USE OF A POPULATION CENSUS TO CONSTRUCT AN AGRICULTURAL LIST FRAME

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I. INTRODUCTION

Dissatisfaction with data collection systems of agricultural statistics in developing countries falls into the following categories: scope, accuracy, timeliness, and cost effectiveness. The lack of an adequate sampling frame for agricultural statistics is one of the most intractable problems confronted by most developing countries interested in improving their agricultural statistics and directly affects the accuracy, timeliness, and cost effectiveness of the statistics produced. The problem is intractable, not because methodologies do not exist to construct frames but because the resources in terms of time and money are usually not available for such investments. This experiment was undertaken to demonstrate that the use of an add-on supplement to a population census will produce a cost effective and reliable sampling frame for agricultural data in developing countries where farmers can report their farm size. Moreover, the population census approach to agricultural frame construction may require less time and effort than one based on a full-scale agricultural census or one based upon aerial photography.

Two kinds of sampling frames, if available, could be used to generate survey information on agricultural area, production, and practices: a list frame or an area frame. A list frame is a list of names and locations of all farmers in the country typically obtained either through a population census or an agricultural census. An area frame is constructed by delineating the geographical boundaries of agricultural areas (or any area) through the use of aerial photography or good topographical maps with consistent scales. An agricultural area frame is usually stratified according to land use; land area segments are sampled for enumeration. A combination of both frames may also be used; first- and/or second-stage areas such as provinces, counties, barrios, or smaller areas can be chosen using some available measures of size correlated with the survey statistics of interest such as counts of number of farms from a recent agricultural census; then lists might be constructed for penultimate-stage segments chosen within the sample first- (or second-) stage units.

The most common method of obtaining a list frame is taking an agricultural census. The frame is usually constructed as one of the by-products of the census operation rather than being one of its main purposes. Unfortunately, agricultural censuses are not always an efficient means for collecting agricultural data because of their large scale and expense. As a result, many countries may not continue to conduct periodic agricultural censuses.

One approach which has been used to overcome the difficulty of keeping list frame up-to-date has been the construction of area sample frames based upon aerial photography or good topographical maps. These frames are efficient for area and crop production estimates. Although initially attractive, experience has shown that this approach has been handicapped by the high cost of frame construction and the long period of time which it requires, often three to five years even in small countries like those in Central America.

The approach discussed here for frame construction is to list all farms during the population census. The principal advantages of this method are its cost effectiveness and the correlation of data with the data from the population census. The disadvantages from an administrative point of view are the burden placed on the enumerators and the respondents as well as reluctance to interfere with the contents of the population census. However, there are few experiments upon which a fair evaluation of this approach can be based.

The timing for the experiment, 1979-1980, was opportune because most countries were planning their decennial population censuses and considering the possibility of taking agricultural censuses. In Latin America and the Caribbean alone, 28 of the 40 countries took agricultural censuses during the 1970 round. Adoption of lower cost options for obtaining information in the agricultural sector would result in potential savings in time and cost of enormous proportions. A reduction in the scope of work involved in data collection should also reduce response errors and processing time. Since virtually all developing countries take decennial censuses of population and housing, the framework necessary to implement the methodology being developed in this project is assured.

The selection of the Republic of Guyana for the experiment was a direct outgrowth of the involvement of the U.S. Bureau of the Census in the long-term development of an agricultural planning capability within the Government of Guyana, sponsored by the U.S. Agency for International Development. Guyana seemed to be an obvious candidate for testing this approach because at lest 30 percent of Guyana's population is involved in farm activities; agricultural data for a remote inland area, the Rupununi, were nonexistent even though the agriculture in the area was thought to be extensive; the land use registration of farms ws not complete; and the costs of a complete agricultural census were prohibitive. To fill this void, the U.S. Bureau of the Census proposed the "census add-on" approach as a special research project to USAID/Guyana and to Guyana's Ministry of Economic Planning and Finance and Ministry of Agriculture. The final objectives specified for the experiment in Guyana were:

(1) to define what constitutes a "farm" for policy purposes by taking a listing of all households engaged in any farming activity including raising animals;
(2) to collect current data needed to develop an improved agricultural sampling frame;

Additional objectives pertaining to the agriculture project only were:

(3) to collect data on farm status and farm size and run special tabulations with the population census data to create a proile of farm households by farm size;
(4) to collect baseline data on livestock inventories; and
(5) to identify more precisely areas where small farm families live.

