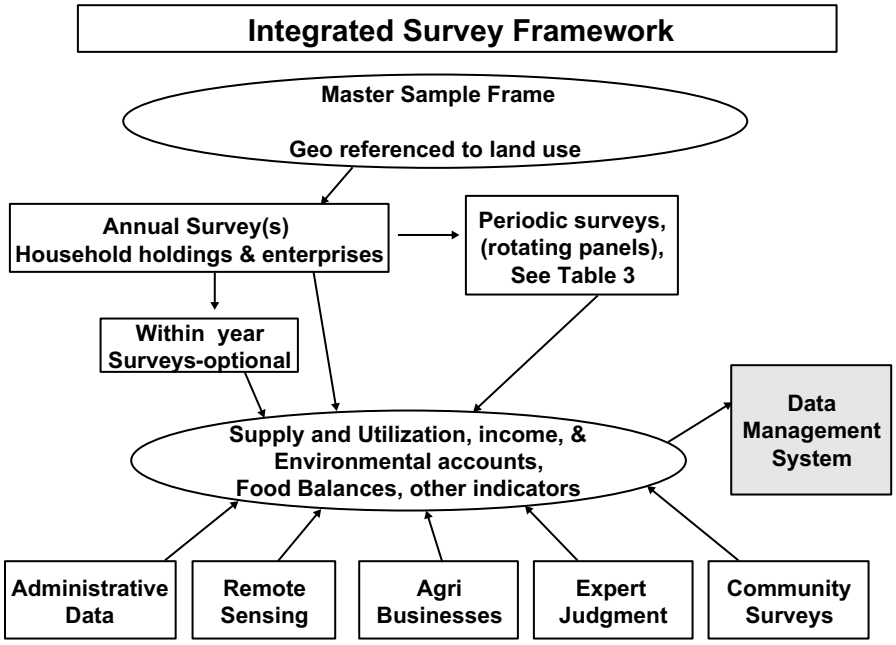
The integrated survey framework shown in figure 3 below provides an overview of how the annual and periodic surveys are connected in the data system. Note that within-year surveys can also be conducted using subsamples from the annual survey.

The survey framework also takes into account the additional data sources that need to be included in the overall framework. These include:

a. *Administrative data.* Governmental interventions such as subsidies, regulation, and legislation often require agricultural holders to report production information. Land ownership and cadastral surveys provide useful information for constructing registers. Food inspections, animal health inspections, and trade data provide input to the utilization accounts.

b. *Remotely sensed data.* These include vegetative indices that show overall crop conditions and information about changes in land cover and use. The survey framework should include the need to provide

FIGURE 3: The integrated survey framework



ground truth data if remote sensing information is to be used to estimate cropland areas.

c. *Agribusinesses* are the source of utilization data and prices.

d. *Expert judgment and windshield surveys* can be used to collect data from experts whose judgments inform evaluations of agricultural conditions. For instance, the *Sourcebook* (World Bank 2008b) refers to a procedure in which experts travel a specified route on a periodic basis and record the condition of crops, which provide an input into crop yield forecasts.

e. *Community surveys. The World Programme for the Census of Agriculture* (FAO 2005b) provides an overview of data that can be collected at the village level. These data include information about the infrastructure and services available to households and agricultural holdings, occurrences of food shortages, frequency of natural disasters, etc.

The integrated survey framework will provide annual data for a core set of items on agricultural production and other variables determined by the national statistical system. The survey framework enables longitudinal analysis of the core data, and it provides links to the data that are collected regarding economic, environmental, and social issues. The use of the master sample frame ensures that data collection is connected to land use as well. The remaining pillar of integration is the management of the data to maximize their use for analysis.

