Remote Sensing & Geographic Information Systems for Agricultural Statistics: Discussion

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1. "New Elements for Harmonized Approaches on Land Cover/Land Use Information Systems" by C. Duhamel, CESD-Communautaire, C. Vidal & D.W. Health, Eurostat, A. Annono & J. Meyer-Roux, JRC

This paper describes the concerns associated with establishing a comparable land cover/land use data set for Europe. The challenges are formidable and will take considerable time and effort to resolve. However, the payoff is also considerable and desirable. Many data users would benefit from such an undertaking. This paper is somewhat brief but the message is powerful.

In some respects, a portion of the concerns in Europe resemble the experience in the United States over the last decade. The formation of the Federal Geographic Data Committee (FGDC) in 1990 and the Presidential Executive Order 12906 in 1994 for "Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure" established a framework. Section 2 of the order assigns to the FGDC the responsibility of coordinating the Federal Government's development of NSDI. It also instructs the committee to seek to involve State, local and tribal governments in the development and implementation of the initiatives contained in the order, and to use the expertise of academia, the private sector, professional societies and others as necessary to aid in the development and implementation of the objectives of the order. National standards have been completed for the framework and several thematic layers, such as vegetative and soils. The FGDC has an informative Internet website at *www.fgdc.gov*.

The U.S. situation is described briefly, not for comparison purposes but only as a description of a somewhat similar situation. Such complex issues as a spatial data infrastructure across nations is rarely a comparable situation. Each group (Europe, U.S., other developed and developing nations) must come up with their solutions, and the United Nations will address the world standards issues.

I believe that the European Steering Committee plans to study "best practices" and then define their solution to a challenging situation is admirable and should serve them well.

2. "Area Frame Sample Design Alternatives: A Comparison with the MARS Project" by Elisabetta Carfagna, University of Bologna, Italy

The author was most ambitious in the number of topics addressed in this paper. Topics included list frame, area frame, multiple frame and the use of spatial correlation for future survey designs. In addition, strengths and weaknesses of alternative approaches for each of the varying topics was also addressed. In some respects, perhaps too many topics were addressed given the page limitation of the conference papers.

A number of quite informative points were made by the author on each topic area. For example, a list frame with excellent coverage and high quality and current data associated with each record is an

extremely valuable tool to agricultural statisticians around the world. The author also points out that list frames can vary greatly in coverage and quality. There is a somewhat arbitrary cutoff point where the coverage and quality are not good enough to serve agricultural statisticians well.

The area frame topics included optimum sample design, sample size, sample unit size and shape, point sampling, and the use of spatial correlation. This part of the paper is where the author was perhaps too ambitious in the number of topics covered versus the amount of detail that could be provided for each topic. One example is that the author mentions the potential for non-sampling errors for various approaches but could not address it in detail because of the number of pages limitation.

The author states that the use of spatial correlation is a key ingredient to evaluating optimum sample designs. This assumes that the data used to calculate the spatial correlation is from a rather dense sample (or complete universe such as census data or remote sensing data) and outliers have been successfully removed, which may not always be the case.

Some other alternatives might be the use of geographic information systems (GIS) to add more stratification (pre- or post-) information, such as soils, watersheds and agro-climate zones.

3. "Remote Sensing in Mexico: An Application in the Agricultural Sector"
by Juan Manuel Galarza & Guillermo Arita, CEA/SAGAR, Mexico

The author provides a good description of a serious problem with the previous agricultural system of Mexico and the steps being taken now to address some of the key deficiencies. Several technologies are being used as part of the solution. Sample surveys that use global positioning system (GPS) receivers to identify locations of samples, remotely sensed data and image processing, and geographic information systems (GIS) are contributing to the new system. The new system is aimed at improving comparability of data from local regions and also in the overall national accuracy, primarily for crop acreage at this first stage of implementation.

One impressive feature is the substantial amount of progress that has been made in two years with quite limited resources (hardware and trained staff) for such a major undertaking. The dedicated leadership of this project is very obvious. Another positive development is the implementation of improvements both for the ground survey system and the remote sensing components.

The description of the ground survey sample design and the remote sensing analysis procedures could have benefitted from more detail. A few more pages with such detail would add to the paper.

4. "Crop Monitoring in Morocco Using Remote Sensing and Geographic Information Systems: From a Management Perspective"
by Seghir Bouzaffour, MOA, Morocco & George Hanuschak, NASS, USDA

This paper was well organized and relatively easy to follow. One feature that could add to the paper would be some tabular information on the performance of the sample surveys. Target coefficients of variation, actual coefficients of variation, sample estimates and official statistics at the provincial and national level would have added to the paper.

The partnership of Morocco's Ministry of Agriculture, Royal Center for Remote Sensing Agricultural University in Rabat and USDA's National Agricultural Statistics Service and Agricultural Research Service seems to be productive. Progress seems to have been made on all of the major project goals.

One area that could have been elaborated more in the paper was the plan for the agricultural statistics system's utilization of remote sensing and GIS.

One important point is that Morocco had an operational area sampling frame and survey program before the use of remote sensing and GIS were considered for enhancements to the program. In addition to that advantage, the major cropland area is concentrated and the frequency of cloud cover low enough to not cause serious coverage problems with the remotely sensed data sources. Morocco has also conducted an agricultural census for the first time in over 20 years. The census data and the associated list frame are also major recent benefits to the agricultural statistics system of Morocco. The dedicated leadership of Morocco's agricultural statistics system over the last fifteen years is impressive.

5. "GIS Use in the Framework of a National Statistical Office: Establishment of Land Use Statistics and Geocoding of National Censuses"
by Rainer Humbel, Swiss Federal Statistical Office

The organization of this paper is outstanding. It is thorough and very accessible.

It addresses the use of GIS in a centralized national statistical agency. The detail of the GIS data layers is quite impressive. As the author cites, the infrastructure to build such detailed and complex GIS applications has substantial start-up costs, both financial and in time for the somewhat steep learning curve involved and formation of the quite detailed data layers. A list of 24 different data products is provided. Products have different scales and formats, such as point data, polygon (vector) or raster.

The Swiss Federal Statistical Office has invested in geocoding all residential and business buildings. In addition, a land cover/land use inventory represented at the one hectare level has been conducted. An impressive feature of the program is the use of GIS to edit the land cover/land use inventory. By putting data from different layers together and analyzing them for potential discrepancies, the land cover inventory data was improved. Seven major categories were defined to identify potentially erroneous data. Points with questionable data were then reviewed again by two team members. If questions remained, then field travel was used to resolve the questions.

One issue not discussed in the paper is data confidentiality protection. It would have been interesting to see the Swiss rules, regulations and laws on confidentiality protection along with the impressive list of GIS products available to the general public. It will also be interesting to see what role Internet will play in future data access and pricing structures.

6. General Discussion

The discussant presented several implementation issues involved when considering the use of remote sensing and/or GIS for agricultural statistics programs. These issues were:

Remote Sensing

- Spatial resolution
- Spectral coverage
- Temporal frequency
- Analysis infrastructure (including ground data system)
- Speed of data delivery & cost of data

Geographic Information Systems (GIS)

- Quality of data layers
- Quality of metadata
- Confidentiality protection
- Common analysis unit
- Sharing data layers