An Evaluation of Alternative Weights for a Weighted Estimator

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ABSTRACT

This report evaluates two weights that are being considered as input into a
weighted estimator of hog and cattle inventories and the number of farms.
The weight based on cropland acreage with a definitional modification is
recommended for further research over the weight based on total acres minus
continuous waste, woods (excluding grazed woodland), roads and ditches. The
cropland weight is preferred because it simplifies the questionnaire and
instructions to the enumerators, should be less susceptible to nonsampling
errors, reduces the data collection and computer editing requirements, and
should provide estimates of similar precision.

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SUMMARY

Two weights were evaluated in five states during the 1981 June Enumerative Survey (JES) for use in a weighted estimator of hog and cattle inventories and the number of farms. The first weight was based on total acres minus continuous waste, woods (excluding grazed woodland), roads and ditches. This weight was infested with reporting and recording problems that could result in seriously biased estimates. Although many of these problems can be remedied, numerous problems are expected to continue. The second weight, which was based on cropland acreage, inherited many nonsampling errors from the first weight. However, these errors can be minimized in the future by modifying the definition of the cropland weight and by improving the questionnaire design and instructions to the enumerators.

The cropland weight is preferred because it: (1) is easier to define, which will simplify the questionnaire and instructions to the enumerators, (2) should be less subject to nonsampling errors, (3) yields greater data collection savings, (4) greatly reduces the number of computer edits, and (5) should provide estimates of similar precision.

Three estimators were evaluated that are based on the cropland weight. These estimators generally provided similar estimates and levels of precision.

The Survey Research Section recommends that research be conducted on a larger scale during the 1982 JES so that the modified cropland weight and the three estimators based on this weight can be evaluated thoroughly.

INTRODUCTION

The Statistical Reporting Service (SRS) uses an area frame sample in sixteen states to provide weighted estimates of hog and cattle inventories and of the number of farms. In addition, SRS uses a weighted estimator as input into multiple frame livestock estimates in thirteen states. The weight or proration factor used in the operational weighted estimator is the total tract acres divided by the total farm acres. A research project conducted in Indiana, North Carolina and Oklahoma during the 1976 December Enumerative Survey revealed that the operational weight was biased upward in all three states mainly due to an underreporting of nonagricultural or waste land on the entire farm operation. $\frac{1/}{}$ One of the recommendations of the research project was that other weights be explored.

SRS collected data on two other weights during the 1981 JES in Georgia, Kentucky, Minnesota, North Carolina and Ohio. The first weight, which is called the alternative weight, was proposed by Methods Staff. This weight is based on total acres minus continuous waste, woods (excluding grazed woodland), roads and ditches. The term "continuous" is defined as all parcels that are large enough to draw off on an aerial photograph as a separate field. Therefore, small parcels of waste within crop fields are not defined as "continuous" waste. The second weight is based on cropland acres. Cropland acreage was defined as land devoted to crops, hay acreage, land in summer fallow, idle cropland and noncontinuous parcels of waste, woods (excluding grazed woodland), roads and ditches within the cropland fields.

The purpose of this report is to compare the operational, alternative and cropland weights with respect to their: (1) data collection requirements, (2) nonsampling errors, and (3) estimates and relative errors.

ESTIMATORS

The results from seven estimators will be presented in this report. The first two estimators, the open and closed estimators, which are not dependent upon any of the three weights, were examined for two reasons: (1) to have a thorough comparison of all estimators available, and (2) because two of the estimators based on the cropland weight depend to a certain extent on the open and closed estimators. The third and fourth estimators are the weighted estimators based on the operational and alternative weights, respectively.

Finally, the last three estimators are mainly based on the cropland weight. These three estimators differ only in their method of solving the problem that the cropland weight is undefined when a farm operation has no cropland.

A brief description of each estimator will now be given. The formulas for the "area frame" estimate of a total and the variance estimate for each estimator are presented in APPENDIX A.

(1) *OPEN ESTIMATOR:* This estimator, which is also referred to as the farm expansion, requires the enumerator to obtain data on the entire farm for each farm operation with headquarters inside the segment.

(2) *CLOSED ESTIMATOR:* To apply this estimator, the enumerator must identify each farm operation which has any land in the segment. The land within the segment operated by a farm operation is called a tract. The enumerator obtains data for the tract rather than for the entire farm from each farm operation. This estimator is commonly called the tract expansion.

(3) *OPERATIONAL WEIGHTED ESTIMATOR:* This estimator, which is also called the weighted expansion, is based on the following two pieces of information from each farm operation which has land in the segment: (1) the entire farm data for the survey item being estimated, e.g. number of hogs and pigs on the entire farm, and (2) the total tract and farm acreages, which serve as a weight to prorate the entire farm data for a survey item to a tract basis. For example, if a farm operator reports 150 hogs and pigs on the entire farm, 10 tract acres and 30 farm acres, then the weighted tract value is: $\frac{10}{30} * 150 = 50$ hogs and pigs. The operational weight is always defined. As mentioned previously, the operational weight has been shown to be biased upward.

(4) *ALTERNATIVE WEIGHTED ESTIMATOR:* This estimator is identical to the operational weighted estimator in all aspects except that a different weight is used. The alternative weight is based on the tract and entire farm data for total acres minus continuous waste, woods (excluding grazed woodland), roads and ditches. This weight was always defined in the five states even though it can be undefined. This estimator is sometimes referred to as the alternative weighted expansion.

(5) *CROPLAND WEIGHTED ESTIMATOR I:* This weighted estimator makes use of the weight based on cropland acres except when the cropland weight is not defined. The cropland weight is undefined when there are no cropland acres on the entire farm for a farm operation. Whenever the cropland weight is not defined, the operational weight is used to prorate the data. A possible disadvantage of this estimator is that the operational weight, which has been shown to possess an upward bias, is utilized whenever the cropland weight is undefined. The effect this may have on an estimate depends upon the following two factors: (1) whether the operational weight is biased when the population of farm operations is limited only to those with no cropland acres, and (2) how often a survey item is nonzero when the operational weight is used.

(6) *CROPLAND WEIGHTED ESTIMATOR II:* This estimator combines the concepts of the open and weighted estimators into a single estimator. The mechanics of this estimator are: (1) whenever the cropland weight is defined for a farm operation the weighted approach based on the cropland weight is used, and (2) whenever the cropland weight is not defined the open estimator is used.

(7) *CROPLAND WEIGHTED ESTIMATOR III:* This estimator differs from the previous estimator in that the closed rather than the open estimator is used when the cropland weight is not defined. That is, the tract data is used in the estimate whenever the weight is 'not defined for a farm operation.

ANALYSIS

The analysis will concentrate on comparisons among the operational, alternative and cropland weights. The comparisons will focus on the following three areas: (1) data collection requirements, (2) nonsampling errors, and (3) the estimates and relative errors.

DATA COLLECTION REQUIREMENTS:

In order to apply a weighted estimator, entire farm information for the survey items is collected from each farm operation with land in the sampled segments and multiplied by the weight corresponding to each operation. The weight is based on the tract and entire farm values for a specified variable. If the weight is zero, entire farm data does not have to be collected since the weighted tract value is automatically zero.

The operational weight is always greater than zero. Therefore, the enumerator must obtain entire farm data from each farm operation when using the operational weight. For this five-state study, the enumerators obtained entire farm data on hogs, cattle and gross farm sales from 6,859 farm operations. In addition, the total acres in the tract and in the entire farm were obtained from each farm operation in order to generate the weight.

An attractive feature of the alternative weight is that this weight is not always greater than zero. If all the land in the tract for a farm operation is classified as continuous waste, woods (excluding grazed woodland), roads and ditches, then the alternative weight is zero. When this occurs, the enumerator does not have to obtain entire farm data for the survey items. In this study, 163 of the 6,859 operations had an alternative weight equal to zero. However, of these 163 operations only 32 had hogs and 95 had cattle. Therefore, only a very small reduction in data collection efforts is anticipated because of the alternative weight being zero. This small savings is greatly offset by the additional time needed to obtain the data for the alternative weight.

Five questions were added to the questionnaire to provide the tract and entire farm data from each farm operation for the alternative weight. Some of these questions were not easy to answer for many operations. For example, every parcel of waste, woods (excluding grazed woodland), roads and ditches in the tract had to be classified as continuous or noncontinuous land. Also, the farm operator had to estimate the total acres in the farm that were continuous waste, woods (excluding grazed woodland), roads and ditches. Finally, the total farm acreage in the farmstead, feedlots, pasture and grazed woodland was asked. Therefore, the respondent burden for the alternative weight was greater than the operational weight.

The cropland weight requires less data collection than the alternative weight for three reasons. The first and most important reason is that fewer and less complicated questions are needed to obtain the cropland weight. Second, the cropland weight will be zero more often than the alternative weight. In this study, 580 of the 6,859 operations had a cropland weight of zero. Therefore, entire farm data for items such as cattle would not have to be asked from these 580 farm operations. Third, if the cropland weighted estimator II or III is used, further savings in data collection occur when the cropland weight is not defined.