THE DATA MANAGEMENT SYSTEM

The data management system fulfills three functions—access to official statistics for dissemination purposes; storage and retrieval of survey results; and access to farm, household, and georeferenced data for research. The data management system should:

i. Support the dissemination of data to ensure the official statistics are readily available, clearly identified by source and time, and are comparable for aggregation purposes, both within and across countries. If more than one institution is involved in the national statistical system, there should either be a single database, or the databases should be coordinated to avoid duplication of official statistics. Such duplication can lead to different numbers, causing confusion among those using the data. These data should become part of FAOSTAT, the FAO statistical data base, which becomes a public good for data access.

ii. Provide the framework for the storage of the aggregated survey results and georeferenced land use data along with the supporting administrative and other data sources. Not all survey results are published; however, they should be available for research and analysis purposes. As described above, the sample and survey design enables the use of ratio and regression estimators requiring links to previous data.

iii. Build on the capabilities provided by the master sample frame's link to land use. The data management system should provide for the storage and maintenance of the farm and household survey data and for the link between the different sets of data that are georeferenced to a common land use. For example, there will be five consecutive years of core production data for the same sample units plus data from the rotating panel surveys. The strength of the integrated survey system will come from the data analysis capabilities provided by this data set.

The data management system must also encompass the other data sources depicted in figure 3. These are necessary for the compilation of supply and utilization accounts, food balance sheets, and other economic and environmental accounts. The use of these accounts provides a means to ensure the consistency of data from different sources. At the same time it helps to integrate agricultural statistics into the national statistical system by compiling them in parallel with indicators from other sectors that follow the same concepts, definitions, classifications, and accounting methodology.

The value of the integrated database will increase over time as the database itself grows. It will enable more analyses across time, and it can be used to improve data quality by comparing survey information with census data or between surveys over time. The output of the aggregated values will be the input to Country STAT,[2] following its methods and principles.

The integration of agriculture into the national statistical system through the implementation of a master sample frame, an integrated survey framework, and an integrated database will require countries to review their current governance structures. Some countries will have to make changes in order to meet the challenges of coordination and to ensure that the statistical system is sustainable.

2. Country STAT is a Web-based information technology system for food and agriculture statistics at the national and subnational levels that provides decision-makers access to statistics across thematic areas such as production, prices, trade, and consumption. The FAO forms partnerships with statistical offices and ministries of agriculture, fisheries, and forestry to introduce the system and build the national capacity to use it. www.fao.org/economic/ess/countrystat/en/.

Chapter 5: THE THIRD PILLAR—THE SUSTAINABILITY OF AGRICULTURAL STATISTICS THROUGH GOVERNANCE AND STATISTICAL CAPACITY BUILDING

The third pillar of the Global Strategy is to establish the governance and capacity that are the foundations of sustainable statistical systems. The sustainability of a statistical system depends on stable and predictable funding that ensures ongoing support for data collection at appropriate intervals. Policy makers and others who use the data are more likely to support the system that provides it and to sustain their demand for the data when it proves to be authoritative and relevant to their needs. In this way, the sustainability of a statistical system is largely a function of the demand for the data it produces and of the financial support that is required to satisfy that demand.

The current situation of poor-quality data leads to their limited use within countries and by the international community; this is an important underlying factor explaining the lack of financial support for agricultural statistics. Understanding the demand for statistical information at the national level and what is required to supply that information is, therefore, a key element of the sustainability of an agricultural statistics system. Demand can be supported and strengthened if the statistical system is responsive to users and provides statistics that are relevant, accessible, timely, and with a level of accuracy that meets their needs.

While donor funding and support will continue to be essential to improve national statistical systems, the collection of core data should, over time, become sustainable using national resources. The integration of agriculture into national statistical system will require many countries to develop an adequate governance structure and to build statistical capacity across the different institutions concerned.

GOVERNANCE

Because multiple governmental organizations are usually involved in the collection of data on agriculture, forestry, and fisheries, most countries will require a statistical coordinating authority. Even in countries where centralized units are already in place within the national statistical systems and coordinate data collection and dissemination as part of their larger responsibility for agricultural and other statistics, coordination mechanisms may be required to ensure that the statistical system is fully meeting the needs of line ministries. In most countries, however, statistical responsibilities are decentralized, and ministries of agriculture produce the agricultural statistics. Both centralized and decentralized systems have advantages and disadvantages. National statistical offices have experience applying statistical methods and using sample frames—experience that other ministries often lack. However, other ministries are likely to have greater technical knowledge about agriculture, forestry, fisheries, and land use. The purpose of the Global Strategy is to provide a framework for integration that builds off the strength of both areas of expertise.