II. METHOD

A. Research Design

In designing this experiment emphasis was placed on accomplishing the goals without adversely affecting the vitally important population and housing data being collected at the same time. First, it was decided that the agricultural questions must be kept to a minimum and would be asked of only one household member after the Population and Housing Census questions were completed. This was done to avoid biases such as respondent fatique or conditioning from entering the population census data. Second, since Guyana's census was designed in participation with the Caribbean Community, the basic design, format, procedures, and machine readable questionnaires were uniformly defined at a regional level. Therefore, a separate and distinct supplement form was designed for collecting agricultural data.

This independent structure of the supplement served to minimize the impact of the supplement on the population census data. While we realized a supplement form would present some logistical problems in the control of forms, in the additional flow of materials in the office and in the field, and in matching to the original census form afterwards to create a profile of the farm households, this approach also brought with it many advantages. Most notably, the importance of the data was emphasized by the fact that a separate form and separate training program and instruction manuals were written for the agricultural supplement. Since the separate, add-on training program was being designed by the U.S. Bureau of the Census staff, a detailed, verbatim training guide could be used, something the Population and Housing Census did not provide. The nature of the supplement also made it possible to process and analyze the data separately from the census data since information needed for basic frame construction and a complete livestock inventory would be self-contained within the supplement. This independent processing capability was viewed as very important due to this historically long delays encountered in processing population censuses in developing countries. In addition, the Caribbean Community countries were using a mark sensing machine-readable form similar to the one that was used in the 1970 Population and Housing Censuses in the Caribbean. Based on the experience of processing the 1970 Census (Guyana's census data were not published until 1978) and the U.S. Bureau of the Census' own reluctance to recommend mark sensing technology for use in developing countries, an independently processable supplement seemed a preferable arrangement.

The first task was to define the tabulation specifications for tables needed for frame construction and to design a series of concisely worded filter questions to determine whether or not the household included one or more farm operators.[1] The questions were then worded appropriately to be clear and concise to respondents. The questions could vary according to the agricultural practices and customs and for this reason, these filter or screen questions need to be tailored specifically for each country. Once a unique farm operator was identified for a particular farm, details on livestock (including poultry) and farm acreage was collected. This information was needed to improve the efficiency of the frame by enabling us to place each farm operation in the appropriate farm size stratum and type.

Finally, special attention had to be given to the geographic coding scheme and the control numbering system for the supplement to fully exploit all the advantages of linkage with the population census.

B. Use of the Census Agricultural Supplement Data as a Sampling Frame

The minimum criteria for farmland and animals used to define a farm operator in the preliminary tabulations from the Agricultural Supplement data were: 0.5 acres of farmland; and/or 5 head of cattle; and/or 10 sheep or lambs; and/or 10 goats or kids; and/or 10 piglets; and/or 100 fowl, chickens, ducks, geese, or guinea birds.

The Agricultural Supplement data can be used to develop either a list frame or an area frame, and different types of sample design can be used with either frame, depending on the timing and purpose of the survey.

III. QUESTIONNAIRE USED IN THE EXPERIMENT

From the earliest drafts it was decided that the supplemental form should attempt to communicate the definition of a farm operator to the respondent so that farm laborers could not misinterpret the intent of the question and represent themselves as "farmers" and that it should adequately handle the problems of multiple operators for a given farm. In addition, U.S. Bureau of the Census staff postulated that additional questions might be needed to handle cooperative farms.

Distinguishing the farm laborer from the farm operator was accomplished by asking "Who is responsible for making day-to-day decisions for this farm?" The definition of "day-to-day decisions" was:

> The decisions necessary to direct the daily operation of a farm. For example, what kind of seeds or planting materials to use; whether or not to buy a particular fertilizer or pesticide; or, in the case of livestock or poultry, what type of feed to use or when to slaughter.

Multiple operators of a farm and cooperatives presented a potential problem for overreporting farms. To identify a farm with a single operator, it was necessary to obtain all the persons responsible for day-to-day decisions for that particular farm and then select the eldest person. This procedure eliminated making judgments as to who was the most important, influential, or responsible decision-maker but used instead age as the selecting factor for the eldest farm operator.

IV. FINDINGS

Results are analyzed below in terms of (1) the timeliness of the actual work and the timely availability of the data for use; (2) the technical and administrative feasibility of adding the supplement to the population census; (3) the cost-effectiveness of data collection via a supplemental form; and (4) the validity of the sample frame.

