Trends Affecting Agricultural Statisticians

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[The views expressed are attributable to the author and do not necessarily reflect those of the National Agricultural Statistics Service.]

ABSTRACT: Important trends shaping agricultural statistics needs in the future are identified and described. Five key roles for statisticians and organizations are defined. Alignment of these roles in adapting to the future trends is then considered.

1. Introduction

In order to discuss roles for statisticians, it is important to first describe the future. There are at least five important trends which will affect agriculture and the needs for statistics. These trends will affect all countries, albeit to different degrees and with time lags in some cases. They are not mutually exclusive; in fact, interactions of specific trends will create some particularly interesting challenges for statisticians and planners.

The five trends are listed below but not in any priority order. A brief description of the features and impacts of each trend is first provided. Data and analysis needs for each trend are then described in more detail. Given that amount of background, five roles for statisticians and organizations are identified, with ramifications of each discussed, as well as alignment of those roles with the future trends.

2. Trends

2.1 Globalization of Trade

The World has become a truly global marketplace. Transportation and communication advances provide the ability for companies, and countries, to choose among a number of suppliers for needed products in the case of importers or among an array of potential customers in the case of exporters.

International trade agreements have broken down some, but not all, barriers to free trading. Work will continue on trading policies with the net effect of opening more trading opportunities.

2.2 Concentration of Production

There are two axioms for agricultural production. First, agricultural production is hard, demanding work. Second, per unit production and efficiency can usually be increased by use of additional non-labor resources. However, those efficiencies usually result in considerable production capacity controlled by a few individuals or organizations.

“Concentration” might be defined as a situation in which 30 percent or less of the producing units control 70 percent or more of the production. Many countries have already experienced extreme concentration of production for some commodities such as poultry and hogs. Concentration has gone beyond the “30-70 ” case to “20-80,” “10-90,” or even greater extents.

(It should be clarified that this trend is occurring in market based economies. It differs from State controlled economies which existed in areas such as the former Soviet Union. In those cases, production might be concentrated on a limited number of State farms, but those units usually did not have the efficiency incentives of market based economies.)

2.3 Specialization of Products

The World today, and in the future, has an amazing array of raw and processed products. As economies develop and consumers have more disposable income, tastes are refined. Instead of buying apples, people become more interested in specific varieties. Similarly, food processing companies may demand soybean varieties which have specific oil and protein characteristics in order to create uniformly processed products at lower costs.

Agricultural producers can take advantage of specific niche markets by specializing in particular varieties or by improving livestock genetics in order to produce more uniformly finished animals. Producers may also be more likely to enter into production contracts.

2.4 Introduction of Technology

It might be argued that this trend could be subdivided into Biotechnology and Communication and Information Technologies. However, for the purpose of this paper, biotechnology will be included under "Specialization of Products."

Many international and national organizations have made amazing adjustments in the past few years in dissemination of information through the Internet. However, those efforts will seem rudimentary as communication technologies continue to evolve. The other major area for the future is the use of technologies for collection and creation of statistics and new data products.

2.5 Expansion of Agriculture Related Concerns

Many issues facing organizations and countries today, and in the future, are multi-disciplinary concerns. People are concerned about the environment and public health. In many cases, there are concerns about possible harmful effects of agriculture, particularly in the case of concentration of production mentioned earlier.

There is another aspect to this shift in concerns that is vital to statisticians interested in agriculture. As countries' economies develop, fewer individuals are normally engaged in agricultural production. If decision-makers and program funders use "farming" as their definition of agriculture, it may become very difficult to maintain a critical resource base for creating agricultural statistics and analyses.

3. Data and Analysis Needs

3.1 Globalization

Some important steps have been taken in recent years which help answer agricultural statistics needs in light of increased World trade. Adoption of the International Harmonized System of Commodity Classification for agricultural products in 1989 and the North American Industrial Coding System (NAICS) in 1997 provides bases for collection and dissemination of relatively compatible production and trade data. However, no harmonization system fully describes products to the extent that people

might like for modern trading. If buyers want specific apple varieties or soybeans with a minimum protein percentage, those data will not be found in an internationally harmonized data set.

Data users will seek and demand more analytic data in the future. For instance, organizations representing producers in one country are very interested in costs of production, marketing, and transportation in competing countries. If such data are available and reliable, they can provide improved advice about production alternatives. Similarly, producer organizations are often looking for any information on the "demand" for products. It is much easier to measure present supplies and disappearance of those supplies than to estimate what quantities might have been demanded or marketed if they had been available, at various price levels.

