IMPROVING AGRICULTURAL & RURAL STATISTICS
Global Strategy

Methods for measuring crop area and yield

Improved crop statistics for better decision-making in agriculture

The importance of measuring crop area and yield

Agriculture is still the most important sector of many national economies, particularly those of developing countries. Agricultural statistics are essential for monitoring trends and estimating the future prospects of agricultural commodity markets.

In particular, the reliable and timely availability of crop statistics plays an important role in planning and allocating resources, and these statistics are vital tools for policy-making in the agricultural sector.

Crop production estimates are the product of two components: area harvested and yield per unit of area. Precise estimation of both components is paramount if accurate statistics on crop production are to be obtained.

Main data items

Area planted: total area sown with temporary and permanent crops

Area harvested: total area from which the crop is gathered

Crop yield: average amount of produce obtained per unit of area harvested

$$\text{CROP YIELD} = \frac{\text{CROP PRODUCTION}}{\text{AREA HARVESTED}}$$

Other data items for the production of crop statistics:

- Use of fertilizers, plant protection products, and irrigation
- Area under different agricultural practices
- Final destination of crop production (own consumption, sales, pay for labour, pay for other inputs)
- Farm gate prices received by farmers

Main users of crop statistics

Many actors of the agricultural sector need good-quality statistics on crops.

National and local government units need data on crops as inputs for:

- Compiling national accounts
- Computing indicators for economic development planning and monitoring
- Formulating policies on health, food security, use of natural resources, rural development, etc.
- Ensuring objective resource allocation

Farmers and other agricultural operators need information on crops to:

- Make decisions on what to plant, when to plant, what seed varieties to use and what cultural practices to implement

Businesses, such as wholesalers and retailers, need data on crop production to:

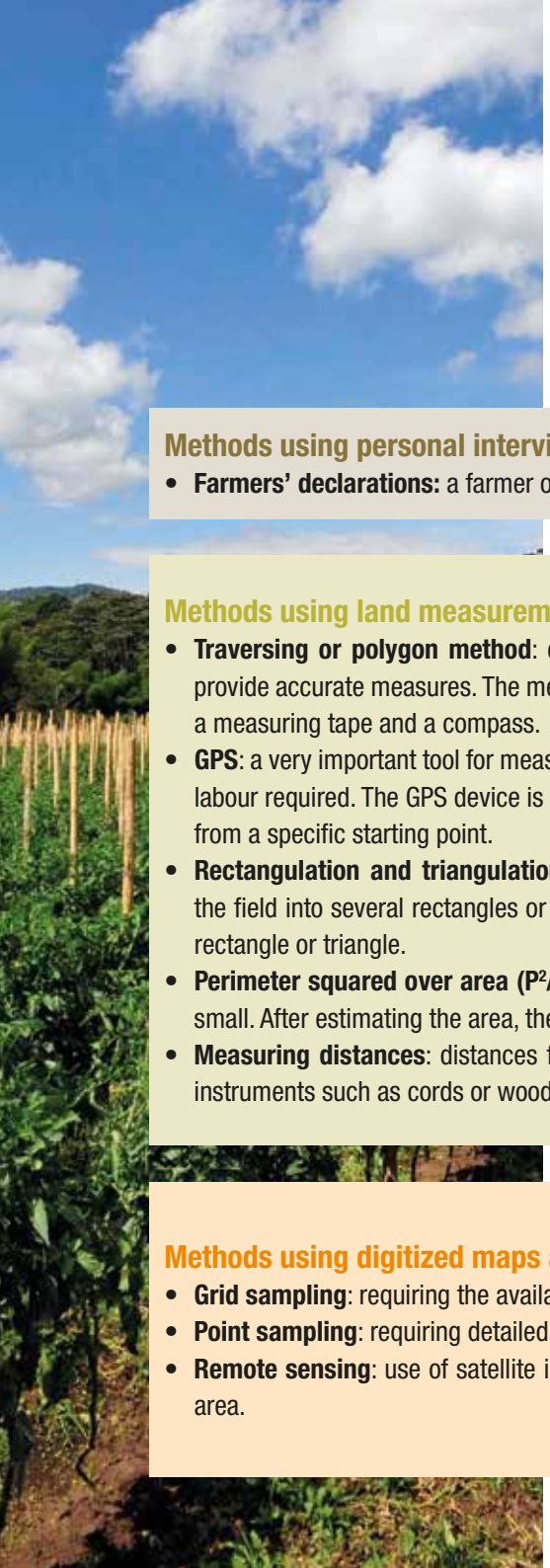
- Plan their marketing strategies
- Assess the demand for export of their produce