A. Timeliness

Timeliness was a very real concern because of the experience from the 1970 Population and Housing Census. To circumvent the possibility of having a similar situation occur, it was planned that the supplemental agriculture form would be independent of the population and housing form so that it could be processed separately. The plan was even

more foresighted than expected because problems in processing the census have abounded with machinery failure, lack of funds, and storage problems. Problems also plagued the processing of the Agricultural Supplement form and the release of the data was 11 months later than planned for distribution.

The actual work of collecting the data was intricately involved with the collection of the population and housing data. Data from the census were approximately one month late arriving at the central office for processing, except for the data from parts of Linden and the hinterland, which were up to six months late. Many forms stayed out in the field in the district supervisors' homes due to lack of storage space at the central office and lack of vehicles to transport the documents.

Problems started with the timetable for the work of the coders and editors. In "real" time, the coding and editing could have been completed in three weeks by 12 persons, but only 8 coder-editors were assigned and then the number was further reduced to three coder-editors although one more coder-editor was added toward the end of the coding and editing. Work was completed in April 1981--9 months late due to lack of personnel and work flow problems.

Keypunching commenced in October 1980, five months late because of funding problems. One-third of the forms were keypunched within 10 days. Then further funding problems developed that halted keypunching until March when another third of the supplemental forms were keypunched. Final keypunching was not completed until September 1981 because of administrative problems concerning release of funds to be used for keypunching which caused delay from the original schedule. Keypunching that should have taken no more than a month to complete took 12 months.

These problems are not unusual in collecting and processing national data in a developing country although processing could have been speedier with better management of available resources, even if funding problems were insurmountable.

The preliminary results were put into use the day the tables were received in Guyana. The Ministry of Agriculture planning department needed to estimate the number of farm operators for small areas within a certain region. Consequently, the data from the preliminary tables were used as references because these data for small areas existed nowhere else. The reliability of small area data will be discussed later in this section.

Use of the agricultural frame will begin the Fall of 1982 with the Area and Crop Production Survey. It is estimated that the frame of farm operators could have been ready for use the Fall of 1981 if funding and administrative problems had not interfered. Under ideal conditions, the supplemental form could be coded, edited, keypunched, and tabulated within six months because of its simplicity.

B. Feasibility

The Guyana experience proved that using a supplemental agriculture form with the population and housing census is feasible. It took one to two months of work to develop a suitable questionnaire that would eliminate double counting of farms with more than one operator by selecting only the eldest operator to be identified with the farm or cooperative, and to obtain enough information on the farm operation to be able to establish the minimum criteria for the identification of a farm. All of this information was recorded on the single side of a one-page form that took an average of three minutes to administer and edit before leaving the household.

Essentially, we feel the instrument has been validated by the Guyana experiment and can be used by other countries.[2] While it is feasible to replicate the data collection in another country, the criteria for use would be that the farm operators be able to estimate their land area and be private farm operators. Modifying the form would entail substituting different animal names and units of measure. During the editing process, the definition of farm operation needs to be used and this also would have to be changed to reflect what is considered a farm in that particular country.

It is important to keep certain essential aspects of the form such as the identification of a farm with the eldest operator and the use of the FAO definition[3] of what constitutes farmland. The substance and order of the questions on the form should not have to be changed.

If the census is being planned and a country needs the listing of farm operators to develop an agricultural sampling frame, the remaining ingredient for success is the will to add the supplement because the added cost of collecting the data is negligible.

C. Cost Effectiveness

Since it is feasible to add a supplement that identifies the farm operators during a population and housing census, the next step would be to study the cost effectiveness of planning such a data collection effort. There are certain cost factors that need to be identified in relation to time, since labor costs vary in each country.

		Time
(1)	development of form	completed
(2)	modification of form (1 professional)	2 days
(3)	development of manual	completed
(4)	modification of manual (1 professional)	5 days
(5)	development of training manual	completed
(6)	modification of training manual (1 professional)	5 days
(7)	training per enumerator	1 day
(8)	administration and field edit of form per household	3 min. avg.
(9)	coding and editing of each form	30 sec. avg.
(10)	keypunching of each form	73 sec. avg.

Developmental costs of the form and manuals can almost be eliminated except for the modification steps which should take no longer than a total of 12 days of professional time. If the basic rates of pay for enumerators, coders, editors, and keypunch operators are all the same, as was the case in Guyana, then a simple formula can be used to calculate approximate cost where the three factors are added together to estimate total cost. These estimates are based on the experience in Guyana.