One other impact of expanding data requests is that statistical agencies will need to maintain differing types of data for different users. The Food and Agriculture Organization of the United Nations (FAO) wants to include country-wide corn data on area planted and harvested, yield, production, and price in its FAO STAT data base. That level of detail is insufficient for organizations responsible for a country's national economic accounts. For national accounts, country level data are needed on corn exports and imports, amounts used for human purposes, amounts fed to livestock, amounts for seed, and changes in inventory levels from year to year. The agricultural industry customers of statistical organizations want corn production data for small areas within a country, preferably ahead of harvest, in order to make transportation, marketing, and processing plans.

Users will also want data even faster in the future. They will not be satisfied with data only from a census every 5 or 10 years, or even annual figures that have considerable lag times. They also will want up-to-date import and export data. Also, users will want to know what form (sizes of packages, cuts of meats, etc.) exports took, not just the total product weight.

Markets will change even faster in the future than presently and the ability to take advantage of new opportunities will depend on information made available by statistical organizations. For instance, the decision to eliminate the Hong Kong poultry industry because of avian flu concerns will create some new market opportunities and adjustments.

3.2 Production Concentration

As production (or processing or marketing) units become larger, new challenges are presented to agricultural statisticians. Data confidentiality concerns may be triggered if individual units become very large. Proprietary information from large units on their present holdings and future plans becomes very important for proper estimates. There is often a concern that large units could withhold their information and gain an advantage over competitors.

Increased variation in the relative size of producing units and increased portions of totals held by just a few units require more statistical rigor for proper estimation and analyses. Stratification of units on reasonable estimates of size becomes essential. Non-response adjustments must be performed within strata and it might be necessary to specifically impute for missing data from very large or unique units.

Statisticians will need to build data bases for large units. Time series analyses will be important in review and editing of currently reported data, as well as for missing data imputation. In order to collect needed data from large operations, considerable personal contact is usually required. In some cases, it may be necessary to develop "contracts" with large producers in which detailed data are collected at specific intervals and those data used for upcoming surveys instead of contacting operations

several times. Use of such data requires modeling to adjust for seasonal variation or growth patterns and marketing of livestock supplies on hand at a particular time.

In some cases, administrative data might be available in lieu of data collection for large operations or for a total industry that has considerable concentration.

3.3 Product Specialization

One interesting result of product specialization is that reporting details, definitions, and published breakouts may differ for domestic needs from what is covered in international data bases. Thus, agricultural statisticians must be aware of international needs and maintain comparability at the same time that domestic statistics programs are tailored to new products.

Adapting to specialization of products requires on-going knowledge of industries and changes in marketing practices. For example, producers may be receiving premiums above posted prices if they can deliver consistently lean hogs or crop varieties in particular demand. Price collection procedures must be developed which keep track of the true situation.

As new specialized products evolve, it might no longer be possible to depend upon traditional data collection methods. The amounts of specialty characteristic corn produced may be too small to estimate from general purpose surveys. Instead, it may be necessary to collect data from buyers since there are usually only limited sales channels as new products come on line. However, some data from buyers might be very sensitive and not releasable for proprietary reasons.

One special category of product specialization will be the introduction and spread of bio-engineered products. Products have already been developed which have bred-in resistance to insects or with tolerances to herbicides which allow the use of very aggressive weed treatment protocols. Testing is also underway of products which are intended to minimize animal waste and odor problems. One new corn may control waste by being much more digestible by animals. Another lowers the phosphorus level of corn which reduces odor and pollution concerns.

One dilemma for public agency statisticians is whether data on area of use and production characteristics can be published if there is only one developer and supplier of newly engineered products. At the same time, organizations representing producers may be looking to public agency statisticians for impartial evaluations of whether these new products have lived up to the claims of their developers.

3.4 Technology Introduction

The 1990s have widely been described as the information age. Computer and telecommunication advancements have provided rapid access to an ever widening wealth of data. At the same time, increased access to data has created interest in even faster and broader access.

Public statisticians and international organizations have taken innovative steps to provide current and historic data. Those efforts need to be continued. Users are now interested in multiple formats. Some users only want to find and browse data so “read only” formats are sufficient. Other users, however, want to pull statistical organization data directly into their own data bases. Users are interested in compatible systems and access to as much related data as possible.

The first challenge to public and private statisticians and international organizations is to provide as much electronic data as possible. Historic data bases will be of particular value and will improve internal operations of the sponsoring organization as well as serving data users.

