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Need for Special-Purpose Sampling in Estimating Agricultural Production

By Charles F. Sarle

Any general-purpose sample used for the collection of information about American agriculture leaves islands of specialty producers and special areas too thinly covered for fully reliable estimates (of their products). The ideas in this paper were presented by the author for discussion by the joint Bureau of Agricultural Economics and Bureau of the Census Committee that is developing plans for an Annual Sample Census of Agriculture.

POPULATIONS being sampled in crop and livestock estimating work may be divided into two broad categories: (1) populations that can be satisfactorily sampled by what might be called general-purpose sampling, and (2) other populations that require special-purpose sampling. There is no well-defined boundary that sharply differentiates one from the other, however. Differences are largely a matter of degree.

The returns from the regular monthly reporters and the individual-farm reporters and the rural mail carrier returns are all general-purpose samples. Each of these samples is a sort of general dragnet designed to catch all agricultural items regardless of their frequency of occurrence or relative economic importance. The preselected interview probability farm surveys in January 1947 and April 1948 were also general-purpose samples.

On the other hand, special-purpose mail sampling is used in forecasting and estimating the acreage, condition, yield, and current production of important commercial crops and classes of livestock, for which an adequate sample cannot be obtained by general-purpose sampling. Examples are commercial fruit, nut, and vegetable crops and such field crops as tobacco, dry beans, broom-corn, sugar beets and sugarcane, seed crops, cattle and lambs on feed, sheep, cattle and goats on ranches, wool and mohair produced, turkeys, broilers, nonfederally inspected slaughter, grain stocks in mills and elevators, chicks hatched, and—in some States—monthly production of eggs and milk. Actually the populations sampled in most of these cases are the farms that have the important commercial farm enterprises which are found on only a small percentage of the farms in a State.

A population of agricultural producers that requires special-purpose sampling may have one or more of the following characteristics.

(1) The agricultural product is of considerable economic importance to some farmers in the State, and is one that is sold rather than consumed on the farm.

(2) The population of these commercial producers is usually small compared with the number of all agricultural producers in a State, so the frequency of occurrence is low.

(3) A relatively small proportion of the larger growers produce a high proportion of the total production—a characteristic of most fruit and truck crops, and in some States a characteristic of poultry and fluid-milk production. For example, in New England less than 10 percent of the farms that report chickens have more than 70 percent of the hens and produce more than 70 percent of the eggs.

(4) The population may be geographically concentrated in one small or a few limited areas because the agricultural product has special requirements of soil, climate, or market.

Some of these populations have a *sporadic* distribution in *space*, as producers of cabbage or green beans in New York State; a few are *sporadic* in *both space and time*, as in-and-out cattle and lamb feeders and producers of such seed crops as red clover and bluegrass. Populations of seed producers are difficult to sample as farmers who harvest grass or clover seed 1 year may retain a reserve supply for 1 or 2 years and not harvest any the next year.

Whether special-purpose sampling is required depends upon the characteristics of the population being sampled. Relatively small populations, or those with a highly skewed distribution and a small proportion of the population accounting for a high proportion of total production or volume, or those of which different segments (either by size of operation or geographic location) react differ-

TABLE 1.—Large dairy farms, Federal Census, 1945¹

States	Farms reporting 30 and more cows milked				
	Farms reporting			Cows milked, percentage of total	Milk produced, percentage of total
	Farms	Percentage of—			
		All farms	Cow farms		
	Number	Percent	Percent	Percent	Percent
California.....	6, 572	4. 7	11. 2	68	72
New Jersey.....	1, 421	5. 4	10. 9	52	57
Florida.....	368	. 6	1. 2	51	66
Massachusetts.....	991	2. 7	6. 2	38	44
New York.....	9, 836	6. 6	9. 4	32	33
Pennsylvania.....	2, 731	1. 6	2. 3	13	16
Wisconsin.....	7, 264	4. 1	4. 6	12	12
Minnesota.....	1, 729	. 9	1. 1	4	6
Iowa.....	758	. 4	. 4	2	3

¹ Special Report, 1945 Sample Census of Agriculture, table 1.

ently to economic and other forces that influence production require special-purpose sampling with a refined method of stratification.

Where Need Is Greatest

There are several field offices of the Agricultural Estimating Service, as those in New England, New Jersey, Florida, Arizona, and California, at which practically all the commercially important agricultural products require special-purpose sampling, and there is probably no field office in which special-purpose sampling in some form is not required. Even such a major crop as corn may require special-purpose sampling in California and perhaps a few other States.