F_1 the total cost of 12 days of professional time for modification

F_2 the incremental cost of 1 training day for each enumerator summed over all enumerators

F_3 the cost of enumerating each household and editing, coding, and keypunching each form to be calculated where:

$$F_3 = \left(\frac{X \times Y}{3,600}\right) \times Z$$

where X = number of estimated households
Y = 283 seconds of time to handle each form
Z = basic hourly rate of pay for white collar workers

The total cost of data collection would be far less than conducting an agricultural census or any other independent data collection effort because the primary cost of development and placing the enumerator in the field have already been covered. Since the technology now exists, comparative research can be done by other countries that meet the basic criteria discussed in the previous section. Agricultural sampling frames have always been expensive to construct but now it is possible to reduce costs considerably to obtain some of the same basic information to construct an agricultural sampling frame as is collected in an agricultural census.

D. Validity

In order to establish validity, we looked at independent estimates for farm operators, animals and acreage; and we studied the error rates.

1. Independent Estimates

The 1980 Census Agricultural Supplement form was compared with data previously collected through a sample survey, the Guyana Rural Farm Household Survey (1978). The count of farmers was very close to the Guyana Rural Farm Household Survey estimate, as was the count of animals, with the draft animal category changing the most. This reflects what has been happening in Guyana where car imports were halted and spare parts almost impossible to obtain, causing an increase in the use of draft animals.

COMPARISON BETWEEN THE CENSUS AGRICULTURE SUPPLEMENT DATA (CAS) AND THE GUYANA RURAL FARM HOUSEHOLD SURVEY DATA (GFRHS)

	GRFHS (1978)	CAS (1980)	Percent Difference
Farm Operators.....	24,635	24,243	-1.6
Cattle.....	67,599	65,517	-3.1
Sheep/Lambs.....	26,980	22,967	-14.9
Goats/Kids.....	12,962	9,762	-24.7
Pigs/Piglets.....	28,748	26,112	-9.2
Donkeys/Horses.....	3,639	5,155	41.7
Fowls/Chickens/Ducks/ Geese/Turkeys/Guinea Birds.....	647,162	725,146	12.0
Farm Land.....	483,799	240,674	-45.2

The farm land owned, rented, or leased was the only count that was a problem. There were several plausible reasons why the discrepancy between the two estimates is as large as it is: (1) there may have been a lack of understanding by the farm operators who reported only crop land rather than all land; (2) there may have been a reticence to report the correct amount of land because of perceived tax problems; and (3) there may have been a bias in imputation procedures because no adjustments were made for large farmers who either did not respond at all or greatly underreported the amount of actual acreage.

It was suspected that a misunderstanding of all land versus crop land occurred because the land reported in the Census Agricultural Supplement (240,674 acres) was comparable to the crop land reported in the Guyana Rural Farm Household Survey (243,055). The misinterpretation could have been the result of asking only two questions on acreage on the Census Agricultural Supplement versus 19 questions asked for specific definition of acreage use in the Guyana Rural Farm Household Survey. These detailed questions in the Guyana Rural Farm Household Survey evoked reporting of grazing land, unused land, and land leased that the farm operators usually do not consider as being part of their farm land.

A definite possibility existed that the reticence to report amount of land could be tied to a recent tax structure that allows the impoverished Government of Guyana to tax up to 74 percent of profits. A farm operator who owns five acres cannot be expected to earn as much profit as one who owns ten acres of crop land.

The fact that 10 percent of the supplement estimate of farm land was imputed is a further indication of the problem of reporting land. Since the largest farms are heavily concentrated in this 10 percent, the imputation procedures would lead to a bias in the total area of farm land as small values are substituted for invalid or missing entries for farm land in the records of large farms.

The discussion of whether the discrepancy of farm land will affect the sampling frame will be discussed later in the section.

2. Error Rates

The error rate was very low. Of all the forms, 86.9 percent had no errors detected at all and 11.0 percent had only one error. Of the 144,000 forms, this meant that 97.9 percent had no more than one error found which indicated that the quality of data collection was very good.

ERROR RATE FOR EDITING 144,000 CENSUS AGRICULTURE SUPPLEMENT FORMS

Number of Errors	Percent of Forms
0	86.9
1	11.0
2	1.8
3	0.2
4	0.1

Error rates were also examined for the forms of farm operators only, since more data was collected from farm operators and more errors could occur; however, as the next error table indicates, this did not happen.

