

Getting and Using Statistics

by CLARENCE M. PURVES

TO OPERATE their farms successfully, farmers must know the conditions of future demand for their products, the prices they may expect before deciding the crops to grow, and the supplies available to decide the best time to market their produce.

Some farmers need only local facts to determine what to produce. Others may need much more information.

The continued improvement in transportation, the increasing commercialization of production, and the widening of competition for markets continually intensify the need for information on production, utilization, trade, and prices.

So also a government needs facts about the agriculture of its country if it is to see to it that people have enough food and other farm products.

Governments also need information about the agriculture of other countries to help their producers find foreign markets for their commodities and determine which products to produce domestically and which to import. Higher efficiency of agriculture has magnified competition in world markets. The prices of products have ebbed. Prices for the items used in agricultural production have gone up. To aid producers in meeting these conflicting trends, governments need statistics to study the past and look into the future.

A primary objective of the United States Department of Agriculture when it was established in 1862 was to collect, arrange, and publish statistical and other useful information on agriculture. Its first crop estimates were published in 1863. Its regular monthly reports on crop conditions and annual reports on acreage, average yield, and production of important crops and on the numbers of livestock on farms became one of its major functions.

Its statistical reports gained a worldwide reputation for value to producers and traders. When David Lubin conceived the idea of a world statistical service, his aim was to provide estimates on world agricultural activities as similar as possible to those being provided for the United States by its Department of Agriculture.

DAVID LUBIN was a merchant from Sacramento, Calif., who tried his hand at farming. After several failures, he became convinced that farmers needed more information about developments in different regions to aid them in deciding what to produce and to judge whether traders were paying them fair prices for their products.

To provide this information, he proposed the creation of a World Chamber of Agriculture. He attempted to interest the heads of various governments in his idea. Finally in 1905 he impressed the King of Italy sufficiently that he called an International Conference of Nations to consider the establishment of an International Institute of Agriculture.

Representatives to the Conference agreed that such an institution would be of value to agriculture, and a treaty was signed in 1905. Ratification of the treaty, arrangements for quarters, and the organization of a permanent committee to administer the Institute were completed by 1908.

The Institute began as soon as possible to fulfill one of its major responsibilities—to collect, compile, and disseminate worldwide information on

acreage sown, crop conditions and yields, and production of farm products. It believed such information would help stabilize world prices and benefit producers and consumers.

It soon learned, however, that it was not easy to collect statistics. Only a few countries had facilities for collecting statistics on current crop conditions and production. Definitions of area and production and ways of reporting crop conditions were not uniform. Units of measurement varied. Different languages were used. Some countries reported sown acreages; others, harvested acreages; and some, total production. Others reported only the production for sale or export. Some reported crop conditions as a percentage of normal; others, as "very good," "good," "passable," and "poor" or in numbers from 1 to 6 to show conditions from poor to excellent.

When the Institute began to publish its statistics in 1910, it was able to report inadequately on only seven commodities. The first reports on the wheat crop covered less than one-third of the world's production.

The Institute found that its limited budget made it impossible to set up a system for collecting statistics and that it must depend on information furnished by its member governments. Production estimates in many countries were not available for a year or more after the harvest. Some countries sent the Institute any figures they had handy.

The Institute decided its greatest service would be to help its members improve their statistical services and to work out more uniform definitions of crop conditions, area, and production and the numbers of livestock on farms.

In its first few years, the Institute engaged primarily in bringing together and summarizing such statistics as were available, determining crop years for world summaries, and standardizing their publications, but it was unable to carry out fully the hopes of its founders of providing current and complete statistics.

Differences of opinion among the permanent committee as to policies, lack of funds, the failure of several members to pay their dues, and the beginning of the First World War demoralized the organization, and the collection of statistics was sharply reduced.

But the urgencies of war, a spiraling of prices in the early postwar years, and the subsequent collapse in agricultural prices showed the need for more and better statistics on production and trade. More countries were willing to support the Institute, and reports on agricultural production and trade were available for more countries and on more commodities.

The 1921 Yearbook of the Institute brought together statistics on wartime production. Data on land use by countries were published in 1923 for the first time.