For the cropland weighted estimator I, there are no additional savings when the cropland weight is undefined because the operational weight is then used in the estimator. However, for the cropland weighted estimator II, the open estimator is utilized when the cropland weight is not defined. Recall that with the open estimator data is not collected from farm operations with headquarters outside the segment. Therefore, it would be unnecessary to obtain entire farm data from farm operations with headquarters outside the segment which do not have any cropland on the entire farm. There were 185 such operations in the five states. Finally, when dealing with the cropland weighted estimator III, there is no need to collect entire farm data from any operation with an undefined cropland weight because the tract data will be used in the estimator for these operations. A total of 712 operations had an undefined cropland weight. Table 1 gives a summary of the number of tracts in the five states for which entire farm data would not have to be collected for each of the weighted estimators.

Table 1: The Number of Tracts With Zero or Undefined Weights
for Each Estimator. The Total Number of Tracts is 6,859.

ESTIMATOR VALUE OF WEIGHT	OPERATIONAL WEIGHTED	ALTERNATIVE WEIGHTED	CROPLAND WEIGHTED I	CROPLAND WEIGHTED II	CROPLAND WEIGHTED III
Zero	0	163	580	580	580
Undefined	0	0	0	185	712
Zero or Undefined	0	163	580	765	1292

The data collection savings provided by the cropland weight when it is zero or undefined are not as great as they appear. Of the 580 operations with a cropland weight of zero, 466 had no hogs and 182 did not have any cattle. Also, of the 712 operations with an undefined weight, 580 and 308 did not have any hogs and cattle, respectively. Therefore, although the three cropland weighted estimators have different data collection requirements, these differences will not be large if operations with no cropland acres, that is, undefined cropland weights, tend not to have livestock. Nevertheless, these savings in addition to the greatly simplified questionnaire illustrate that the cropland weight requires less data collection than the alternative weight.

A comparison of the data collection requirements for the operational and cropland weights is difficult to quantify. One additional question will be needed on the questionnaire to properly obtain the cropland weight, which will increase the respondent burden. On the other hand, data collection savings are provided by the

cropland weight when the weight is zero and are possible when the weight is undefined. How much savings are actually provided will depend on how often the cropland weight is zero or undefined, which estimator is used, and the sizes of the operations that tend to have a zero or undefined weight. In conclusion, the data collection requirements for the cropland weight should not be much higher than the requirements for the operational weight.

NONSAMPLING ERRORS:

Each weight is constructed by obtaining tract and entire farm data for a particular variable. Sections A and D of the 1981 JES questionnaire were used to obtain the tract and entire farm data, respectively, for each of the three weights. Sections A and D are shown in APPENDIX B.

If a weight is not accurately obtained, the weight may be biased, thereby resulting in biased estimates. A research project in three states demonstrated that the weighted estimates based on the operational weight were biased upward. [1]/ Therefore, the operational weight is not satisfactory.

Numerous problems were encountered with the alternative weight during the 1981 JES. Probably the most serious problem was the classification of waste, woods (excluding grazed woodland), roads and ditches both in the tract and in the entire farm. In the tract, the enumerator was instructed to classify waste, woods (excluding grazed woodland), roads and ditches into one of two categories -- continuous or noncontinuous land. A parcel of land was considered continuous if it was large enough to draw off on an aerial photograph as a separate field. Unfortunately, the wrong category was often coded by the enumerator. For example, a field of woods was often erroneously coded as noncontinuous woods, or noncontinuous waste in a crop field misclassified as continuous waste. These mistakes went undetected through the manual edits in many instances, and the computer edits were not designed to discover many of these problems.

Improvements could be made to the questionnaire wording and the enumerator's instruction manual that would reduce the incidence of errors when classifying waste at the tract level. Also, a change in the classification criterion of waste would decrease misclassifications. The classification criterion used in the five states was difficult to apply successfully, especially when classifying waste on the entire farm. The recommended classification criterion would classify the waste simply as either waste within crop fields (regardless of size) or all other waste. Finally, field by field computer edit checks are needed to minimize erroneous classifications. Without all of these changes, problems are expected to continue at the tract level.

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When gathering data for the alternative weight on the entire farm, several problems were readily apparent. First of all, the concept of continuous waste, that is, large enough to draw off on the aerial photograph, does not extend itself to the entire farm in many cases because the enumerator does not delineate each field for the entire farm. The recommended modification in the classification criterion for waste, woods, etc. should remedy this problem.

Referring to Section D in APPENDIX B notice that the total land was divided into three categories: (1) Cropland, (2) Farmstead, Feedlot, Pasture and Grazed Woodland, and (3) Continuous Waste, Woods (Excluding Grazed Woodland), Roads and Ditches. The sum of the first two categories makes up the denominator of the alternative weight. The assumption was made that all farmers would include noncontinuous waste, woods, etc. that were in the crop fields in the first category. This assumption, however, was not addressed on the questionnaire or in the enumerator's instruction manual. Preliminary results from a followup study in North Carolina and discussions with enumerators in Minnesota, North Carolina and Ohio indicated that this was not a valid assumption. A total of 35 of the 113 respondents in the North Carolina study indicated that they did not include parcels of waste, woods, roads and ditches in their estimate of cropland acreage. Also, some farmers will include a continuous parcel of wasteland in the cropland estimate rather than include it in the continuous waste category.

An easier definition is needed for cropland acreage with regard to waste in the fields in order to minimize these problems. The farm operator should be asked either to include or to exclude all waste. A computer check should also be initiated to make sure that the farm cropland acres is at least equal to the tract cropland acres.

Another problem encountered had to do with the second category -- Farmstead, Feedlot, Pasture and Grazed Woodland. The entry was zero for this category in numerous cases even though a farmstead is almost always associated with a farm. This error was corrected during the manual edit when detected. However, 157 farm operations on the clean JES file had a zero value for this category. If the farmstead acreage was classified as waste, the weight is biased upward. A computer edit check is needed to assure that the farm data for the second category is greater than or equal to the corresponding tract data. Also, to reduce errors caused by the operator not including the farmstead in this category, a computer check should be made that the second category is greater than zero.

The alternative weight was greater than one on the clean JES file for 265 of the 6,859 operators. This occurred because a computer check was not made on the weight being less than or equal to one. The alternative weight was originally greater than one for many other operations but was corrected during the editing process because of computer checks comparing separately total land in the tract and farm and continuous waste, etc. in the tract and farm. To avoid getting weights greater than one, a computer edit check should be developed for the alternative weight.

Review of a random sample of JES questionnaires in Minnesota, North Carolina and Ohio from operations that were selected for another research study revealed that much editing was required in the offices for the three land categories in Section D. For example, in North Carolina, if refusals are excluded from the count, a total of 36 of 117 completed JES questionnaires required some office editing in one or more of the three categories. This is naturally quite alarming and brings to light the difficulty operators and enumerators encountered trying to classify the total land into the three land use categories. Similar problems were observed in Minnesota and Ohio.

Discussions with enumerators revealed that these questions were not popular with the enumerators and farm operators. Also, several enumerators thought that the second and third categories were the major source of the unpopularity. Although nothing concrete can be said about the effect on the estimates from all this editing, it should be obvious that the data obtained in the categories is highly suspect. Therefore, in its present form, Section D seems to be ineffective in obtaining the entire farm data accurately for the alternative weight.

In summary, there were many problems with the alternative weight. Many of these problems can be remedied by: (1) improving the wording on the questionnaire, (2) addressing the topic in more detail in the instructions to the enumerators, (3) modifying the definition of the weight, (4) incorporating additional tract-level computer edit checks, and (5) initiating field-level computer checks on the classification of waste. All these recommendations except for the field-level edits can be implemented with ease. The field-level edits would require significant changes in the edit program, which should be avoided, if possible. However, without the field by field

checks on the waste classifications, many errors are expected to continue with the alternative weight. A simple solution to this dilemma is to use a weight that should be more accurate and that does not require field-level edit checks. One such weight would be a weight based on cropland acreage.

The weight based on cropland acres in this study was also subject to nonsampling errors. Cropland acres was defined as land devoted to crops, hay acreage, land in summer fallow, idle cropland and noncontinuous waste, woods (excluding grazed woodland), roads and ditches within the crop fields. Therefore, the cropland weight inherited the problems from the alternative weight with respect to the misclassification of continuous and noncontinuous waste in the tract and in the entire farm. For example, the cropland weight exceeded one for 439 of the 6,859 operators on the clean JES data file. Most of these unacceptable weights were caused by misclassified waste in the tract or entire farm. Some of the misclassifications on the entire farm were probably caused by not mentioning in the enumerator's manual that noncontinuous waste, etc. was to be included in the estimate of cropland acreage for the entire farm.

