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of estimates. But it should be remembered that crop estimates should be more accurate, as the factors which influence prices and some other economic phenomena are very complex.

Many areas are open to improvement in the estimation work. Among the possibilities are: Better methods in sampling and the collection of data; improved statistical techniques for use in projection; more extensive use of objective measurements; and placing more emphasis on the timely and correct interpretation of abnormal conditions that might affect the crop, including better and more timely interpretation of the effects of weather. Accurate long-term weather forecasts would be a great asset to crop estimators, but they are not yet feasible.

Improvement may be limited by time and funds. Actually some savings or cuttings in funds are losses and false economy. Certainly some serious planning, thought, and investigation should be carried on aimed at (1) possible improvement in estimation work and (2) setting up organizational machinery so that progress can be made as time goes by. Much may be possible with only small increases in expenditures.

That crop estimation is imperfect does not mean that it is not of value. It is still useful and is counted on by many people as a reliable and unbiased source of information. Much market manipulation and misinformation is prevented by its use. But, it can and should be improved.

Probability Sampling as a Method of Obtaining Objective Facts

By Morris H. Hansen

THE RECOMMENDATIONS of the Special Subcommittee of the Committee on Agriculture on the crop estimating and reporting services of the Department of Agriculture and the discussion that has taken place here have made it abundantly clear that obtaining objective facts on which to base forecasts would be an important step toward the improvement of the present system. Probability sampling has been mentioned as a method of obtaining the facts but has been questioned chiefly on the ground that it is considerably more expensive than present methods.

In my opinion, probability sample surveys that will produce useful and timely results at acceptable costs can be established. Such surveys can assist in improving the accuracy of crop forecasts, although they will in no sense provide a complete solution of the problems. An exploration of the subject should include not only the question of what a well-designed probability survey would cost. In view of the amount of money at stake when the crop forecasts are in differing degrees of error, we should also explore the question of what it would be worth to achieve differing levels of accuracy in the basic facts used in forecasting.

First, it should be made clear that a probability sample survey will not yield objective predictions. But it can deal effectively with the factual aspects of the problem, such as measuring the acres in a particular crop at some point in time, the number of acres that have been abandoned, certain measures with respect to condition of the crop, or other facts capable of fairly accurate measurement on individual farms.

Objective sample survey methods have advanced to the stage where their application to the measurement of such characteristics is feasible and, at least for national estimates, can furnish results at moderate cost. Some added cost for achieving the protection provided by appropriate use of probability sampling would surely be justified in the light of the risks involved in a poor prediction. The committee report, for example, indicates that the high 1951 estimates on the cotton crop alone may have cost the farmers of the country 125 million dollars. The cost of objective surveys would be very small in comparison with this figure, and probably no greater than the cost of other surveys being conducted by the Government in fields of no greater importance.

Preliminary Experimental Work

Needless to say, it would not be feasible to put an effective probability survey into effect overnight. Some time would be required for experimental work before the survey could be put into operation in a form that would be most useful. Such experimental work should be devoted to questions of optimum measurement methods, including the use of mail, personal interview, or direct observations and measurements on fields, and combinations thereof; optimum follow-up methods; optimum estimating techniques; and related questions; and to the evaluation of results from the viewpoint of sampling and response variations. There should also be further opportunity for refinements in the prediction techniques, utilizing the objective results of the survey in combination with other relevant information.

A related experience in the Bureau of the Census occurred in the field of retail-trade measurement when a probability sample survey replaced a survey in which complete dependence was placed on a sample of cooperating respondents obtained by a mail survey without extensive follow-up, and based on readily available lists of stores. The combined use of mail, field enumerators, and telephone techniques with probability samples, raised the ultimate 10 to 15 percent rate of cooperation previously achieved in the survey to a rate of more than 90 percent.

Experience indicates that expenditures added to improve survey methods pay off at times when accurate measures are most needed. However, the improved methods now used for the retail-trade survey were achieved only after introducing probability sampling, and the results of experiments conducted on the best approach to the respondents, the content of the

reporting form, and so on. The survey had a sampling error of only 1 percent for the national estimate of the level of sales and, because of its effectiveness in covering part-year operations, provided even more accurate measures of national sales than did the recent census of retail trade.

A sample survey could be designed that would produce results of a similar character in connection with acreages and production of important agricultural crops. Thus, a properly designed sample of about 5,000 cotton farms could produce national estimates of total acreage planted in cotton with an expected error of no more than 1 to 2 percent.

Summary

In summary, sample survey methods are now developed that could produce, on a reasonable time schedule and at moderate cost, objective information that would be exceedingly helpful in reducing errors in predicting crop yields. I believe that statisticians can and should provide those responsible for predictions with sufficiently accurate basic factual information. This is not to imply that probability sampling methods could completely displace other methods or the need for judgment in predictions. Nevertheless, they can provide objective information that would reduce substantially the degree of dependence on less satisfactory survey methods, judgments, and speculation.

Finally, as suggested in the Subcommittee Report, a program for objective measurement could be efficiently carried out by cooperation between the Bureau of the Census and the Bureau of Agricultural Economics. Initial planning for such cooperation already has taken place in connection with the discussion of plans for an annual sample Census of Agriculture.