One important lesson for organizations is to maintain historic comparability of data series as new access capabilities are added. While some users of agricultural statistics are one-time users and current numbers suffice, most users are looking either for comparisons with historic relationships or the ability to make judgements about the future.

There are other important new technologies that all domestic statistical agencies and international organizations should be evaluating. Three of those are data warehouses, geographic positioning devices, and geographic information system capabilities. Each is discussed below in terms of their potentials for statistical organizations.

Data warehouses provide an unprecedented capability for many organizations. It might be stated that "data warehouses provide an organization with a unique opportunity to learn about its own data." A well organized, fully stocked data warehouse can enable an organization to do additional analyses not operationally feasible before. Warehousing also offers the opportunity for an organization to expand its product offerings. It should now be possible to create improved products, whether they be historic data summaries or more interrelationships of current data in existing reports. As a minimum, a data warehouse effort should drive efforts to create additional user summaries which can be provided electronically.

The capability to relate data to a fixed geographic location on the earth provides unique approaches to many 20th and 21st century problems. However, that capability brings in legal, proprietary, and even ethical concerns. Global positioning (GPS) creates the ability to register production data to a map base. It also can relate the application of particular chemicals or use of particular crop techniques to a physical location. Such data might answer many environmental questions but also expose situations in which a prohibited chemical or improper land use practice was used. Releasing such information or informing regulatory organizations might mean the end of voluntary cooperation from producers. Thus, public and private statisticians must proceed with caution. As a minimum, use of data from GPS systems creates a number of new confidentiality concerns.

A related, but separate, technology is Geographic Information Systems (GIS) capabilities. A GIS system can provide many data layers which include information for various political boundaries, physical boundaries, and specific points. A good GIS capability can be a beneficial adjunct to a data warehouse. It will enable an organization to create improved standard user products, such as yield or livestock concentration maps. The GIS system can also expand the ability of an organization to analyze temporal data for improving current estimation techniques.

3.5 Expansion of Agricultural Related Concerns

In addition to data and analyses needs of agricultural related organizations and their customers, there are self protection reasons for statisticians to look broadly at issues related to agriculture. Statistical organizations might be interested in protecting their critical funding and resource base as the percent of the population involved in production agriculture goes down. They may want to expand their scope into measuring logical agricultural handoff situations such as the first stages of marketing or processing of agricultural products. Agricultural producers may be able to expand their net income by carrying out some first stages of processing such as washing and sorting potatoes by size in the field to collect

premiums. It takes considerable diligence on the part of statistical agencies to keep abreast of such changes and to properly report them. There are also many interests in "value-added" aspects of agriculture. Such estimates require detailed surveys on the sources and costs of input agricultural products, the expenses incurred in the additional production priorities, and the sales value and marketing expenses of the final products.

The other major data and analyses needs have to do with new interests on the "impacts" of agriculture. For example, there are many concerns about potential point and non-point pollution impacts of concentrated livestock operations on the environment. There are also very broad questions being asked about health effects of crop chemical production practices and of feed additives in animal production.

4. Definitions of Roles

The writeups above which characterized data and analysis needs implied specific actions for private and public statisticians and international organizations. The individual efforts can be summarized under five role headings. Those roles are **stabilization** (of data), **adaptation** (to new industry changes), **expansion** (of services), **innovation** (in offering new services), and **collaboration** (in tackling new concerns). As with the trends identified earlier, the roles listed are not mutually exclusive. They also do not necessarily parallel the five trends mentioned, although each will be particularly appropriate to at least one trend. Each role is discussed in more detail below.

4.1 Stabilization

Politicians, decision-makers, businesses, and the general public look to statistical agencies and international organizations for a wealth of background data and information. That is an important function and one that organizations have served well.

Stabilization for the future will not mean retention of old definitions and display of traditional data. Relevant historic data series should and must be maintained. However, stabilization for the future will involve development and maintenance of additional crosscutting data bases which answer current questions.

Another role for private and public statisticians and international organizations is the creation and verification of historic relationships. If a national statistical office has not previously created livestock data bases and provided them to organizations such as FAO but does have considerable data for different time periods, they should consider analyzing all previous information and creating a historic series even if that series contains data only every 5 or 10 years. That data set will be of unmeasurable value to future analysts.

One extremely important stabilization role of statisticians is to create metadata explanations for their data files. Even seemingly straightforward statistical numbers such as livestock numbers or planted acres of specific crops may have important caveats (such as representing peak inventory numbers, numbers as of July 1, or not including State and institutional farms). Creating and preserving metadata files are important statistical functions.