Reporting problems with the cropland weight can be minimized in the future if cropland acreage in the entire farm is defined as it currently is in the tract. That is, all waste associated with the crop fields should be deducted when estimating cropland. This will greatly reduce the number of times the cropland weight is greater than one. This approach will also simplify the questionnaire and enumerator's manual and will greatly reduce the number of computer edits required since field-level checks would not be needed. As previously mentioned, a computer edit check on cropland acreage should be implemented to insure that the tract cropland acres does not exceed the farm cropland acres. In conclusion, the proposed cropland weight should be much less subject to reporting and record-ing problems than the alternative weight.

ESTIMATES AND RELATIVE ERRORS:

Numerous hog and cattle survey items were selected for testing. Some of these items have data on the tract and entire farm while others have data only on the entire farm. APPENDIX C contains a list of the survey items selected. Twenty-two hog and eighteen cattle survey items were evaluated. Ten of the hog items and eleven of the cattle items examined had tract and entire farm data, while twelve hog and seven cattle items only had entire farm data. Finally, the variable, number of farms with gross value of sales of at least $1,000, was included in the analysis.

The number of segments and the number of farm operations in each state for the JES are also shown in APPENDIX C. The results of the analysis for each state and the five states combined are shown in APPENDIX D. The estimates and relative errors from each of the seven estimators are displayed in Tables D-1 through D-7 for survey items with tract and entire farm data. The results for survey items that only have entire farm data are shown in Tables D-8 through D-14 for the five estimators. The analysis dealing with hog items in North Carolina was done with all the data and then with the hog data from seven large hog operations deleted since these operations had an overwhelming influence on the results. The estimates and relative errors for the five states combined do not include the hog data from these seven operations.

Remember that the estimates shown for the alternative and cropland weights are affected by the reporting problems stated previously, and may very well be biased. For example, the open estimate for the number of farms was always less than the operational, alternative and cropland weighted estimates. The largest differences occurred in the three southeastern states where the percent difference between the open and weighted estimates ranged from 11.0 to 19.7 percent. The possibility exists that biases in the weights have contributed to the differences. Therefore, detailed comparisons among the estimates and relative errors are not worth pursuing until these problems are resolved. To this end, only a few general comments will be made with regard to the estimates and relative errors.

The estimates generated by the alternative and cropland weights for hog and cattle items and the number of farms were generally very reasonable in comparison to the operational weighted estimates in all states except North Carolina. Large differences existed for hog numbers in North Carolina because of several very large hog operations. Without these atypical operations, the hog estimates by the alternative and cropland weights were much closer to the operational weighted estimates.

The relative errors from the operational, alternative and cropland approaches were also very similar except for hogs in North Carolina. In most cases, the operational weight had the lowest relative error and the cropland weight the highest. The three cropland weighted estimators (estimators 5, 6 and 7) gave very similar results in most cases. This is largely due to the fact that the value of the survey items was often zero when the cropland weight was undefined. Over 600 of the 712 operations with an undefined cropland weight had a zero value for many of the survey items, e.g. sows and boars no longer used for breeding.

Table 2 provides a summary of the performance of the estimators based on the three weights for the five states combined. The hog inventories from the

seven large hog operations in North Carolina were excluded because of their impact on the hog results. Shown in this table for each estimator is the average relative errors for hog and cattle items with tract and farm data and with only farm data and the relative error for the number of farms estimate. The relative errors by the cropland weighted estimators are very similar to the operational and alternative estimators.

Table 2: Average Relative Error for Groupings of the Hog and Cattle Items and the Relative Error for the Number of Farms for the Five States Combined

| VARIABLES | RELATIVE ERROR (%) | | | | |
| | OPERATIONAL WEIGHTED | ALTERNATIVE WEIGHTED | CROPLAND WEIGHTED | | |
			I	II	III
Tract and Farm Data:					
10 hog items	8.7	8.7	8.9	8.9	8.8
11 cattle items	5.0	5.1	5.4	5.5	5.4
Farm Data:					
12 hog items	12.4	12.3	12.8	12.8	
7 cattle items	5.2	5.3	5.6	5.7	
Number of farms	2.1	2.1	2.2	2.2	

CONCLUSIONS AND RECOMMENDATIONS

The alternative weight that is being considered as a replacement for the operational weight had many reporting and recording errors during the 1981 JES. Although many of these errors can be corrected, problems are expected to persist.

A cropland weight would be much easier to define, would simplify the questionnaire and the instructions to the enumerators, should be less susceptible to nonsampling errors, guarantees additional data collection savings, greatly reduces the amount of computer editing, and should provide levels of precision that are similar to the alternative weight. A change in the definition of the cropland weight used in this study will be made to minimize reporting and recording errors and to simplify the questionnaire and enumerator's manual. This change involves defining the cropland weight only in terms of cropland acreage and not in terms of cropland acreage and noncontinuous waste, woods (excluding grazed woodland), roads and ditches as was done during the 1981 JES.

The three cropland weighted estimators generally gave very similar results with respect to the estimates and the precision of the estimates. In order to fully evaluate the redefined cropland weight and the three cropland weighted estimators under a wider range of conditions, research should be conducted with this cropland weight on a larger scale during the 1982 JES.

REFERENCES

1/ Hill, George and Farrar, Martha, "Impact of Nonsampling Errors on Weighted Tract Survey Indications," Statistical Reporting Service, U.S. Department of Agriculture, December, 1977.

The formulas at the state level for the area frame estimate of the total and the estimated variance of this estimate will be presented in this appendix for each of the seven estimators evaluated.

(1) **OPEN ESTIMATOR:**

The sample estimate of the total, namely $\hat{Y}_1$, for the open estimator can be expressed as:

$$\hat{Y}_1 = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} y'_{ijk} = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} e_{ij} \, y_{ijk},$$

where

y'_{ijk} = the expanded data for a survey item in the kth segment, j^{th} paper stratum and i^{th} land use stratum,

e_{ij} = the expansion factor for each segment in the jth paper stratum in the ith land use stratum,

r_{ij} = the number of sample replicates in the jth paper stratum in the ith land use stratum,

P_i = the number of paper strata in the ith land use stratum,

s = the number of land use strata in the state,

$$y_{ijk} \begin{cases} = \sum_{\ell=1}^{g_{ijk}} y_{ijk\ell} & \text{if } g_{ijk} > 0, \\ = 0 & \text{if } g_{ijk} = 0, \end{cases}$$

g_{ijk} = the number of farm operations with headquarters in segment k, paper stratum j and land use stratum i,

$y_{ijk\ell}$ = the value of a survey item, e.g. number of hogs, for the entire farm operation for the ℓth operation in the kth segment, j^{th} paper stratum and i^{th} land use stratum.

The estimated variance of $\hat{Y}_1$ can be expressed as:

$$V(\hat{Y}_1) = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} \frac{(1 - \frac{1}{e_{ij}})}{(1 - \frac{1}{r_{ij}})} \{y'_{ijk} - \bar{y}'_{ij\cdot}\}^2,$$

where $\bar{y}'_{ij\cdot} = \sum_{k=1}^{r_{ij}} \frac{y'_{ijk}}{r_{ij}}$. That is $\bar{y}'_{ij\cdot}$ is the mean of the expanded data for a survey item in the jth paper stratum and i^{th} land use stratum. This variance formula makes use of the paper strata to calculate the estimate of the variance and includes the finite population correction factor.

(2) CLOSED ESTIMATOR:

The sample estimate of the total, namely $\hat{Y}_2$, for the closed estimator is:

$$\hat{Y}_2 = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} y'_{ijk} = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} e_{ij}\, y_{ijk},$$

where y'_{ijk}, e_{ij}, s, P_i and r_{ij} are defined the same as with the open estimator,

$$y_{ijk} \begin{cases} = \sum_{\ell=1}^{f_{ijk}} t_{ijk\ell} & \text{if } f_{ijk} > 0, \\ = 0 & \text{if } f_{ijk} = 0, \end{cases}$$

f_{ijk} = the number of tract farm operations in the kth segment, j^{th} paper stratum and i^{th} land use stratum,

$t_{ijk\ell}$ = the "tract" value of a survey item, e.g. number of beef cows in the tract, for the ℓth farm operation in the kth segment, j^{th} paper stratum and i^{th} land use stratum.

The formula for the estimated variance of $\hat{Y}_2$ is the same in notation as $\hat{V}(\hat{Y}_1)$.