Thereafter annual reports contained the statistics by countries on total area and population; land use; agricultural area, yield, and production of crops (25 crops in 1923); numbers of livestock; imports and exports of agricultural products; stocks of grains in major exporting countries; prices of leading agricultural commodities in world markets; and ocean freight rates and exchange rates.

Shortly after the First World War, the Institute began publishing monthly reports on crop conditions in major agricultural countries, but they were largely descriptive, rather than quantitative, estimates.

The Institute was urged during the twenties to accompany the statistical summaries with an analysis of their economic significance on the world supply and demand conditions for farm products. It issued its first agricultural situation report in 1930. It described by countries the production situation and the potential market for farm products, government measures for farm relief, action taken by voluntary organizations in the interest of producers, and the economic situation and its relation to world agriculture.

Since one of the first essentials of a crop reporting system is a periodic census of agriculture to provide a benchmark from which to measure annual changes, the Institute began planning for a worldwide agricultural census to be taken about 1930.

In making arrangements to conduct the census, representatives of the Institute visited every cooperating country and instructed them in the problems of census taking, tabulation, and analysis. Special emphasis was placed on making the enumeration as complete as possible, avoiding duplication due to multiple cropping or multiple ownership, training enumerators on methods of making estimates from incomplete data, and adjusting estimates for interplanted crops.

Fewer than one-third of the countries of the world had ever taken an agricultural census before 1930, but 63 countries participated in 1930.

Several of the countries found the problems of obtaining a complete enumeration more difficult than had been anticipated, and the problems of tabulating and preparing the data for publication in some countries was so great that only part of the data collected was analyzed and published.

The census, however, did add greatly to the statistical knowledge available on world agriculture and was instrumental in increasing the interest in agricultural statistics and pointing out the value of statistics in assessing the significance of agricultural resources.

During the Second World War, the activities of the Institute were again sharply curtailed. Agricultural production and trade in a large part of the world were disrupted. Food supplies of nearly all of the allied countries were pooled and allocated among nations to provide adequate food for the fighting forces and to ration supplies among the civilian populations as equitably as possible. This endeavor emphasized the glaring inequities in living standards between groups and countries and an alliance was formed to fight hunger, disease, inequality, and illiteracy.

In an international conference in 1943 in Hot Springs, Va., 44 countries took steps to offset hunger by producing more food and providing markets to absorb it. An interim committee was set up to draft a constitution for an International Food and Agricultural Organization. In 1945, the constitution was adopted, and the Food and Agriculture Organization of the United Nations became the international forum for world agriculture.

STATISTICAL PROGRAMS and publications of the International Institute of Agriculture were taken over and expanded by FAO. From its beginning, FAO realized that reliable and adequate statistical information was indispensable to all concerned in planning and promoting agricultural development, in improving the distribution of food and other products, and in raising the general standard of living.

FAO took the lead in organizing the program for the 1950 world agricultural census and giving assistance to member countries in carrying out its program. Experts were sent to various countries to assist their governments in setting up statistical organizations and in improving their methods of collection, analysis, and presentation of agricultural facts. This assistance to foreign governments has been continued. Even more aid was given to member countries to conduct and tabulate the 1960 census.

FAO has been able to expand its statistical coverage of world production and trade in agricultural products through its larger membership. By 1964, 112 countries had joined FAO as full, or associate, members, and all major agricultural countries were members, except the Soviet Union and mainland China.

Each member is requested to report its production and trade of agricultural products. Attention has been given to providing statistical instructions to member countries and in standardizing reports on production and trade.

The regular statistical reports of FAO

now include yearbooks on production and on trade and a monthly bulletin on agricultural economics and statistics. The contents of the yearbooks are an elaboration of those published by the International Institute and contain data for nearly every agricultural commodity in international commerce.

When reports from member countries are unusually late, FAO uses private sources or includes unpublished estimates in its continental or world totals in order to make them comparable with earlier years.

In most cases, FAO does not adjust the production and trade reports of member countries for incompleteness or other inaccuracies in the estimates, but rather depends upon improving its statistics through working with the member countries and helping them to improve their estimates.