ERROR RATE FOR EDITING 24,243 CENSUS AGRICULTURE SUPPLEMENT FORMS

Number of Errors	Percent of Forms
0	81.9
1	16.3
2	1.1
3	0.3
4	0.1
5	0.1

3. Effect of Identification Coding Problems

Most of the identification problems in the agriculture supplement data resulted from a lack of coordination between the office and field staff working on the 1980 Guyana Census and the cartographic unit, as well as inadequate operational and quality control procedures. Insofar as most of the coding problems which were identified in the supplement data were subsequently corrected, the effect on the quality of the sampling frame based on the supplement data would be minor. The main effort of these coding problems was to increase considerably (by several months) the amount of time required to process the data.

Approximately 98 records of agricultural supplements were deleted during the second edit from the comptuer file because of duplication of identification numbers. Part of this duplication resulted from coding problems, whereby some otherwise valid records were deleted from the file. In many cases, this would result in a slight undercoverage in the corresponding enumeration districts. If the agriculture supplement were to be used as a list frame, this undercoverage would result in a corresponding bias.

It is not recommended at this point that the supplement be used as a list frame because of the potential change in farm households over the period of more than two years since the 1980 census; also the imputation of some identification codes would lead to further complications.

In the case of an area frame based on the supplemental data, the deletion of valid records would result in a slight discrepancy in the measure of size (number of operators or farm households) for the corresponding villages; this would cause a small increase in the sampling error of survey estimates, but no bias would result. However, in cases where the entire set of records from an enumeration district were deleted because of the duplication of identification numbers, a bias would be introduced if that enumeration district is excluded from the frame. Overall, it is believed that the coding problem would only have a minor effect on the usefulness of the agricultural supplement frame.

4. Effect of Underreporting of Farm Land

The underreporting of farm land decreases the sampling efficiency of the agriculture supplement frame, i.e., it makes it necessary to use a larger sample to obtain a specified precision for survey estimates than would a perfect frame. However, this problem in itself will not lead to biased results from a survey based on a supplement area frame. The loss in sampling efficiency would be caused by the deficient stratification due to the underreporting of land. If one major objective of an agriculture survey is to measure total area and production in different crops, it is important to include the largest farms in the sample with certainty. Since a list of large farms from the supplement data would be incomplete because of nonresponse or underreporting acreage, the large farms not included would have to fall in the sample at random, increasing the sample error of the estimate of total farm land. The area of farm land corresponding to the farm operators in enumeration districts can also be used for an implicit stratification of the enumeration districts. These types of stratification would suffer from similar deficiencies. Although it is not yet possible to quantify the increase in variance caused by the underreporting of land, it is not believed that it would have a major negative impact on the quality of the supplement as an area frame. In the case of the frame of large farms identified from the supplemental data, it can be updated from other sources of data.

E. Final Comments

Although the Census Agriculture Supplement was administered successfully with very few errors during the Guyana 1980 Population and Housing Census, the problems that can occur with a poorly managed census should not be underestimated. The identification problems are a result of no operational or quality control during the Population and Housing Census itself. The validity of the agricultural supplement data was indicated by the accurate counts of farm operators and farm animals, but certain quality control measures were built into the form itself to assure accurate data collection.

Since the data produced a census count of farm operators and farm animals with a high degree of validity, the data can be used for small area data. The need for small area data was apparent when the tables were put to use the day of arrival in Guyana, specifically for small area data to provide planning information for the Ministry of Agriculture.

Another final conclusion is that the original timetable was to take no longer than 6 months and this timetable is still probably accurate because the delays were due to poor management and administrative problems. Although the editing and coding took too much time to complete, the machine consistency edit did show a low error rate. The slow keypunching problem was due to administrative problems in releasing money to another ministry. It could have been completed within the original time frame of less than one month because the keypunchers' rate of production was very high and their accuracy was verified.

The Census Agriculture Supplement can be used to collect reliable data in a cost effective manner that will be timely to construct an agricultural sampling frame. The only remaining ingredient is the will to collect the data.