The international community needs:

- Integrated data on trends and future prospects of agricultural commodity markets
- Crop statistics as inputs for assessing the role of agriculture in trade and economic development
- Data to support efforts to meet agricultural production requirements for food security and poverty alleviation, and to assess the environmental impact of agricultural activities

DATA SOURCES FOR MEASURING CROP AREA AND YIELD

DATA SOURCES	MAIN TYPOLOGIES	PROS	CONS
Censuses 	Agricultural censuses	• Complete enumeration of agricultural holdings producing crops; no sampling error. • Data used to build list frames for sample surveys	• Normally conducted every 5 or 10 years. Statistics become obsolete quickly • Normally covers structural variables such as crop area, and not crop production • Processing and validating data is time-consuming
Sample surveys 	Agricultural surveys, crop production surveys, household surveys integrated with a module on agriculture	• Can provide reliable estimates • Normally done more frequently (annual, quarterly, etc.) • Smaller compared to censuses; data can be promptly processed and analysed • Questionnaires normally have a wide scope, including questions on area planted, quantity produced, prices and agricultural practices	• Presence of sampling error • If a new survey programme must be established, it implies additional costs
Administrative data sources 	Farm and land registers, administrative reporting systems, data from local government units	• Inexpensive because already available • Offer complete coverage • Timely	• Potentially large measurement error • Hard to assess data accuracy
Remote sensing 	Aerial photographs, satellite imagery	• Offer quick and easy area estimation • Information is produced with a high level of disaggregation	• Expensive • When high-resolution images are used, estimate accuracy decreases for small plots • Need for ground truth data to assess the accuracy of estimates



Methods for measuring crop area

Methods using personal interviews:

- **Farmers' declarations:** a farmer or holder is asked to report the total area planted and harvested.

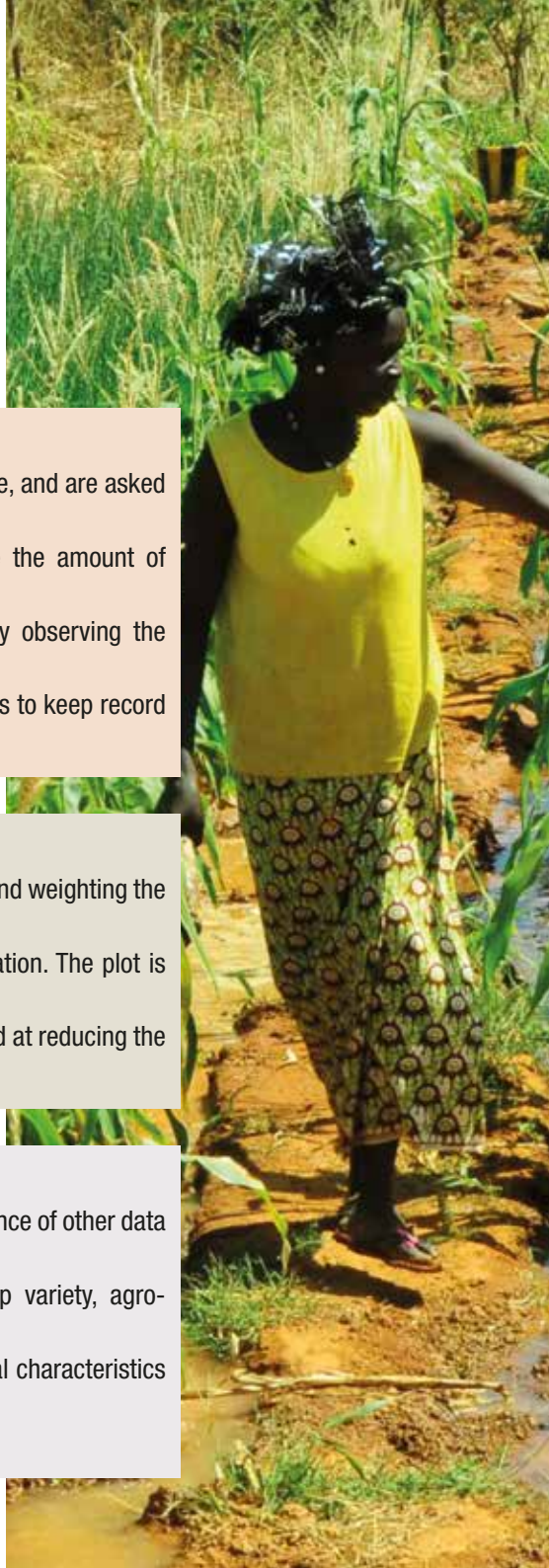
Methods using land measurement tools:

- **Traversing or polygon method**: considered the gold standard for crop area estimation, in view of its potential to provide accurate measures. The method involves measuring the length of each side and the angle of each corner using a measuring tape and a compass.
- **GPS**: a very important tool for measuring the area under a crop, with the significant advantage of reducing the time and labour required. The GPS device is held by the enumerator while he or she walks along the entire perimeter of the field from a specific starting point.
- **Rectangulation and triangulation**: used to measure fields with irregular boundary lines. They consist in dividing the field into several rectangles or triangles, and measuring the total area of the plot as the sum of the areas of each rectangle or triangle.
- **Perimeter squared over area (P^2/A)**: a good option when the perimeter is known and the number of enumerators is small. After estimating the area, the P^2/A is used to check the gross error of calculations.
- **Measuring distances**: distances from specific corners of the field can be measured by pacing or using measuring instruments such as cords or wooden poles.

Methods using digitized maps and satellite imagery:

- **Grid sampling**: requiring the availability of large-scale, accurate and detailed maps or photographs/imagery.
- **Point sampling**: requiring detailed maps or satellite imageries covering a particular geographic area.
- **Remote sensing**: use of satellite imagery and geographic information systems (GIS) techniques to estimate the crop area.

Methods for measuring crop yield



Collecting production data through personal interviews:

- **Farmer recall**: farmers are interviewed after harvest operations have taken place, and are asked to recall the amount produced from each parcel.
- **Farmer predictions**: these are taken when the farmer is asked to estimate the amount of production expected from a plot that has not been harvested yet.
- **Expert assessment**: refers to the visual assessment of crop performance by observing the condition of the crop. Normally employed by agronomists or extension officers.
- **Crop cards**: refined version of the farmer recall method, and encourages farmers to keep record of quantities harvested.

Measuring yield through objective measurements:

- **Crop cutting**: this consists in harvesting a randomly located subplot in the field, and weighting the harvested crop after drying.
- **Whole plot harvest**: may be treated as the gold standard for crop yield estimation. The plot is harvested entirely and crops are weighted after drying.
- **Sampling the harvesting units**: offshoot of the whole plot harvest method aimed at reducing the time required for weighting the harvest.

Other methods:

- **Administrative records**: can be used to validate production estimates or, in absence of other data sources, can also be used as primary data sources.
- **Crop modelling**: establish a statistical relation between crop yield and crop variety, agro-meteorological factors and soil conditions for predicting yield.
- **Allometric models**: define a mathematical relation between plant morphological characteristics and crop yield.
- **Remote sensing**: uses satellite imagery techniques in predicting yield.

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Crop Yield Forecasting: Methodological and Institutional Aspects

Handbook on Master Sampling Frames for Agricultural Statistics

Handbook on Remote Sensing for Agricultural Statistics

Methodology for Estimation of Crop Area and Crop Yield under Mixed and Continuous Cropping

Measuring Crop Area and Yield under Pure Stand, Mixed and Continuous Cropping: Findings from the Field Tests in three countries

Handbook on Crop Statistics: Improving Methods for Measuring Crop Area, Production and Yield (UPCOMING)

October 2018