Another limitation of the FAO statistical yearbooks, as a source for agricultural statistics, is their delay in publication. Because of the mass of data involved and frequent delays in reports from member countries, estimates on production for a given harvest are not available in yearbooks until 1 to 2 years after the actual harvest. The lag in publication of trade data is about as great. The monthly bulletin of agricultural economics and statistics is the major referent for updating statistical data. This publication presents the latest data on production and trade for the major agricultural products and monthly prices in major world markets for the preceding 12 months.

One of the first research projects conducted by FAO after its organization was to prepare food balances for as many countries as possible. These were based upon data from many sources and contained many unsupported guesses. They indicated the source of supplies and the utilization of food products and provided a basis for appraising the completeness and reliability of statistics for different countries. Although they were incomplete for many countries, they were an

important source of information for the Freedom From Hunger campaign of the Food and Agriculture Organization. Research in food balances has been continued.

Training centers have been set up in Latin America, Africa, Asia, and Europe to assist governments in their statistical problems. These training centers have enabled FAO to provide closer supervision of technical statistical programs in each area, to meet the needs of training for statisticians, and to service the various regional statistical bodies and meetings of experts. Assistance in conducting sample surveys and agricultural censuses have been an important part of the work of these regional offices.

The annual reports of FAO on the state of food and agriculture have become important in presenting analyses of world and regional production, consumption, stocks, trade, and price changes of agricultural products and for summarizing special statistical research projects.

Index numbers are prepared to measure the world's total agricultural production, as well as food, and are shown by regions. These index numbers have been useful in comparing the trends in production in different areas of the world and for measuring the relationship between the increases in food production and the growth in population.

Index numbers also are presented for the major individual countries in each region, thus facilitating further comparison. These data provide a background for the accompanying analysis of the world agricultural situation outlining major problems existing in agricultural production and distribution and the steps taken by individual countries and international organizations in an effort to solve them.

Many of the smaller and lesser developed countries with limited statistical services depend largely on the Food and Agriculture Organization for their statistics on world agriculture. Most of the larger exporters and importers of agricultural products, however, have

built up their own system for collecting world agricultural statistics and have adapted their sources to meet their own requirements.

THE UNITED STATES Department of Agriculture began collecting and compiling statistics on foreign agricultural production, trade, and prices in 1921 with the establishment of the Bureau of Agricultural Economics. The statistics were needed to provide exporters with current information on possible export markets and on supplies likely to be available from competing countries.

It also collected statistics on some important imported commodities, such as wool, sugar, and tropical products, to provide information on available supplies, and to aid the Government in making policy decisions on tariffs and other international trade problems.

The Department collects information on foreign agricultural production and trade from many sources. At first it made widespread use of foreign publications and trade sources in foreign markets, but it soon found that it would have to set up a corps of trained representatives in foreign countries if it were to bring together dependable and timely information.

These representatives—agricultural attachés—could observe crop conditions abroad, talk with representatives of foreign governments and importers to determine demand conditions, and report promptly to the Department for general release. Only a few agricultural attachés were sent at first to larger exporting and importing countries. The information obtained by them proved to be so useful to exporters and Government departments that their number has been increased.

In countries not covered by the service, periodic reports are received through the Current Economic Reporting Program of the Foreign Service, Department of State. Through this system, current agricultural statistics are obtained for every country in the world except those not recognized by the United States.

Most of the world summaries are published in the Department of Agriculture's annual release, *Agricultural Statistics*. The 1963 issue contained 114 tables on world livestock numbers and world production and trade of the major agricultural products.

Supervision of the program introduced in 1954 to export agricultural products in exchange for local currencies under Public Law 480 and other relief and economic development programs has greatly increased the need for current information on agricultural production and trade activities in underdeveloped countries.

An accurate measure of the food supply situation is necessary to determine the amount of food imports needed to carry out effectively their economic development programs.

Public Law 480 requires that the commodities received under these programs shall be utilized within the country receiving them and that they be in addition to the usual imports of the country. To check compliance accurately requires current statistics on production and trade.