Obviously, a particular crop or kind of livestock may require special-purpose sampling in one State and not in another, depending upon the population characteristics. One rule of thumb that might be applied to a crop of considerable economic importance in a State is that when less than 5 percent of the growers produce more than 25 percent of a given product it probably needs special-purpose sampling. Another appropriate rule might be to use this special-purpose sampling when there is a low frequency of occurrence of the item considered.

In table 1 the first four States—California, New Jersey, Florida, and Massachusetts—are examples of States that require special-purpose

sampling of farms when milk production or year-to-year changes in number of cows milked are estimated. In these States a comparatively small percentage of farms reported cows milked; a considerably smaller percentage of all farms have from 38 to 68 percent of all the milk cows in their respective States and produce from 44 to 72 percent of the total milk. New York State is probably a border-line case. On the other hand, general-purpose sampling would appear to be satisfactory for the last four States listed—Pennsylvania, Wisconsin, Minnesota, and Iowa.

In table 2 the first five States—New Jersey, New Hampshire, California, Utah, and Maryland—would seem to require special-purpose sampling when estimates of poultry and eggs are being made, whereas general-purpose sampling might be considered satisfactory for the last two—Missouri and Georgia. Idaho is a border-line case.

In the case of white potatoes, practically every State in which the crop is of any appreciable economic importance requires special-purpose sampling. (See table 3.) In most States, the large potato farms, those with 15 acres and more, comprise a small percentage of all the potato farms and an even smaller percentage of all the farms. This is likely to be the situation in the case of most commercial fruit and vegetable crops, but frequency distributions are not available from the 1945 Federal census for crops other than those included in this discussion.

TABLE 2.—Large poultry farms, Federal Census, 1945 ¹

States	Farms reporting 400 and more chickens on hand				
	Farms reporting			Chickens, percentage of total	Eggs produced, percentage of total
	Farms	Percentage of—			
		All farms	Chicken farms		
	<i>Number</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
New Jersey.....	5,357	20.4	26.7	86	88
New Hampshire.....	1,424	7.6	14.8	82	81
California.....	8,202	5.9	9.4	76	77
Utah.....	2,028	7.7	11.1	66	68
Maryland.....	1,173	2.8	3.5	32	36
Idaho.....	655	1.6	2.0	19	22
Missouri.....	2,640	1.1	1.2	7	6
Georgia.....	856	.4	.4	9	11

¹ Special Report 1945 Sample Census of Agriculture, table 2.

Evidence indicates a substantial trend toward greater concentration of commercial agricultural production in the hands of relatively few producers. This means that special-purpose sampling will become essential as time passes.

Special-purpose sampling is required for 66 crops in practically all States in which these crops are commercially important. Seven of these are field crops from which it was estimated that the 1946 cash farm income was as follows: Potatoes 441 million dollars, peanuts 166 million dollars, sugar beets 111 million, rice 140 million, dry edible beans 136 million, sugarcane for sugar 40 million, and hops 33 million dollars. Fruit and nut crops made up 22 of these with a range in farm income for 1946 from 3 million dollars for filberts to 318 million dollars for oranges; 26 are truck crops for fresh market, with a range in value of production, in 1946, from \$500,000 for kale to 97 million dollars for tomatoes, and 11 truck crops for manufacture, with a range from 1.4 million dollars for pimientos to 104 million dollars for tomatoes.

Special-Purpose Sampling Is Exacting

Special-purpose sampling as usually done is more expensive than general-purpose sampling. A much higher degree of control over the entire sampling process is necessary. Special-purpose sampling requires the maintenance of as complete a list as possible of all producers of a specified agricultural product (or of processing establish-

ments in a specified field) or of the larger producers. This list must be brought up to date each year.

With some agricultural products, it is possible to combine the two kinds of sampling. Take the case of poultry producers in New England, for instance. Special-purpose sampling is definitely needed with the 10 percent of the farmers who produce 70 percent of the eggs; that is, a complete current list is needed of all farmers who have flocks of 400 or more hens. General-purpose sampling could be used with the remaining 90 percent who produce less than 30 percent of the eggs. If the population is large and fairly normally distributed as to size of the specific enterprise, a complete list may not be necessary, but it should be a representative sample of the special producers, such as might be obtained from a large annual area survey made by interviews, or a sample census. The cost of making and maintaining these complete current lists of either all producers or all large producers has been prohibitive in the case of most agricultural products. In view of the limited resources available, careful consideration must be given to the economic importance of agricultural products requiring special-purpose sampling, uses to be made of the estimates, and the response of the public to the lack of accuracy in such estimates.