(3) OPERATIONAL WEIGHTED ESTIMATOR:

The sample estimate of the total, that is $\hat{Y}_3$, is given by:

$$\hat{Y}_3 = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} y'_{ijk} = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} e_{ij} y_{ijk},$$

where y'_{ijk}, e_{ij}, r_{ij}, p_i, s, f_{ijk} and $y_{ijk\ell}$ are defined as in the first two estimators,

$$y_{ijk} = \begin{cases} \sum_{\ell=1}^{f_{ijk}} a_{ijk\ell} \, y_{ijk\ell} & \text{if } f_{ijk} > 0, \\ 0 & \text{if } f_{ijk} = 0, \end{cases}$$

$a_{ijk\ell}$ = the weight for the ℓth farm operation in the kth segment, j^{th} paper stratum and i^{th} land use stratum. This weight is the ratio of the total acres in the tract to the total acres in the entire farm. The sum of the weights over all segments for a given farm operation is equal to one. This insures that $\hat{Y}_3$ is an unbiased estimate of the population total.

The formula for the estimated variance of $\hat{Y}_3$ is the same in notation as $\hat{V}(\hat{Y}_1)$.

(4) ALTERNATIVE WEIGHTED ESTIMATOR:

The sample estimate of the total, $\hat{Y}_4$, is:

$$\hat{Y}_4 = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} v'_{ijk} = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} e_{ij} y_{ijk},$$

where y_{ijk}
$$\begin{cases} = \sum_{\ell=1}^{f_{ijk}} b_{ijk\ell} \, y_{ijk\ell} & \text{if } f_{ijk} > 0, \\ = 0 & \text{if } f_{ijk} = 0, \end{cases}$$

$b_{ijk\ell}$ = the ratio of the tract and entire farm figures for the variable, total acres minus continuous waste, woods (excluding grazed woodland), roads and ditches for the ℓth farm operation in the kth segment, j^{th} paper stratum and i^{th} land use stratum,

and all other variables are as previously defined.

The formula for the estimated variance of $\hat{Y}_4$ uses the same notation as $\hat{V}(\hat{Y}_1)$.

(5) CROPLAND WEIGHTED ESTIMATOR I:

The formula for $\hat{Y}_5$ can be expressed as:

$$\hat{Y}_5 = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} y'_{ijk} = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} e_{ij} \, y_{ijk},$$

where y_{ijk}
$$\begin{cases} = \sum_{\ell=1}^{f_{ijk}} d_{ijk\ell} \, y_{ijk\ell} & \text{if } f_{ijk} > 0, \\ = 0 & \text{if } f_{ijk} = 0, \end{cases}$$

$d_{ijk\ell}$
$$\begin{cases} = c_{ijk\ell} & \text{if } c_{ijk\ell} \text{ is defined}, \\ = a_{ijk\ell} & \text{if } c_{ijk\ell} \text{ is not defined}, \end{cases}$$

$c_{ijk\ell}$ = the ratio of the tract cropland acres to the entire farm cropland acres for the ℓth tract farm operation in the kth segment, j^{th} paper stratum and i^{th} land use stratum,

and all other variables are as previously defined.

The formula for the $\hat{V}(\hat{Y}_5)$ is of the same form as the previous variance estimates.

(6) CROPLAND WEIGHTED ESTIMATOR II:

The formula for $\hat{Y}_6$ is:

$$\hat{Y}_6 = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} y'_{ijk} = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} e_{ij} \, y_{ijk},$$

where y_{ijk} $\begin{cases} = \sum\limits_{\ell=1}^{f_{ijk}} y'_{ijk\ell} & \text{if } f_{ijk} > 0, \\ \\ = 0 \text{ if } f_{ijk} = 0, \end{cases}$

$y'_{ijk\ell}$ $\begin{cases} = c_{ijk\ell}\, y_{ijk\ell} & \text{if } c_{ijk\ell} \text{ is defined,} \\ \\ = y_{ijk\ell} & \text{if } c_{ijk\ell} \text{ is not defined and the farm operation has headquarters in the segment,} \\ \\ = 0 & \text{if } c_{ijk\ell} \text{ is not defined and the farm operation does not have headquarters in the segment,} \end{cases}$

and all other variables are as previously defined.

The formula for the estimated variance of $\hat{Y}_6$ is of the same form as the variance estimate given for the first estimator.

(7) <u>CROPLAND WEIGHTED ESTIMATOR III</u>:

The formula for $\hat{Y}_7$ can be given by:

$$\hat{Y}_7 = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} y'_{ijk} = \sum_{i=1}^{s} \sum_{j=1}^{P_i} \sum_{k=1}^{r_{ij}} e_{ij}\, y_{ijk},$$

where y_{ijk} $\begin{cases} = \sum\limits_{\ell=1}^{f_{ijk}} y''_{ijk\ell} & \text{if } f_{ijk} > 0, \\ \\ = 0 \text{ if } f_{ijk} = 0, \end{cases}$

$y''_{ijk\ell}$ $\begin{cases} = c_{ijk\ell}\, y_{ijk\ell} & \text{if } c_{ijk\ell} \text{ is defined,} \\ \\ = t_{ijk\ell} & \text{if } c_{ijk\ell} \text{ is not defined,} \end{cases}$

and all other variables are as previously defined.

The $\hat{V}(\hat{Y}_7)$ has the same notation as the estimated variance for $\hat{Y}_1$ given for the first estimator.

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SECTION A — ACREAGES OF FIELDS AND CROPS INSIDE BLUE TRACT BOUNDARY

How many acres are inside this blue tract boundary drawn on the photo *(or map)*? . . . . **Acres** [•   ]

Now I would like to ask about each field inside this blue tract boundary and its use in 1981.

FIELD NUMBER . . .	1	2	3	4
1. TOTAL ACRES IN FIELD	•	•	•	•
2. CROP OR LAND USE *(Specify)* ————————				
3a. CONTINUOUS WASTE, WOODS (excluding grazed woodland) ROADS, DITCHES, etc.	831 •	831 •	831 •	831 •
3b. GRAZED WOODLAND, EMPTY FARMSTEADS WITH ASSOCIATED FEEDLOTS	830 •	830 •	830 •	830 •
3c. WOODS, WASTE, ROADS, DITCHES, etc. (non-continuous parcels within field boundaries)	829 •	829 •	829 •	829 •
4. OCCUPIED FARMSTEAD OR DWELLING	843 •	■■■	■■■	■■■
5. PASTURE — Permanent—Not in crop rotation	842 •	842 •	842 •	842 •
5. PASTURE — Cropland—Used only for pasture	856 •	856 •	856 •	856 •
6. TWO CROPS PLANTED IN THIS FIELD for harvest this year or two uses of the same crop?	NO ☐ YES ——— 844 •	NO ☐ YES ——— 844 •	NO ☐ YES ——— 844 •	NO ☐ YES ——— 844 •
7. ACRES LEFT TO BE PLANTED?	61_ •	61_ •	61_ •	61_ •
8. ACRES IRRIGATED AND TO BE IRRIGATED?	6_ _ •	6_ _ •	6_ _ •	6_ _ •
9. SPRING WHEAT OTHER THAN DURUM--Planted	550 •	550 •	550 •	550 •
10. DURUM WHEAT -- Planted and to be planted	553 •	553 •	553 •	553 •
11. WINTER WHEAT — Planted	540 •	540 •	540 •	540 •
12. WINTER WHEAT — For Grain	541 •	541 •	541 •	541 •
13. RYE — Planted and to be planted	547 •	547 •	547 •	547 •
14. RYE — For Grain	548 •	548 •	548 •	548 •
15. OATS — Planted and to be planted	533 •	533 •	533 •	533 •
16. OATS — For Grain	534 •	534 •	534 •	534 •
17. BARLEY — Planted and to be planted	535 •	535 •	535 •	535 •
18. BARLEY — For Grain	536 •	536 •	536 •	536 •
19. CORN — Planted and to be planted	530 •	530 •	530 •	530 •
20. CORN — For Grain	531 •	531 •	531 •	531 •
23. OTHER USES OF GRAINS PLANTED Use — Acres abandoned, cut for hay, silage, etc. Acres	•	•	•	•
24. HAY Cut and to be cut — ALFALFA and ALFALFA MIXTURES	653 •	653 •	653 •	653 •
25. HAY Cut and to be cut — OTHER HAY Kind / Acres	65_ •	65_ •	65_ •	65_ •
26. SOYBEANS Planted and to be planted	600 •	600 •	600 •	600 •
27. TOBACCO Class *(Specify _____)*	67_ •	67_ •	67_ •	67_ •
33. SUGAR BEETS Planted and to be planted	691 •	691 •	691 •	691 •
34. SUNFLOWERS Planted and to be planted	697 •	697 •	697 •	697 •
35. FLAXSEED Planted and to be planted	693 •	693 •	693 •	693 •
36. POTATOES Planted and to be planted	552 •	552 •	552 •	552 •
38. OTHER CROPS Acres planted or in use	_ _ _ •	_ _ _ •	_ _ _ _ •	_ _ _ •
39. LAND IN SUMMER FALLOW	847 •	847 •	847 •	847 •
39a. IDLE CROPLAND - - Idle all during 1981	857 •	857 •	857 •	857 •

Refer to Face Page for Type of Operation

Individually . . . . ☐ ⎫
                          ⎬ *Go to item 1.*
Partnership or Joint . . . . . ☐ ⎭

Managed Land . . . . ☐ - *Go to item③*

1. Now I would like to ask you about the **total acres you operate** under this land arrangement. Include all cropland, woodland, pastureland and wasteland.