Governance at the national level involves the organization of a national statistical system that includes sector ministries and other agencies that provide data. In the case of agricultural statistics, this will include the ministries responsible for agriculture, forestry, fisheries, and any other institutions that collect agriculture-related data.

A coordination mechanism is employed to ensure that the different data producers adhere to a common set of standards. Their compliance with these standards prevents duplications of efforts and resources as well as the publication of conflicting data from different reporting agencies. It also ensures statistical integrity by making the data available and accessible. The coordination mechanism should provide a common voice for seeking resources for the agricultural statistics system within the framework of the national statistical system. The governance it provides should enable the ministries and agencies involved in the collection of agricultural data to integrate agriculture into the preparation of the national strategies for the development of statistics.

A governance body such as a national statistics council should be established to organize the efforts of statistics stakeholders. Such a council would include the ministry of agriculture, the national statistical office, and other organizations providing statistics or administrative data to jointly organize and coordinate the development and use of the master sample frame, the integrated survey framework, and the database. It may be determined that certain ministries are best suited for activities such as those involving the master sample frame or the collection of specific types of data. All data collected, whichever ministry or agency collects them, will be based on the master sample frame in an integrated survey system with the outcomes stored in an integrated database. The role of each institution should be clearly defined and build on its knowledge and technical expertise (crops, livestock, aquaculture and fishery, forestry, land, and water).

The integration of agricultural statistics into a country's national statistical system does not mean that all responsibilities fall on the national statistical office, the ministry of agriculture, or any other agency in particular. It does, however, mean that the organizations with overlapping data needs accept the master sample frame, integrated survey framework, and database principles.

For international organizations, the integration of agriculture into the national statistical system has several implications. They will have to present their data requests to the national statistical system rather than to the individual sector institution concerned. The consolidation of data requirements between multiple international organizations would reduce the amount of overlap and minimize the data reporting requirements.

The Strategy has implications for donor organizations, including those that support statistical capacity building. Again their efforts will need to focus on the governance structure each country has organized rather than going directly to individual sectors.

A country's national statistics council will need to deal with the following cross-cutting and coordination functions:

a. Prepare or revise national strategies for the development of statistics, identifying the respective roles of each organization in the national statistics council.
b. If necessary, implement or revise legislation regarding the authorities and responsibilities for statistics—including legislation and regulations regarding confidentiality of data.
c. Develop a strategy to foster public support for the funding that a sustainable statistical system requires, particularly among policy makers and other data users. The goal is to increase country ownership of the planning process to produce statistics and the outcome.
d. Provide common standards, salary scales, and professional requirements across the organizations in the national statistical system for agricultural statistics.
e. Determine who does what in developing and maintaining the master sample frame, in determining the framework of the integrated surveys to be conducted, and in assigning responsibility for the data management system.
f. Reach agreement on the content, scope, and coverage of data, and how frequently it will be provided by the national statistical system in addition to the core data based on policy maker and other data user requirements.
g. Establish a framework to ensure that the provision of data is user driven and responsive to user requirements for timeliness and quality.
h. Work with the FAO, other international organizations, and donors to prepare a detailed assessment of the current national capabilities, and prepare a framework for statistical capacity building.
i. With input from international and regional organizations, determine funding requirements for capacity building, development of the master sample frame, and the costs necessary to sustain a survey system.

Integrating agriculture into the national system will change the focus of statistical capacity building. This capacity building currently focuses mainly on national statistical offices. Including agricultural statistics into the national statistical system makes those statistics a primary element of the national strategies for the development of statistics.

STATISTICAL CAPACITY BUILDING

The statistical capacity building component of the implementation plan of the Global Strategy should take into account the quality of agricultural statistics as a function of their accuracy, relevance, timeliness, comparability, availability, and accessibility. These different dimensions of quality all need to be incorporated into the design of systems for agricultural statistics; they should all also be addressed in efforts to build capacity for data collection and analysis. The seasonal nature of agricultural production presents a special challenge for agricultural statistics, especially for the *accuracy* and

timeliness quality dimensions. The often conflicting needs for accuracy and timeliness can be difficult to reconcile. The need for some types of data such as timely crop production estimates minimizes the time available for data collection and analysis, which has implications for accuracy.