Another advantage of a worldwide network of agricultural attachés, in addition to timeliness of data, is their ability to appraise the reliability of official estimates and recommend adjustments where they feel the official estimates of a country may be low because of incompleteness in reporting or to an unusual method of estimating production. Some countries are also known to overestimate production for political or economic reasons. When estimates are known to be too low or too high, the Foreign Agricultural Service adjusts them to be in line with the estimates for other countries.

THE REGIONAL ANALYSIS Division of the Economic Research Service of the Department analyzes the statistics collected in regular commodity reports on commercial crops and brings together any data available on crops grown primarily for local consumption.

It prepares index numbers and food

balances by countries for use in determining trends in agricultural development. These are used to show levels of food consumption by countries in the administration of Agency for International Development programs and in the analysis of probable foreign demand for United States agricultural products.

Economic Research Service, in cooperation with Foreign Agricultural Service, also issues an annual Outlook Situation report about midway in the fiscal year. It projects production for the year and analyzes market conditions, country by country. Their index numbers and food balances, based largely on the foreign statistics collected by Foreign Agricultural Service, provide an important background for appraising the outlook for exports summarized in the Agricultural Situation report.

The two agencies also conduct long-term supply-and-demand projections by countries to determine the trends of such factors as changes in population, economic development, per capita income, and agricultural programs that are likely to affect the long-term supply-and-demand situation for agricultural products in those countries.

The studies are done under contract with colleges and research institutes within the countries under study and are financed by foreign currencies that become available for market development under Public Law 480.

COLLECTING agricultural statistics is not easy in any country. The extensive area covered by agricultural activities and the variations of soil, climate, and topography increase the dispersion in any facts collected and may lead to errors unless a large sample is taken. To avoid these errors, most countries prefer a complete periodic counting.

Several personal and social factors also make the collection of statistics difficult. Few farmers have records or accurate measurement of the acres planted or amounts produced. Livestock range over wide areas, often in

community flocks. Their products are sold in small amounts and in many forms. Some farmers can only guess. Many hesitate to tell their true output because they are suspicious of the use that will be made of the data. Illiteracy, ignorance, a lack of interest, and superstitions are other factors. The expense and time involved limits the amount of data many countries can collect.

STATISTICIANS have been working for years on ways to overcome these handicaps, to obtain true objective estimates with only random errors.

Sampling is a widely used technique in collecting data. A sample of a small number of observations properly chosen at random tends to have the characteristics of the universe from which it is taken. Some error exists, of course, and facts can be determined only approximately. Sampling restricts precise information for small areas, but it cuts the cost, reduces the time of tabulation and analysis, and often makes possible the obtaining of information when a complete enumeration is impossible.

The United States, a pioneer in statistical sampling, has used it to measure intercensal year-to-year changes in crop production and livestock numbers. The high level of literacy of its farmers and the fact that the area planted to each crop by each farmer generally is fairly accurately known have been major factors in the success of the Department's crop reporting system.

By continual research in sampling techniques and ways of measuring bias and by checking against periodic censuses, the errors in estimates have been reduced greatly, but there are still occasional changes in conditions that result in significant errors in sample data based upon opinions.

The success of the United States with sampling agricultural activities has induced some other countries to try it. The Food and Agriculture Organization has advocated it through

publications and instructions and has assisted several countries in the use of sampling in taking censuses as well as in making annual estimates.

Two general types of sampling are followed. One is to choose representative areas and study thoroughly the agriculture of each area. A total for the country or region studied is obtained by multiplying the totals of the sampled areas by their inverse relationship to the total of area they represent.

The second is to choose a sample of holdings, study them thoroughly, and multiply their tally by inverse ratio to the total number of holdings in the universe.

The first does not provide reliable information on the characteristics of the holdings, such as size of farm and tenure. The second is more subject to underenumeration because of fragmentation and the amount of urban holdings.

Neither provides accurate estimates for minor civil areas, but both can give fairly reliable estimates for a universe if the size of the sample is adjusted to the precision required and ways can be found to overcome the personal and social bias of the persons enumerated.