   How many acres do you:

a. Own?	901 •
b. Rent from others?	902 •
c. Rent to others?	905 •

   Then the total land you operate is *(items a + b — c)*   900   •

This total land operated consists of how many:

Cropland Acres	Farmstead, Feedlot, Pasture, & Grazed Woodland	Continuous Waste, Woods (Excluding grazed woodland) Roads, Ditches, etc.
903	906	907

(Go to Section E)

③ Now I would like to ask you about the **total acres you operate** as a hired manager.

How many acres do you operate as a hired manager?   904

(Complete codes 903, 906 and 907 above, then go to Section E.)

The following hog and cattle items, which have tract and
farm data, were used to compare the estimates and relative errors from the
seven estimators:

LABEL   SURVEY ITEM

H1   Sows, gilts and young gilts bred and to be bred
H2   Boars and young males for breeding
H3   Hogs and pigs for breeding
H4   Sows and boars no longer bred
H5   Market and home use hogs and pigs under 60 lbs.
H6   Market and home use hogs and pigs between 60 and 119 lbs.
H7   Market and home use hogs and pigs between 120 and 179 lbs.
H8   Market and home use hogs and pigs over 180 lbs.
H9   Hogs and pigs not for breeding
H10   Total hogs and pigs

C1   Beef cows
C2   Milk cows
C3   Cows that have calved
C4   Bulls weighing at least 500 lbs.
C5   Heifers weighing at least 500 lbs. for beef cow replacement
C6   Heifers weighing at least 500 lbs. for milk cow replacement
C7   Other heifers weighing at least 500 lbs.
C8   Total heifers weighing at least 500 lbs.
C9   Steers weighing 500 lbs. or more
C10   Heifers, steers and bulls weighing less than 500 lbs.
C11   Total cattle and calves

The following hog and cattle items and the number of farms,
which only have information for the entire farm, were used to compare the results
from the five estimators:

LABEL   SURVEY ITEM

H11   Farrowing intentions for the next quarter
H12   Farrowing intentions for the second quarter
H13   Farrowing intentions for the next six months
H14   Sows and gilts farrowed during the previous quarter
H15   Sows and gilts farrowed during the second previous quarter
H16   Sows and gilts farrowed during the past six months
H17   Pigs from the previous quarter
H18   Pigs from the second previous quarter
H19   Pigs from the last six months
H20   Hog and weaned pig deaths during the previous quarter
H21   Hog and weaned pig deaths during the second previous quarter
H22   Hog and weaned pig deaths during the last six months

LABEL	SURVEY ITEM
C12	Cattle and calves on feed for slaughter
C13	Cows and heifers remaining to calve in 1981
C14	Calves born since January 1, 1981
C15	Calf crop for 1981
C16	Cattle deaths since January 1, 1981
C17	Calf deaths since January 1, 1981
C18	Total cattle and calf deaths since January 1, 1981
F1	Number of farms (gross sales of at least $1000)

The Number of Segments and Farm Operations for Each State

STATE	Number of Segments	Number of Farm Operations
Georgia	436	1,046
Kentucky	338	1,630
Minnesota	343	1,470
North Carolina	391	1,511
Ohio	324	1,202
TOTAL	1,832	6,859

Table D-1: Estimates and Relative Errors for Each Estimator for Selected Survey Items in Georgia.

SURVEY ITEM	OPEN Est. (000)	OPEN R.E. (%)	CLOSED Est. (000)	CLOSED R.E. (%)	OPERATIONAL WEIGHTED Est. (000)	OPERATIONAL WEIGHTED R.E. (%)	ALTERNATIVE WEIGHTED Est. (000)	ALTERNATIVE WEIGHTED R.E. (%)	CROPLAND WEIGHTED I Est. (000)	CROPLAND WEIGHTED I R.E. (%)	CROPLAND WEIGHTED II Est. (000)	CROPLAND WEIGHTED II R.E. (%)	CROPLAND WEIGHTED III Est. (000)	CROPLAND WEIGHTED III R.E. (%)
H1	262.7	26.1	199.3	20.4	212.8	13.1	202.7	13.3	191.7	12.3	191.7	12.3	191.9	12.3
H2	21.7	20.7	18.8	19.8	19.0	10.5	18.0	11.1	17.5	10.7	17.5	10.7	17.6	10.6
H3	284.4	25.5	218.1	20.2	231.8	12.8	220.7	13.0	209.2	12.0	209.2	12.0	209.5	11.9
H4	12.6	40.3	14.7	36.3	17.5	39.1	15.5	32.5	15.1	33.3	14.4	34.7	15.2	33.2
H5	696.7	22.3	561.1	19.2	599.7	11.8	582.5	12.5	539.3	12.1	533.3	12.2	541.1	12.1
H6	529.3	34.8	337.2	26.7	422.9	16.2	415.5	15.5	415.5	16.7	418.8	16.8	410.1	16.9
H7	261.4	33.7	234.4	35.7	276.4	21.7	265.4	22.1	263.4	25.1	264.8	25.0	264.0	25.0
H8	99.0	47.8	93.8	40.8	168.8	27.4	163.9	28.0	154.3	30.7	129.8	30.8	158.0	31.3
H9	1599.1	25.1	1241.0	21.7	1485.5	13.5	1442.7	13.6	1387.5	14.4	1361.0	14.6	1388.4	14.5
H10	1883.5	25.1	1459.1	21.0	1717.3	13.0	1663.4	13.1	1596.7	13.7	1570.2	13.8	1597.9	13.7
C1	746.6	13.1	891.2	12.8	883.1	7.2	827.9	7.9	854.5	8.9	783.0	9.0	854.7	8.8
C2	59.8	58.0	93.6	47.4	126.8	30.5	137.4	29.6	120.8	32.2	120.9	32.2	120.7	32.3
C3	806.4	13.1	984.8	12.6	1009.9	7.4	965.3	8.0	975.3	8.9	903.9	9.2	975.4	8.9
C4	50.5	11.1	60.1	12.6	57.9	7.7	56.3	8.2	56.8	8.5	52.5	8.9	56.6	8.7
C5	107.8	23.0	93.9	16.2	132.1	10.3	118.6	10.0	113.9	10.7	104.9	11.5	113.8	11.0
C6	18.5	55.0	63.8	32.7	38.3	29.8	42.0	28.9	40.0	29.1	34.8	31.1	44.8	31.1
C7	58.2	36.7	63.4	40.8	60.1	23.8	56.4	24.9	60.0	22.4	49.8	23.9	68.4	28.8
C8	184.5	19.3	221.0	16.6	230.5	10.1	217.0	10.6	213.9	11.0	189.5	11.8	227.0	12.6
C9	60.5	35.3	74.9	35.1	70.2	18.6	74.0	22.6	78.9	26.3	74.0	27.3	95.0	26.3
C10	575.3	13.0	742.0	12.4	682.7	7.3	652.7	7.7	672.9	8.6	613.7	8.8	677.0	8.7
C11	1677.3	13.0	2082.9	11.3	2051.1	6.9	1965.2	7.5	1997.9	8.5	1833.7	8.9	2031.1	8.9

Table D-2: Estimates and Relative Errors for Each Estimator for Selected Survey Items in Kentucky.