Carrying out the Strategy will require levels of expertise that can be difficult to find (or to maintain) in many developing countries. The use of remote sensing technologies, the design of an integrated survey framework, and the use of a data management system require experienced technical personnel. While building and maintaining technical capacity in countries will be problematic, there are possibilities. One of these is to establish regional centers of excellence that can provide remote sensing capabilities, develop statistical methods, and guide the implementation of information technologies in providing support to national institutions. The establishment of these centers could be a focal point for support from donors and international organizations.

The success of the Global Strategy will require a national and international effort and commitment to implement the statistical capacity building required to rebuild the statistical systems in some countries and to make improvements in others. The implementation of the Strategy should build on a detailed country assessment that defines specific actions at country, regional, and international levels to identify priority areas, resources required, and timeframes. For many developing countries, assistance from donor agencies and technical cooperation agencies will be needed to support capacity building. This capacity building begins with support to:

- Develop national strategies for the development of statistics; where such strategies are in place, review them to determine where revisions are needed.
- Build a network of statisticians and supporting staff including data collectors.
- Educate staff on statistical methodology for sampling, survey design, data compilation, and data analysis.
- Develop and maintain the master sample frame, implement the new survey framework, and develop the data management system.
- Provide computers, software, and other technical equipment.
- Provide the satellite imagery georeferenced by land use.
- Disseminate the results and respond to requests.

The Global Strategy is a long-term plan that will face many challenges and require a concentrated effort from all stakeholders.

Chapter 6: SUMMARY OF RECOMMENDATIONS AND THE WAY FORWARD

SUMMARY

The Global Strategy to Improve Agricultural and Rural Statistics addresses the declining state of both the quantity and quality of data in developing countries. In addition, it responds to increasing demand from policy makers and the donor community for information to deal with sky-rocketing food prices and emerging issues relating to the use of biofuels, the environment, climate change, and monitoring the MDGs.

The Global Strategy broadens the scope of agricultural statistics to include aspects of rural households, fisheries, and forestry.

This broadened scope of agricultural statistics led to the basic fundamentals of the Global Strategy that are based on three pillars: (i) the identification of a minimum set of core data; (ii) the integration of agriculture into the national statistical system by the development of a master frame for agriculture, its use in an integrated survey system, and the implementation of a data management system; and (iii) the sustainability of agricultural statistics through governance and statistical capacity.

Because of the current poor state of agricultural statistics, the Global Strategy essentially provides the basis for a re-engineering of the statistics system. This will require a renewed commitment from the countries and international organizations to build statistical capacity.

The United Nations Statistical Commission at its 41st session in February 2010 welcomed the Strategy and endorsed its technical content and strategic directions. The Commission urged the expedited development of an implementation plan, including taking the steps necessary to develop the master sample frame, the integrated survey framework, and the data management system.

With regard to the implementation plan, the Commission further recommended that a comprehensive technical assistance and training program be established. It also stated that the implementation plan should include a well-targeted research agenda to support the implementation of the statistical methodology required by the strategy and also the development of methodological guidelines for specific conditions such as small-scale agriculture, agriculture under difficult conditions, and nomadic populations. The Commission recognized that the implementation of the Global Strategy will require the mobilization of resources and technical support from countries, the donor community, and international organizations.

The Commission, in its endorsement of the integration of agriculture into the national statistical system, extended the scope of the integration to include other statistical domains, including macroeconomic statistics and national accounts.

THE WAY FORWARD

The endorsement of the Global Strategy by the international statistical community led the UN Statistical Commission to direct its Friends of Chair working group and the FAO to develop the implementation plan which should reflect the varying capabilities of the countries.

This effort should begin with a complete assessment of the statistical capabilities of each country, the data they currently provide, and their readiness to begin to implement the components of the Global Strategy.