This second problem—bias—has proved to be the more difficult to solve. Publicizing the uses and needs of accurate data, assuring the informants that their answers will be kept confidential and used only in totals and averages, and helping the informant determine correct answers all help to improve reporting, but they cannot overcome the natural conservativeness of most farmers and their lack of accurate records.

Experiments have been made with taking strictly objective samples of areas and yields. It is possible to make precise acreage estimates from aerial photographs of agricultural areas. Cultivated land, native pasture, woodland, and so on are easy to identify.

Many crops, like corn, soybeans, cotton, and tobacco, also are distinguished easily. Recent technical

developments indicate it may soon be possible to identify separately areas in wheat, oats, and other grains.

In the aerial sampling, enumerators are given photographs of definite segments that delineate the boundaries of each field. Then by personal enumeration they obtain a record of the name and acreage of the crop in each field and check it against the aerial measurements. From these samples, an estimate for the universe—the total area surveyed—is made by increasing the acreage in the sample to equal that in the universe. If the sample is 1 percent of the total area, the results would be multiplied by 100.

After the first survey of acreage has been verified, future enumerated changes in the identical sample can be used to estimate total changes from year to year. This method, restricted to small, compact areas, gives lower sampling errors than random sampling and is well adapted for measuring things fixed to a specific area, such as numbers of farms, crop acreages, and storage facilities.

Variation in yields, which usually are the cause of greatest fluctuations in production, have traditionally been based on the judgment of farmers and therefore have been subject to bias and errors of judgment. Through research and development, methods have been found to use sample data for estimating yields per acre by weighing, measuring, or counting growth factors on small measured plots and relating them to final yields.

OBJECTIVE surveys of yield based upon sampling involve three stages.

First, a sample of fields is chosen, located at random for each crop. The samples for defined areas are chosen in proportion to the acreage of the crop in each area—thus providing a self-weighted sample.

Secondly, plots to be measured within each sample field are located by random numbers, so that all areas of a chosen field have an equal probability of selection.

Thirdly, the enumerator marks off an area of uniform size and makes prescribed observations of growth factors that are later compared with measured yields. These relationships can be used in future years for forecasting yields through observing growth factors before harvest. Such surveys take time and must be done accurately by highly trained observers, but a relatively small sample so obtained is a valuable check on data obtained by other methods and provides information on the quality of the crop, such as protein content or weight per bushel, in addition to yield measurement. While objective yield surveys have been used in only a few countries, their use is expanding.

The Food and Agriculture Organization has devoted much of its resources to conducting training centers, preparing statistical instructions in census taking, and sampling and gathering data on crop yields.

It has helped countries conduct sample censuses and set up crop reporting systems and standardize units of reporting area and production.

It has also cooperated with the United Nations in working out standard statistical classifications for recording trade, measuring the value of trade, and grouping commodities.

Finally, it has given some scholarships to students specializing in statistical methods and in the solution of statistical problems, helped countries prepare their census data for electric data processing, and arranged for a few countries to have their data tabulated in processing centers.

United States aid programs also have helped several countries to set up crop estimating systems and train their workers in statistics. A large number of promising students from foreign countries have been sent to the United States to attend colleges and to receive training in crop estimating and other types of statistical collection and analysis. Nearly 300 foreign visitors from 59 different countries have been trained in agricultural statistics since 1942.

Several other countries have also given training courses for students from countries lacking college facilities. While many of these students take up positions in industry and trade rather than government after returning to their home countries, they are adding to the statistical knowledge and to the use and appreciation of statistics in their countries.

International commodity groups also help countries to improve their statistics and make them more comparable and to acquaint them in the methods of analyzing production and marketing problems.

WHILE STATISTICS for many countries are still little more than guesses, rapid strides have been made in bringing together data on world agriculture so that farmers and governments everywhere can now get information on supplies and market conditions for their products and for alternative products, providing them a sounder basis for their decisions.

More and more countries that were hesitant about publishing their facts on their agriculture now make them available, and the number of countries that change their statistics for political purposes or in the hope of getting a better price for their products is steadily diminishing.

While David Lubin's goal of making accurate and current statistics available on world production, trade outlets, and prices for all major agricultural products is still far from achievement, it now appears possible. Their need no longer is questioned.

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