SURVEY ITEM	OPEN		CLOSED		OPERATIONAL WEIGHTED		ALTERNATIVE WEIGHTED		CROPLAND WEIGHTED I		CROPLAND WEIGHTED II		CROPLAND WEIGHTED III	
	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)
H1	139.2	20.3	134.2	19.7	173.7	12.1	170.9	12.5	171.7	14.6	170.2	14.7	170.0	14.8
H2	10.5	18.8	11.1	17.1	13.5	11.4	13.5	11.8	14.0	13.8	13.8	13.9	13.8	13.9
H3	149.7	20.1	145.2	19.3	187.3	12.0	184.4	12.3	185.7	14.5	184.1	14.6	183.8	14.6
H4	5.0	45.0	1.1	71.3	3.8	35.1	3.5	32.9	3.6	35.0	3.6	35.2	3.6	35.2
H5	345.7	23.5	386.1	22.5	462.1	13.2	464.4	13.6	480.5	16.3	479.2	16.3	480.0	16.3
H6	159.5	31.9	182.0	30.3	205.0	18.0	206.4	18.4	211.6	21.3	211.3	21.3	213.7	21.1
H7	78.1	33.6	139.0	36.8	155.5	18.7	154.6	19.5	164.0	21.9	161.2	22.3	167.4	21.5
H8	48.6	36.4	66.1	33.5	86.9	21.8	86.0	22.7	105.5	27.9	105.4	27.9	107.5	27.4
H9	636.8	24.7	774.3	24.0	913.3	13.8	914.9	14.3	965.1	17.7	960.8	17.8	972.1	17.6
H10	786.5	23.5	919.5	22.6	1100.5	13.2	1099.3	13.7	1150.8	17.0	1144.8	17.1	1155.9	16.9
C1	847.1	10.0	1082.1	6.9	1019.6	5.2	1046.9	5.3	894.5	6.5	874.8	6.5	893.2	6.5
C2	223.7	17.9	226.7	16.2	234.1	12.1	239.4	11.9	227.2	11.8	227.4	11.8	227.2	11.8
C3	1070.8	8.2	1308.7	6.2	1253.8	4.7	1286.3	4.7	1121.7	5.6	1102.2	5.6	1120.4	5.6
C4	65.5	9.2	80.2	10.3	74.0	5.0	76.4	5.2	64.6	5.8	63.0	5.8	64.3	5.8
C5	119.2	13.6	138.5	11.8	136.2	8.4	138.6	8.4	134.9	11.0	131.0	11.3	134.9	11.0
C6	141.6	49.0	93.8	29.4	111.9	23.7	109.5	24.0	108.9	28.4	107.8	28.6	109.6	28.2
C7	30.5	30.2	42.0	21.4	60.0	17.3	60.1	17.4	61.0	21.9	61.1	21.9	61.1	21.9
C8	291.3	24.0	274.3	12.0	308.1	9.5	308.8	9.5	304.8	11.7	299.9	11.9	305.7	11.7
C9	184.0	27.6	251.7	21.7	268.3	17.2	266.9	17.3	200.5	14.4	189.0	14.9	217.0	17.2
C10	782.1	8.4	936.9	6.5	902.8	5.2	930.7	5.3	792.0	6.3	780.8	6.4	785.0	6.3
C11	2393.8	7.9	2851.9	5.5	2807.0	4.4	2869.1	4.5	2483.6	5.6	2434.9	5.6	2492.4	5.6

Table D-3: Estimates and Relative Errors for Each Estimator for Selected Survey Items in Minnesota.

SURVEY ITEM	OPEN Est. (000)	OPEN R.E. (%)	CLOSED Est. (000)	CLOSED R.E. (%)	OPERATIONAL WEIGHTED Est. (000)	OPERATIONAL WEIGHTED R.E. (%)	ALTERNATIVE WEIGHTED Est. (000)	ALTERNATIVE WEIGHTED R.E. (%)	CROPLAND WEIGHTED I Est. (000)	CROPLAND WEIGHTED I R.E. (%)	CROPLAND WEIGHTED II Est. (000)	CROPLAND WEIGHTED II R.E. (%)	CROPLAND WEIGHTED III Est. (000)	CROPLAND WEIGHTED III R.E. (%)
H1	590.8	18.7	561.6	15.3	624.8	12.7	642.5	12.6	648.0	12.7	648.0	12.7	648.0	12.7
H2	39.8	18.8	35.0	14.6	42.0	13.7	43.2	13.7	43.7	14.1	43.7	14.1	43.7	14.1
H3	630.6	18.7	596.5	15.2	666.8	12.7	685.7	12.6	691.7	12.7	691.7	12.7	691.7	12.7
H4	19.1	29.5	19.3	30.3	25.5	29.2	25.6	29.4	26.5	29.9	26.5	29.9	26.5	29.9
H5	1791.4	18.6	1607.8	17.4	1854.0	14.1	1908.0	14.0	1907.7	14.0	1907.6	14.0	1907.8	14.0
H6	981.8	20.8	871.0	17.9	1055.6	12.4	1084.7	12.4	1082.5	12.3	1082.2	12.3	1082.6	12.3
H7	749.8	20.0	659.3	18.8	746.7	14.6	766.2	14.6	758.2	14.5	757.7	14.5	758.2	14.5
H8	406.3	23.2	390.7	22.4	438.7	18.2	454.9	18.1	453.3	18.1	453.0	18.1	453.4	18.1
H9	3948.4	18.0	3548.1	16.4	4120.5	12.5	4239.4	12.5	4228.2	12.5	4226.9	12.5	4228.4	12.5
H10	4579.0	17.9	4144.6	16.0	4787.3	12.4	4925.1	12.4	4919.9	12.3	4918.6	12.3	4920.1	12.3
C1	452.6	13.6	510.5	11.0	610.4	9.9	622.0	9.9	612.5	10.2	613.8	10.1	613.7	10.1
C2	972.1	11.6	831.6	11.7	878.0	8.3	915.7	8.3	937.1	8.2	937.3	8.2	937.3	8.2
C3	1424.8	8.6	1342.2	7.7	1488.4	6.2	1538.7	6.3	1549.6	6.3	1551.0	6.3	1551.0	6.3
C4	54.2	14.4	50.6	13.1	55.6	10.1	57.8	10.2	59.4	10.3	59.5	10.3	59.5	10.3
C5	77.3	15.6	104.9	20.2	94.1	11.4	95.9	11.3	92.9	11.8	93.1	11.8	93.1	11.8
C6	381.5	12.6	313.0	12.6	345.2	9.1	360.3	9.2	354.6	9.0	354.8	9.0	354.8	9.0
C7	257.9	21.8	319.3	24.7	279.0	13.6	285.6	13.6	291.5	13.7	291.7	13.7	291.7	13.7
C8	716.8	11.0	737.1	12.2	718.3	7.3	741.8	7.3	739.0	7.4	739.6	7.4	739.5	7.4
C9	528.9	15.9	573.1	17.0	721.1	10.2	741.0	10.3	754.8	10.4	755.6	10.4	755.6	10.4
C10	941.0	8.2	907.6	7.7	1045.2	6.3	1083.6	6.4	1090.0	6.7	1091.0	6.7	1091.0	6.7
C11	3665.6	8.1	3610.6	7.3	4028.5	5.7	4161.9	5.8	4192.7	5.9	4196.7	5.9	4196.7	5.9

Table D-4: Estimates and Relative Errors for Each Estimator for Selected Survey Items in North Carolina.

SURVEY ITEM	OPEN Est. (000)	OPEN R.E. (%)	CLOSED Est. (000)	CLOSED R.E. (%)	OPERATIONAL WEIGHTED Est. (000)	OPERATIONAL WEIGHTED R.E. (%)	ALTERNATIVE WEIGHTED Est. (000)	ALTERNATIVE WEIGHTED R.E. (%)	CROPLAND WEIGHTED I Est. (000)	CROPLAND WEIGHTED I R.E. (%)	CROPLAND WEIGHTED II Est. (000)	CROPLAND WEIGHTED II R.E. (%)	CROPLAND WEIGHTED III Est. (000)	CROPLAND WEIGHTED III R.E. (%)
H1	90.1	25.1	154.4	33.0	483.3	39.6	302.6	23.7	494.1	38.9	206.5	19.8	248.5	22.6
H2	11.7	16.6	14.8	22.4	43.1	42.4	24.8	17.1	43.8	41.7	20.4	15.2	23.1	16.9
H3	101.8	23.7	169.2	32.0	526.4	39.8	327.4	23.1	538.0	39.1	226.9	19.2	271.6	22.0
H4	9.5	36.1	9.9	31.0	11.0	24.3	11.8	24.9	13.0	26.5	12.2	27.7	13.8	26.7
H5	217.8	22.6	797.8	45.1	1416.2	34.4	1057.0	31.8	1441.3	34.0	529.8	20.1	990.3	35.5
H6	96.1	23.1	475.4	57.1	1068.2	41.8	695.7	38.8	1071.0	41.8	339.3	25.2	619.4	44.5
H7	96.6	37.5	398.1	66.7	921.5	48.0	570.0	46.4	939.3	47.2	216.7	25.1	487.4	54.9
H8	23.9	44.9	836.5	72.4	758.4	55.6	400.1	56.9	762.5	55.3	93.4	29.2	903.2	67.1
H9	444.0	18.3	2517.7	47.5	4175.2	42.7	2735.2	39.4	4227.1	42.2	1191.4	21.0	3014.1	39.7
H10	545.8	18.5	2686.9	44.9	4701.6	42.0	3062.7	37.2	4765.1	41.6	1418.3	20.5	3285.7	36.8
C1	368.2	14.5	473.7	11.4	434.7	8.3	442.7	9.0	377.6	9.0	379.3	9.7	392.1	8.8
C2	152.6	30.3	123.6	30.3	192.3	23.0	185.6	22.8	175.2	24.2	175.3	24.2	175.3	24.2
C3	520.8	13.8	597.3	11.5	627.0	9.5	628.3	9.6	552.8	10.5	554.6	10.8	567.4	10.3
C4	32.3	11.2	38.0	9.4	39.1	8.1	38.9	8.1	36.5	9.5	35.6	9.8	37.3	9.5
C5	72.9	18.1	80.2	18.7	77.2	11.8	79.9	12.7	80.6	13.9	83.6	14.5	82.4	13.6
C6	76.2	31.9	75.3	28.8	77.7	23.1	75.5	23.3	63.2	24.2	63.2	24.2	63.2	24.2
C7	16.4	32.4	16.2	30.3	23.9	25.9	23.6	26.5	12.0	22.8	10.9	24.3	13.9	24.2
C8	165.4	18.0	171.7	16.2	178.7	12.0	179.0	12.0	155.7	12.4	157.8	12.5	159.5	12.2
C9	40.6	26.1	41.7	21.8	40.7	14.1	40.3	14.5	31.6	15.4	31.2	15.7	32.7	15.2
C10	301.6	13.0	373.6	11.2	394.2	8.5	393.8	8.8	356.2	10.0	348.7	10.4	357.0	9.9
C11	1060.7	13.0	1222.3	10.3	1279.7	8.6	1280.4	8.8	1132.9	9.6	1127.8	9.9	1153.8	9.4

Table D-5: Estimates and Relative Errors for Each Estimator for Selected Hog Survey Items
in North Carolina with Seven Large Hog Operations Excluded.