The National Strategies for the Development of Statistics (NSDS) should be reviewed and, where necessary, be revised to reflect the integration of agriculture into the national statistical system and to also reflect the implementation of the master sample frame, the integrated survey framework, and the data management system.

Based on the assessment of the statistical capabilities and the revised NSDS, a comprehensive training and technical assistance program plus a research agenda should be outlined and identify the responsibilities of the different stakeholders.

The implementation plan should provide the framework for countries to prepare detailed action plans within a period of 6 to 12 months after the Strategy is launched.

Because of the importance of the Global Strategy, the U.N. Statistical Commission will continue to be engaged and requests a progress report be made to its 42nd meeting in February 2011.

The Global Strategy and implementation planning efforts should provide the main focus for the October 2010 meeting of the International Statistical Institute Conference on Agricultural Statistics (ICAS-V).

The Global Strategy provides a ground-breaking effort to improve agricultural statistics that has important implications for other sectors in the national statistical system. While it took many years for agricultural statistics to deteriorate to the current situation, the implementation provides a fresh start. The Global Strategy should be considered a living document that will be revised on a need basis.

Annex A. MENU OF INDICATORS FOR AGRICULTURAL STATISTICS

TABLE 1: Menu of indicators, data requirements, data sources and technical notes[3]

	INDICATOR	DATA REQUIREMENTS	DATA SOURCES	TECHNICAL NOTES
	SECTOR WIDE INDICATORS FOR AGRICULTURE AND RURAL DEVELOPMENT			
1	Gross domestic product (GDP).		Censuses and surveys of firms, farms, and households for small holders.	Value added should include unreported activities as well as the value of informal or small-scale operations. Annual estimates between census or surveys based on extrapolations based on other indicators.
2	GDP growth from agriculture value added	Estimates of total production and value for all commodities produced in the country, including that from small holders and household plots minus estimates of the cost of inputs such as seed, feed, energy, fertilizer, labor, etc. Agriculture includes forestry and fisheries.	Censuses and surveys, agricultural enterprises, farm and rural households, and administrative and processor data.	SNA concepts followed. Problems include estimation of output consumed by the household and the annual coverage of all commodities for which only periodic census data are available. Annual estimates made using previous census and other administrative data if available.
3	Amount of public spending on agriculture, subsidies, and infrastructure	Government budget allocations and spending related to agriculture. Agriculture includes forestry and fisheries.	Ministry of finance, national accounts, planning commissions, donor reports.	The definition for public spending on agriculture should follow the U.N. Classification of Functions of Government (COFOG) for agriculture.
4	Amount of public spending on rural infrastructure, health, and education	Government budget allocations and spending related to rural areas.	Ministry of finance, national accounts, planning commissions, and donor reports.	Rural defined using national description.
5	Change in investment in capital stock	Inventories of machinery and equipment owned by agricultural holdings, buildings such as milking purposes, animal breeding stock, area of semi-permanent crops such as trees and vineyards, number of trees and vines.	Agricultural resource surveys of holdings and agricultural enterprises.	Machinery and equipment inventories should be by purpose (tillage, harvesting, etc.) and size.
6	Demographics of agricultural and rural population	Rural population and number of rural households, number of agricultural households and population living in them, age and education levels. Agriculture includes forestry and fisheries	Census of Population, Census of Agriculture, Household surveys, administrative records	Rural defined using national description
7	Rural poor as a percent of total poor population	Household income and consumption estimates for national and rural poverty lines. Purchasing Power Parities (PPPs) for comparisons across countries.	Household surveys. International Comparison Program for comparisons across countries.	Countries should use poverty estimates based on PPPs and extrapolate between ICP benchmarks.
8	Rural hungry as a percent of total poor population	Household income and food consumption estimates for national minimum energy requirements.	Household surveys. International Comparison Program for comparisons across countries.	Countries should use hunger estimates for monitoring food deprivation levels.
9	Food production index	Area, production, and yield for food crops, livestock numbers, and production of meat, milk, eggs, fish captured and cultured, and other food products, nonfood use of food products, and food imports and exports.	Agricultural census, surveys of agricultural enterprises, processors, fish landings, administrative data such as imports and exports. Food balances and household consumption surveys.	Follow FAO guidelines for inclusions and exclusions.