4.2 Adaptation

As indicated earlier, one common development will be concentration of production of at least some commodities under the control of a few large enterprises. Statistical agencies need to be constantly

aware of the production procedures within their country. As practices change, statistical organizations need to adapt survey and estimation procedures accordingly.

Another example of adaptation is restructuring of data series to better serve data user needs. A once-a-year inventory series for total livestock numbers may serve many users and provide some useful data for national account purposes. However, that data set may obscure significant changes within the industry. Breakdowns of breeding and market stock or by ages or weight group might be much more valuable to many data users. Statistical organizations can often structure or adapt present collection efforts to provide such data.

4.3 Expansion

The expansion role relates not only to adjusting statistical programs to emerging specialized products and agricultural issues, but also to expansion of services. In both cases, agricultural statisticians need to judge data user needs and then determine proper statistical procedures to better meet those needs.

One caveat in expansion of services is to verify the relevance of new reports or features before release. It is usually helpful to have at least two data points for a new service before the first release. Otherwise, it is not possible to determine if the first time collection effort might have had some inherent problems or was measuring an unusual (high or low) point.

4.4 Innovation

The role of innovation is particularly important for taking advantage of new technology opportunities. Agricultural statisticians should observe what other organizations of all types are doing with communication and computer technologies and then build on those ideas. There is a common expression that organizations should "steal shamelessly" when searching for ideas to improve present performance. Observing the features of other organizations often leads to improvements that do not duplicate the offerings of others but adapt concepts to the particular population that an organization is serving.

4.5 Collaboration

One important role that organizations can serve for the future is "partnering" with other organizations interested in agricultural related issues such as environmental or public health concerns. One reason for such an approach is self preservation — decision-makers may look on agriculture as just farming unless statisticians work with others on the logical agricultural related issues.

The second reason for collaboration is that many future public concerns will take a multidisciplinary approach. Studying concentrated agricultural production impacts on the environment might require agronomists, animal scientists, geologists, hydrologists, sociologists, and statisticians in order to examine all effects of animal wastes on soils, the water table, and the human population.

The third reason for collaboration is to better understand how decisions affecting agriculture and agricultural producers are being made. For example, the National Agricultural Statistics Service (NASS) of the USA has conducted good quality chemical use surveys for a number of major crops. Without exception, those studies have shown that agricultural producers use only a few of the various agricultural insecticides and herbicides available in producing crops and tend to use less than the maximum allowed dosages. In spite of such consistent evidence, the U.S. Environmental Protection

Agency, charged with concerns about effects of chemicals on the environment, continues to assume that farmers apply *all* authorized chemicals at *maximum* application levels on crops for which statistical surveys have not been done. If that assumption cannot be changed, NASS needs to collaborate with other agricultural agencies and producer organizations to collect the necessary data to verify chemical usage for additional crops.

5. Alignment of Trends and Roles

Although this paper did not start out to identify a set of future trends and specific roles of private and public statisticians to respond to each trend, further analyses indicate a fair amount of pairing across trends and roles. The discussion below looks at the applicability of roles to trends and the appropriate roles for each type of organization.

The **stabilization** role is particularly appropriate to the globalization of trade trend. However, it plays a significant role as new procedures are developed in response to concentration of production and new reports are developed because of product specialization. Stabilization is a particularly important role for both public agricultural statisticians and international organizations.

The **adaptation** role of applying proper statistical techniques is particularly apropos to the concentration of production trend. It also plays a supporting role in providing the best answers to the globalization of trade and specialization of products trends. Adaptation will be largely a role for public sector agricultural statisticians.

The **expansion** role describes quite well what organizations should do as new, significant products are developed. However, it also has application to the introduction of technology and expansion of related concentration trends. This is viewed as primarily a public sector agricultural statistician role, but private organization statisticians may be involved.

The **innovation** role seems helpful for assisting with all future trends, but it is extremely important in the introduction of new technology. It is likely a public sector agricultural statistician role, but international organizations can be helpful in encouraging country level organizations to utilize new technologies as quickly as possible.

Collaboration is also a role which has wide application to emerging trends and problems, but it is particularly appropriate for working on the expansion of agricultural related concerns. Individuals and organizations interested in agriculture need to create alliances with public health, environment, and other special interest groups. This is one role in which private agricultural statisticians could make a major contribution in searching out counterparts in other groups.