ESTIMATOR SURVEY ITEM	OPEN		CLOSED		OPERATIONAL WEIGHTED		ALTERNATIVE WEIGHTED		CROPLAND WEIGHTED I		CROPLAND WEIGHTED II		CROPLAND WEIGHTED III	
	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)
H1	90.1	25.1	91.1	25.0	165.9	16.6	158.6	16.2	168.4	16.3	167.3	16.5	169.9	16.3
H2	11.7	16.6	10.9	16.3	17.7	12.7	17.0	12.9	18.0	13.2	18.0	13.2	18.2	13.2
H3	101.8	23.7	102.0	23.7	183.7	16.0	175.7	15.6	186.4	15.7	185.3	15.8	188.1	15.7
H4	9.5	36.1	7.7	33.4	9.1	24.5	9.8	26.0	10.9	28.4	11.7	28.7	11.7	28.7
H5	217.8	22.6	245.2	22.4	437.9	16.0	418.9	17.6	440.4	17.7	422.8	17.9	440.1	1₹.7
H6	96.1	23.1	140.5	24.8	275.1	21.1	251.1	19.2	262.5	20.5	254.5	20.9	263.3	20.5
H7	96.6	37.5	98.3	31.8	158.3	21.6	155.7	21.8	163.8	23.0	160.4	23.5	164.2	22.9
H8	23.9	44.9	26.7	35.6	70.7	31.4	65.6	28.0	68.2	29.7	68.2	29.7	68.2	29.7
H9	444.0	18.3	518.3	19.0	951.1	16.5	901.0	15.4	945.9	16.2	917.6	16.5	947.4	16.2
H10	545.8	18.5	620.3	18.9	1134.8	16.0	1076.7	15.0	1132.3	15.7	1102.9	16.0	1135.6	15.6

Table D-6: Estimates and Relative Errors for Each Estimator for Selected Survey Items in Ohio.

SURVEY ITEM	OPEN Est. (000)	OPEN R.E. (%)	CLOSED Est. (000)	CLOSED R.E. (%)	OPERATIONAL WEIGHTED Est. (000)	OPERATIONAL WEIGHTED R.E. (%)	ALTERNATIVE WEIGHTED Est. (000)	ALTERNATIVE WEIGHTED R.E. (%)	CROPLAND WEIGHTED I Est. (000)	CROPLAND WEIGHTED I R.E. (%)	CROPLAND WEIGHTED II Est. (000)	CROPLAND WEIGHTED II R.E. (%)	CROPLAND WEIGHTED III Est. (000)	CROPLAND WEIGHTED III R.E. (%)
H1	200.9	27.4	161.8	29.0	195.7	17.6	192.6	17.8	201.0	18.8	200.9	18.8	200.9	18.8
H2	14.4	23.0	12.8	24.0	13.4	14.9	13.4	15.2	13.8	16.3	13.8	16.3	13.8	16.3
H3	215.3	27.0	174.6	28.3	209.1	17.4	205.9	17.5	214.8	18.6	214.7	18.6	214.7	18.6
H4	2.7	43.7	5.4	51.0	5.6	29.7	5.3	28.9	4.9	30.0	4.9	30.0	4.9	30.0
H5	600.9	24.1	389.7	26.5	672.7	17.5	652.3	17.3	673.1	17.8	673.1	17.8	673.1	17.8
H6	451.5	28.9	262.4	31.2	371.5	16.5	370.4	17.0	377.6	17.4	377.6	17.4	377.6	17.4
H7	326.6	28.5	200.5	38.3	252.4	18.7	243.1	18.9	250.0	19.1	249.4	19.1	249.4	19.1
H8	171.1	53.1	70.3	39.8	163.2	25.2	160.3	26.0	163.2	26.3	163.0	26.3	164.2	26.1
H9	1552.7	23.5	928.3	22.5	1465.3	15.4	1431.5	15.3	1468.7	15.7	1468.0	15.7	1469.3	15.7
H10	1768.0	23.5	1102.9	22.5	1674.4	15.2	1637.4	15.1	1683.5	15.6	1682.7	15.6	1683.9	15.6
C1	300.7	14.9	356.2	13.0	344.2	9.7	352.9	9.5	335.9	10.6	315.0	10.7	330.9	10.7
C2	462.7	18.0	475.2	16.8	407.5	11.2	404.3	11.5	397.5	12.1	397.5	12.1	397.5	12.1
C3	763.3	12.6	831.4	11.3	751.7	7.4	757.1	7.5	733.4	8.0	712.4	8.1	728.4	8.0
C4	38.2	13.2	37.2	15.1	36.4	9.6	38.0	9.8	37.4	11.5	37.1	11.6	37.1	11.6
C5	51.8	25.8	43.5	17.6	54.7	14.0	54.8	13.7	57.3	18.5	53.6	19.5	55.1	19.1
C6	179.5	20.7	156.8	16.7	166.5	13.3	166.1	13.6	159.4	13.8	159.3	13.8	159.5	13.8
C7	177.2	58.1	69.0	19.9	84.9	27.8	87.3	29.4	81.5	30.5	81.3	30.6	83.1	30.0
C8	408.5	28.4	269.3	11.4	306.1	11.2	308.1	11.7	298.2	12.0	294.2	12.2	297.7	12.1
C9	365.2	32.3	204.8	30.3	238.6	15.3	242.1	15.6	235.4	15.8	234.5	15.9	237.7	15.9
C10	479.1	12.3	480.9	11.8	488.9	9.6	494.3	9.5	483.0	10.0	466.3	10.1	479.1	10.1
C11	2054.3	15.5	1823.6	9.5	1821.8	7.3	1839.6	7.4	1787.4	7.8	1744.5	7.9	1779.9	7.8

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Table D-7: Estimates and Relative Errors for Each Estimator for Selected Survey Items in the Five States Combined (Excluding Hog Data from Seven Hog Operations in North Carolina).