3 Indicators should be disaggregated by gender.

continued

TABLE 1: Menu of indicators, data requirements, data sources and technical notes[1] (*Continued*)

	INDICATOR	DATA REQUIREMENTS	DATA SOURCES	TECHNICAL NOTES
10	Change in value of trade—imports and exports	Imports and exports—quantities and values of agricultural products including fishery and forest products.	Customs inspections—in some countries the customs offices collect the data, which then are turned over to the national statistical office for compilation.	National statistical offices should collaborate with customs officials to ensure coding and classifications follow international guidelines.
	INDICATORS FOR AGRICULTURAL SUBSECTORS AND RURAL AREAS			
11	Productivity of crop production as measured by crop yields	Quantity harvested per unit of area such as hectare and area harvested. Area harvested distinguished between irrigated harvested crops and rainfed harvested crops.	Census of agriculture, crop-cutting surveys. Production sample surveys, processor surveys, such as oil seed crushers and cotton ginners.	Difficult to measure with multi-cropping or with crops that can be harvested more than once a year. Crop cutting can over estimate yields.
12	Change in components of crop balances	Area harvested, quantity harvested, quantities imported or exported, change in stocks, quantities by utilization such as food, biofuels, own consumption for every crop including those produced for fiber and oil.	Surveys of agricultural enterprises, administrative data on trade, processors by utilization, and household surveys for own consumption.	Crop balances should reflect the growing cycle and marketing year, which could be different from the calendar year.
13	Livestock value added	Estimates of quantity and value of production of meat, poultry, milk, eggs, by-products such as hides and skins and wool mohair minus costs of inputs such as feed and replacement stock.	Surveys of agricultural holdings, enterprises such as slaughter plants, dairies, and processors. Household surveys for own consumption	Own consumption should be included, difficult to measure.
14	Change in components of livestock and poultry balances by species	Number of animals born, acquired, slaughtered, and deaths from disease. Number of animals by purpose such as breeding, meat, milk, wool, and by age breakdowns relevant to specie (see FAO 2010 Census).	Surveys of agricultural holdings at least annually but more often for species with more frequent births during a reference period. This ranges from annually for cattle to monthly for egg production.	Data collection intervals should reflect the reproductive cycles. This suggests annual for cattle, semiannual for pork, and quarterly or shorter for poultry and milk.
15	Change in productivity of capture fish production	Quantity of fish taken by unit of fishing effort; scientific estimates of fish stock and exploitation rates.	National fishery surveys, surveys at landing sites, onboard observers, national, regional, and global assessment results.	
16	Change in productivity of aquaculture	Estimates of quantity and value of production of fish by species minus costs and quantity of inputs such as seed, feed, and fertilizers.	Surveys of aquaculture enterprise, and holdings, aquaculture census, market certifications,	
17	Change in components of fish balances	Quantities and value of captures from coastal and offshore waters, rivers, and lakes including nonlanded catch; quantities and value of products from aquaculture; utilizations including own consumption and discards, imports and exports.	National fishery surveys, fishery census, aquaculture census, surveys of fishery and aquaculture enterprises, processors, market information, and administrative and inspection sources.	See *CWP Handbook* and FAO coding and classification.
18	Change in components of forestry balances	Quantity and value of removals of products from forested areas and respective utilizations.	Appropriate ministries, satellite imagery, price surveys, or processor data.	
19	Commodity price indexes	Market reports of prices being offered by commodity and location. Prices received by the enterprise at the first point of sale.	Market observers, surveys of enterprises, agro-enterprises purchasing commodities from agricultural enterprises.	Care needed to ensure units of measure for pricing are comparable.
20	Consumer price indexes	Monthly or seasonal prices paid by the consumer.	Consumer price index.	Care is needed to ensure highly seasonal products do not distort the price series.
21	Early warning of change in food security.	Monthly or seasonal prices paid by the consumer.	Windshield surveys of crop conditions, amount of precipitation, satellite imagery of vegetative indexes, changes in trade data, and animal disease outbreak.	These do not have to be statistically rigorous, mainly to provide an early warning that other interventions are needed.