F. Recommendations

The Census Agricultural Supplement was designed to permit each farm, as identified by its operator to be compiled so that the data could be used to develop a list frame for post-census agriculture surveys. The accuracy of a list frame for survey-

taking depends on its coverage, how old the frame is, and the degree of change since the frame was developed. The sampling based on a list frame is usually carried out in two or more stages, with large clusters of households selected at the first stage in order to concentrate the sample in relatively few locations to reduce transportation costs and increase control. In the case of the Agricultural Supplement frame, the census enumeration districts could be used as clusters to be sampled at the first stage. In order to make the sampling frame more efficient, the enumeration districts should be stratified into homogeneous sets, such as geographic or land use strata for multipurpose agricultural surveys.

Notwithstanding some apparent minor problems due to possible undercoverage in the population census, the main concern about using the Agricultural Supplement as a list frame would be the changes which occur in the time period between May 1980 and the conduct of the agriculture survey. The farm operators who move following the census enumeration have no probability of selection in a survey using the Agricultural Supplement as a list frame. Attempting to identify new households which correspond to a farm operation which changed hands is very problematic. The mobile population not represented in the sample may be quite different from the remaining population, resulting in biased survey estimates. Since any agricultural survey based on the Agricultural Supplement frame in Guyana will be carried out more than 18 months after the census, it is recommended that the Agricultural Supplement not be used as a list frame, unless some updating is carried out.

An alternative to a list frame is an area frame approach. As the name implies, an area frame consists of a set of geographic areas (with well-defined boundaries) that cover the entire population of interest. Typically, the sampling for a survey based on an area frame is carried out in two or more stages, with a listing of the analytical units within the sample areas selected at the penultimate sampling stage. Since the sample areas are defined in terms of fixed boundaries and each element of the population always falls within exactly one area, this type of frame is much more permanent than a list frame which deteriorates over time. For this reason, the Agricultural Supplement data are more suited in the long run to be used in developing an area frame if the country has a well-developed mapping system of enumeration districts such as Guyana has. Of course, an area frame is also more costly to use than a list frame, since each survey based on the area frame requires a new or updated listing in sample areas. However, the cartographic work involved in determining natural boundaries for small areas, which is one of the more costly aspects of developing an area frame, has already been carried out in connection with the population census.

It is important that the penultimate stage areas be small enough for listing purposes, while having boundaries that can be easily identified in the field. In the case of the Agricultural Supplement frame, the census enumeration districts are ideal to use as primary sampling units in a two-stage design. In Guyana, the enumeration districts were designed to have an average of 100 households, which one enumerator should be able to list in two days. Also, sketch maps are available which define the boundaries of each enumeration district. The Agricultural Supplement data can be used for stratification purposes and to obtain measures of size (number of farm households or operators) for each enumeration district.

If estimating total area and production in crops or livestock production is a major objective of a survey based on the Agricultural Supplement frame, it is important to identify the largest operators and include them with certainty in the sample. In this case, it is possible to use a combined area and listing frame to make the sample design more efficient. A computer printout can be obtained from the Agricultural Supplement data of the farms with the largest area of farmland or number of livestock, to be included in the sample with certainty. It is essential that the two frames be made disjoint of each other, in order to avoid any bias resulting from duplication. The listing is carried out in each sample enumeration district, any farm included in the list frame of large farms should be excluded from the area frame prior to carrying out the second-stage selection operation in the area frame. Although the list frame may not include new large farms or those omitted due to inaccurate Agricultural Supplement data, such farms would still have their appropriate probability of selection from the area frame.

G. Future Use of Data in Guyana

The plans to use the Agricultural Supplement data in Guyana are to develop a combined list and area frame for a cattle survey. The largest cattle operations would come from the list frame and would be included in the sample with certainty, while the number of smaller cattle operations in each enumeration district would be used as the measure of size in a two-stage area frame sample design. It will be necessary to carry out fieldwork to update the listing of farm operators for each enumeration district selected.

At a later time, it is planned to use the Agricultural Supplement data for a multipurpose farm household survey with a sample frame similar to the combined list and area frame discussed earlier in the paper and in the preceding section.

FOOTNOTES

[1] The farm operator is the person who makes the day-to-day decisions for the farm and care must be taken to avoid duplication of farms when there is more than one operator for a farm, as well as to avoid undercounting farm operations when there is more than one operator (and operation) in a household.

[2] The software program for editing and data processing are also developed but may be less adaptable due to differences in hardware and software packages available in other countries.

[3] Programme for the 1980 World Census of Agriculture, Food and Agriculture Organization of the United Nations, Rome, 1976, Chapter 3, pp. 15-19.