If a complete list of the producers comprising the population to be sampled is at hand, it is possible to combine the advantages of voluntary mail surveys and interviewing individuals selected

TABLE 3.—Large white potato farms, Federal Census, 1945 ¹

States	Farms reporting 15 acres and more of white potatoes				
	Farms reporting			Acres in potatoes, percentage of total	Potato production, percentage of total
	Farms	Percentage of—			
		All farms	Potato farms		
	Number	Percent	Percent	Percent	Percent
California.....	715	0.5	18.6	92	95
Maine.....	3,567	8.5	18.2	89	92
North Dakota.....	2,088	3.0	4.7	86	90
Oregon.....	686	1.1	8.8	74	84
Nebraska.....	877	.8	3.2	61	77
Pennsylvania.....	1,254	.7	1.6	27	37

¹ Special Report 1945 Sample Census of Agriculture, table 26.

by a probability sample. Two or three requests can be made by mail, and then the nonrespondents, or a sample of them, can be interviewed. Obtaining data from at least a sample of nonrespondents is essential if accuracy in the resulting estimates is of prime importance. This combination of voluntary and probability sampling is known as controlled mail sampling. The interviewing of nonrespondents contributes to the expense of special-purpose sampling.

All of the Bureau's field offices maintain lists of the names and addresses of specialized agricultural producers, which are used in special-purpose voluntary mail sampling. In the offices of some of the far Western States, as many as 10 to 15 lists are maintained although it has not been possible to keep many of them complete or strictly up to date. Considerable attention needs to be given to meeting this situation.

Possible Partial Solutions

A partial answer lies in close cooperation with the Bureau of the Census in which BAE (1) would aid that Bureau to get as complete coverage as possible of all these specialty producers in each State and (2) would obtain from the Bureau of the Census, for use in making agricultural estimates, a complete list of the names, addresses, *enumeration district location*, and acreage and production of these special commercial producers and special tabulations that will show joint frequency distributions of numbers of producers and acreage or production, or both. (There are now

certain legal restrictions on the Bureau of the Census which might need to be modified to make it possible to furnish such information.) It is important to have the location of the farms of these special producers. This information should be made available as soon as possible after the 1950 census is completed, and in time for use in connection with sampling and estimating 1951 production. These lists would then need to be brought up to date, annually, by each field office until the next census figures become available.

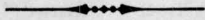
With complete current lists of these special producers, their acreage or production in the census year, and their geographic location, it would be possible to utilize techniques of controlled mail sampling either alone or in combination with an annual sample census.

The proposed annual sample census of agriculture is another possible approach to solution. It should be planned in such a way that it (1) will provide a firm statistical foundation for general-purpose sampling of the major crops, important classes of livestock, and other agricultural phenomena, and (2) will include provision for interviewing the nonrespondents of voluntary mail sampling of the commercial producers who require special-purpose sampling. If the interviewing is done effectively, controlled mail sampling can replace present methods of purely voluntary mail sampling, especially in connection with those populations in which less than 5 percent of the producers account for 25 to perhaps 90 percent of the production. For example, consider again the poultry

industry of New England. Controlled mail sampling might be used for the large producers, comprising 10 percent of all farms in New England that have flocks of hens, and the general-purpose phase of the annual sample census might be used to represent the other 90 percent of the poultry farms having less than 30 percent of the hens. This same principle would have broad application in the case of many of the populations that require special-purpose sampling, including fruits and vegetables and specialized field crops.

If the proposed annual sample census is limited to general-purpose sampling, even a national sample as large as 400,000 farms would not solve the problem of adequately sampling these 60 to 70 populations of specialized producers which require

special-purpose sampling. Nor would it solve the problem of increasing the accuracy of State estimates of major crop and livestock items, in those States in which the production of those items is geographically concentrated in one or a few limited areas, because of special soil, climate, or market requirements. A general-purpose annual sample census would not be satisfactory for meeting the more important problems of sampling and estimating in the six New England States, or in such States as New Jersey, Delaware, Maryland, Florida, Idaho, Colorado, Utah, Arizona, and the Pacific Coast States. It would leave unsolved problems in many other States where the specialized crops are less important in relation to the over-all agricultural enterprise.



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