TABLE 1: Menu of indicators, data requirements, data sources and technical notes[1] (*Continued*)

	INDICATOR	DATA REQUIREMENTS	DATA SOURCES	TECHNICAL NOTES
	CLIMATE CHANGE, LAND, AND THE ENVIRONMENT			
22	Change in land cover and use	Land Cover Classification System (LCCS), area and georeferenced for cultivated land, grass or pasture, inland water, marine water, wetlands, shrubland, woodland, fallow or idle cultivated land, barren land, urban or developed areas, areas equipped for irrigation.	Land use surveys, satellite imagery. Georeferenced data on economic situation of agricultural holdings needed to understand effect of policy decisions on land use.	Ground truth data required to provide more detailed breakdowns of cultivated land, especially for crops in small plots. Difficult to apply in detail where multicropping is used.
23	Change in proportion of land area covered by forests, rate of deforestation	Area georeferenced to map materials.	Ministry responsible for forestry, satellite imagery.	Follow LCCS classification.
24	Percent of land and water area formally established as protected areas	Land and water area and georeferenced to mapping material.	Responsible ministry—satellite imagery.	Follow LCCS coding with expansion covering inland and marine water bodies.
25	Irrigated land as percent of total cropland Productivity of irrigation	Total cropland and area irrigated by source of water for irrigation (surface water, groundwater, treated wastewater, etc.) and by method (surface, sprinkler, localized irrigation). Crop yields from irrigated land compared to yields from nonirrigated areas.	Agricultural census, other crop-related surveys or water-user survey.	Irrigation refers to the artificial application of water to assist in the growing of crops (and pastures). Can be done by letting water flow over the land ("surface irrigation"), by spraying water under pressure over the land concerned ("sprinkler irrigation"), or by bringing it directly to the plant ("localized irrigation").
26	Withdrawal of water for agriculture as a percent of total water withdrawal	Area under irrigation, number of irrigations, irrigation intensity and requirements by crop, water withdrawal and turnover rate for aquaculture consumption, and per capita consumption by people and animals.	Appropriate ministries, special studies or surveys to estimate water use in agriculture and aquaculture, and surveys of aquaculture enterprises and holdings.	Should include both surface and ground water. Coding and classifications should be defined.
27	Change in soil loss from watersheds	Reduction in crop yields, reduction in area of cultivated land.	Appropriate ministries, georeferenced data with satellite imagery.	
28	Change in affect of inputs on the environment	Fertilizer, pesticide, and other chemicals applied to the soil, water bodies, and plants by type of crop and watershed area, stocking.	Agricultural census and or follow-up surveys to measure fertilize and chemical use, tillage methods.	Data should be georeferenced to land cover and use.
	THE AGRICULTURAL AND RURAL ECONOMY			
29	Number of family and hired workers on the holding	Include unpaid labor of the operator of the holding and family members plus number of hired workers.	Labor force surveys of holdings.	Need to establish standards for minimum ages of workers and the number of hours worked per week to be considered a worker. Need to define reference period. Need to ensure female workers are counted.
30	Number of household members employed by farm and nonfarm	The employment status for work off the agricultural holding for each household member.	Labor force surveys—household surveys.	Need to distinguish defined employment from unpaid household service work such as domestic chores.
31	Change in farm and rural nonfarm household income from all sources	Income to the household by sector, crop, livestock, etc. Income from investments or employment outside the agricultural holding.	Rural household survey.	Rural to be defined using national definitions.
32	Percent of rural population using services of formal banking institutions	Total number of rural households, number using credit or savings services.	Central bank or commercial banks, special surveys, agricultural census.	
33	Change in sales of agro-enterprises	Sales, net profits of enterprises providing services to agriculture.	Special surveys.	Use standard accounting principles.

Annex B. EXAMPLES OF SAMPLE FRAMES USED FOR AGRICULTURAL STATISTICS

Population census enumeration areas. The population census is usually conducted using an administrative structure in which cartographic or other mapping materials are used to divide the country into enumeration areas, which is the first level of data aggregation. Depending on the country's capabilities, the only results from the population census in some countries are the enumeration area totals for numbers of people, households, and so on. Therefore, the sampling frame is basically the listing of enumeration areas and associated aggregated data from the census. Random samples of enumeration areas are selected and screened for households from which subsamples are selected for household surveys—a two-stage sampling process. Some countries use their administrative structure of counties, townships, and villages as their framework for the census, with the village becoming the enumeration area. Villages are also used as a first-stage sampling unit in countries where the village is where the farm households are generally located.

Household registers from the population census. Countries with statistical capacity are able to develop a register of all households included in the population census. The list of population households is the sample frame used for household surveys. One problem is that the list of households becomes out-of-date with households changing or dissolving and new households being formed. Unless administrative data or other means are used to keep the population register up-to-date, survey results contain an increasing coverage bias over time.

Agricultural census enumeration areas. In many countries, the cartographic materials and data from the population census are used for the agricultural census. The sampling frame consists of enumeration areas and aggregated data from the census data collection. As in the population census, random samples of enumeration areas are selected and screened for farms or agricultural holdings for agricultural production surveys.

Registers of farms from the agricultural census. As in the household registers, countries with the capacity can use the agricultural census to develop registers of farms. This provides a powerful sampling tool because it allows a choice of many alternative sampling designs. A major weakness is that the registers rapidly become out-of-date. Out-of-date population and farm registers erode all of the data quality dimensions because the completeness of coverage changes over time, thus affecting the comparability and accuracy of the resulting estimates.

Registers of farms based on administrative sources such as business registrations or tax collections. This process is used in some developed countries. It offers the advantages of the registers from the agricultural census, but again, it needs to be updated regularly. A disadvantage of the administrative sources is that they may not include the total population, especially units below a threshold required to be registered or pay taxes. In other words, while they will be inclusive of commercial farms, they are not likely to include small-scale farms and subsistence farming units.

Area sample frames. An area sample frame is the land mass of the country or the space within a country containing the populations of interest. Both maps and satellite images are used to divide the country into administrative areas such as provinces, districts, and so forth. Satellite imagery can be used to subdivide the administrative areas into land-use categories such as cropland, rangeland, woodlands, urban areas, and so on. Sampling units of segments of land with identifiable boundaries can be formed, or each land-use stratum can be divided into square grids with a sample of points becoming the sampling units. During the data-collection process, rules of association are used to connect farm holdings or households to the segments or points. An area frame is suitable for obtaining information about variables associated with land such as crops, livestock, forests, and water. Depending on the process used, area frames can be costly and time consuming to construct. However, recent innovations using satellite imagery and two-stage sampling of points have reduced both the cost and time. An advantage of an area frame is that the frame does not go out-of-date; it is complete in its coverage, and provides a

basis to georeference survey data with the underlying land use. It also provides ground truth useful for classifying satellite imagery by land cover. The primary disadvantage of area frames is that the sampling is based on land use and not on the size and type of agricultural holding. Sampling variability becomes a problem if there is a large range in size of the agricultural holdings. A summary of the methodology of area-frame sampling is provided by Gallego (1995). Another disadvantage is that data-collection costs exceed those based on registers where telephone or mail can be used instead of personal interviews.

Multiple frames. A combination of the above frames is used, often involving the use of an area frame in conjunction with one of the list frames, to take advantage of the strengths and weaknesses of each. The United Nations Food and Agricultural Organization (FAO 1998) provides an overview of multiple-frame sampling. This is appropriate where there is a large variation in the sizes and types of agricultural holdings with a subset of large commercial farms. The list of commercial farms can be stratified by size and type, and the area frame ensures the population is completely covered by providing coverage of the small and subsistence farms.

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THE WORLD BANK

Agriculture and Rural Development (ARD)
1818 H Street, NW
Washington, D.C. 20433 USA
Telephone: 202-477-1000
Internet: www.worldbank.org/ard

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