SURVEY ITEM / ESTIMATOR	OPEN		CLOSED		OPERATIONAL WEIGHTED		ALTERNATIVE WEIGHTED		CROPLAND WEIGHTED I		CROPLAND WEIGHTED II		CROPLAND WEIGHTED III	
	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)
H1	1283.7	11.4	1147.9	9.7	1373.0	7.1	1367.2	7.2	1380.8	7.3	1378.1	7.3	1380.7	7.3
H2	98.1	9.9	88.5	8.5	105.6	6.6	105.2	6.8	107.0	7.0	106.9	7.0	107.1	7.0
H3	1381.8	11.2	1236.4	9.5	1478.7	7.0	1472.4	7.1	1487.8	7.2	1484.9	7.2	1487.9	7.2
H4	49.0	17.8	48.2	18.3	61.5	17.2	59.7	16.1	60.9	16.5	61.0	16.6	61.8	16.4
H5	3652.4	11.1	3189.9	10.4	4026.4	7.7	4026.1	7.8	4040.9	7.9	4016.0	7.9	4042.0	7.9
H6	2218.2	14.0	1793.0	11.6	2330.1	7.5	2328.1	7.4	2349.8	7.6	2344.4	7.6	2347.2	7.6
H7	1512.4	13.4	1331.4	13.4	1589.3	8.9	1584.9	8.9	1599.3	9.2	1593.5	9.2	1603.3	9.1
H8	749.0	18.8	647.6	15.8	928.4	11.3	930.7	11.4	944.6	11.6	919.5	11.6	951.3	11.6
H9	8181.0	11.1	7010.1	10.1	8935.6	7.1	8929.5	7.1	8995.5	7.2	8934.4	7.3	9005.7	7.2
H10	9562.8	11.0	8246.5	9.8	10414.3	6.9	10401.9	7.0	10483.2	7.1	10419.3	7.1	10493.5	7.1
C1	2715.2	5.9	3313.7	4.9	3292.1	3.5	3292.4	3.6	3075.0	4.0	2965.8	4.1	3084.6	4.0
C2	1870.9	8.4	1750.7	8.2	1838.7	5.9	1882.3	5.9	1857.9	6.0	1858.3	6.0	1858.0	6.0
C3	4586.0	4.8	5064.4	4.2	5130.8	3.0	5174.7	3.1	4932.9	3.4	4824.1	3.4	4942.6	3.4
C4	240.7	5.4	266.1	5.5	263.0	3.6	267.5	3.7	254.7	4.0	247.6	4.1	254.7	4.0
C5	429.0	8.6	460.9	7.6	494.2	4.8	487.8	4.8	479.5	5.6	466.2	5.8	479.3	5.7
C6	797.3	12.0	702.6	8.9	739.6	7.0	753.4	7.0	726.1	7.3	719.9	7.4	731.9	7.3
C7	540.2	22.2	509.9	16.6	507.8	9.5	513.5	9.8	506.1	10.0	494.9	10.2	518.2	10.2
C8	1766.6	9.2	1673.5	6.6	1741.7	4.4	1754.8	4.4	1711.7	4.7	1680.9	4.8	1729.4	4.8
C9	1179.2	13.2	1146.2	11.4	1338.9	7.1	1364.2	7.2	1301.2	7.2	1284.4	7.3	1337.9	7.3
C10	3079.2	4.7	3441.0	4.3	3513.8	3.2	3555.1	3.2	3394.0	3.6	3300.5	3.6	3389.1	3.6
C11	10851.7	5.0	11591.2	3.8	11988.1	2.9	12116.2	2.9	11594.5	3.2	11337.5	3.3	11653.8	3.3

Table D-8: Estimates and Relative Errors for Each Estimator for Selected Survey Items in Georgia.

ESTIMATOR / SURVEY ITEM	OPEN		OPERATIONAL WEIGHTED		ALTERNATIVE WEIGHTED		CROPLAND WEIGHTED I		CROPLAND WEIGHTED III	
	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)
H11	147.7	32.0	101.9	16.6	96.4	16.4	90.6	14.9	90.4	14.9
H12	112.5	23.7	99.3	12.4	96.6	12.6	93.6	12.3	93.2	12.3
H13	260.2	27.2	201.2	13.8	193.0	13.8	184.2	12.8	183.6	12.8
H14	108.2	24.1	100.5	13.0	96.8	12.8	92.0	12.3	91.1	12.4
H15	147.8	30.6	122.7	14.7	114.4	14.2	109.4	13.5	108.4	13.6
H16	256.0	26.6	223.3	13.4	211.2	13.1	201.4	12.4	199.5	12.5
H17	809.7	24.4	728.3	12.4	700.2	12.2	666.9	12.1	662.2	12.2
H18	1053.8	30.6	855.6	14.6	800.6	14.0	770.5	13.6	761.4	13.8
H19	1863.5	26.7	1584.0	13.0	1500.8	12.7	1437.4	12.3	1423.6	12.4
H20	35.0	26.5	81.0	66.6	78.4	66.3	83.9	70.2	83.5	70.6
H21	55.7	28.8	98.4	55.5	96.1	54.8	102.8	57.9	103.9	58.1
H22	90.7	26.2	179.4	60.4	174.5	59.9	186.7	63.3	187.4	63.4
C12	9.8	71.9	13.5	34.4	13.4	36.9	11.6	48.8	10.7	52.0
C13	254.8	15.2	358.7	9.1	340.8	10.0	325.0	10.5	311.7	11.2
C14	519.1	13.8	589.5	8.0	570.7	8.4	589.8	9.6	539.6	9.8
C15	773.9	13.2	948.2	7.5	911.5	8.1	914.8	9.0	851.2	9.4
C16	15.0	18.1	17.1	12.7	15.4	12.9	16.9	14.6	14.1	15.9
C17	30.8	18.3	34.2	12.6	32.5	13.9	33.5	14.4	30.8	15.5
C18	45.8	16.3	51.3	11.4	47.9	12.3	50.4	12.8	44.9	13.9
F1	53.3	6.5	63.2	5.2	62.1	5.4	63.0	5.5	59.3	5.7

Table D-9: Estimates and Relative Errors for Each Estimator for Selected Survey Items in Kentucky.

SURVEY ITEM	OPEN Est. (000)	OPEN R.E. (%)	OPERATIONAL WEIGHTED Est. (000)	OPERATIONAL WEIGHTED R.E. (%)	ALTERNATIVE WEIGHTED Est. (000)	ALTERNATIVE WEIGHTED R.E. (%)	CROPLAND WEIGHTED I Est. (000)	CROPLAND WEIGHTED I R.E. (%)	CROPLAND WEIGHTED II Est. (000)	CROPLAND WEIGHTED II R.E. (%)
H11	69.9	22.0	78.9	13.9	76.9	14.1	78.2	15.1	76.8	15.3
H12	54.3	23.0	73.0	13.0	72.1	13.3	71.7	15.1	71.5	15.1
H13	124.2	21.1	151.9	12.5	149.0	12.8	149.9	14.5	148.3	14.7
H14	50.8	23.7	66.0	13.2	66.2	13.4	66.7	15.0	66.5	15.0
H15	53.9	24.3	64.2	14.7	62.8	15.1	64.6	16.8	64.6	16.8
H16	104.7	22.4	130.1	12.9	129.0	13.2	131.3	15.2	131.1	15.2
H17	364.9	24.5	473.4	13.5	474.8	13.8	486.0	15.8	484.6	15.8
H18	367.2	24.6	443.7	15.2	434.7	15.6	450.7	18.0	450.7	18.0
H19	732.1	22.9	917.0	13.3	909.5	13.7	936.7	16.3	935.3	16.3
H20	10.1	42.6	9.5	28.7	9.4	29.6	10.7	30.9	10.5	31.5
H21	17.3	36.1	20.5	22.9	20.7	23.2	20.4	24.6	20.0	25.0
H22	27.3	34.5	30.0	19.8	30.1	20.3	31.0	22.5	30.5	23.0
C12	13.9	59.2	17.8	40.8	18.1	40.3	15.3	45.6	15.3	45.6
C13	300.5	10.1	384.5	8.2	394.0	8.1	356.5	9.7	351.8	9.9
C14	735.1	8.7	852.5	4.9	878.4	5.0	744.2	5.5	728.6	5.5
C15	1035.6	8.3	1237.0	4.9	1272.4	4.9	1100.7	5.6	1080.4	5.6
C16	10.2	16.5	15.2	9.9	15.4	10.1	15.3	13.1	14.6	13.6
C17	36.9	10.1	45.9	6.9	47.5	6.9	43.4	8.5	42.2	8.6
C18	47.2	9.8	61.1	6.5	62.9	6.5	58.7	8.6	56.9	8.8
F1	84.7	5.2	99.7	4.0	101.4	4.0	95.8	4.4	94.0	4.4

Table D-10: Estimates and Relative Errors for Each Estimator for Selected Survey Items in Minnesota.

SURVEY ITEM	OPEN Est. (000)	OPEN R.E. (%)	OPERATIONAL WEIGHTED Est. (000)	OPERATIONAL WEIGHTED R.E. (%)	ALTERNATIVE WEIGHTED Est. (000)	ALTERNATIVE WEIGHTED R.E. (%)	CROPLAND WEIGHTED I Est. (000)	CROPLAND WEIGHTED I R.E. (%)	CROPLAND WEIGHTED II Est. (000)	CROPLAND WEIGHTED II R.E. (%)
H11	281.3	18.5	299.6	13.6	308.3	13.6	309.5	13.7	309.5	13.7
H12	273.1	19.2	276.6	13.1	285.3	13.1	287.9	12.9	287.9	12.9
H13	554.4	18.5	576.1	12.8	593.7	12.8	597.3	12.8	597.3	12.8
H14	275.2	18.5	290.8	13.2	300.1	13.2	304.3	13.1	304.3	13.1
H15	252.8	20.1	251.5	13.5	258.3	13.5	261.0	13.5	261.0	13.5
H16	528.0	18.8	542.3	13.0	558.5	13.0	565.3	13.0	565.3	13.0
H17	2155.0	19.2	2263.5	14.2	2335.7	14.1	2363.1	14.0	2363.1	14.0
H18	1882.5	21.6	1903.9	15.1	1954.7	15.0	1973.5	15.0	1973.5	15.0
H19	4037.5	20.0	4167.4	14.3	4290.4	14.2	4336.6	14.1	4336.6	14.1
H20	58.5	24.7	60.4	22.7	63.4	22.3	63.8	22.3	63.8	22.3
H21	69.6	25.8	78.1	21.5	81.2	21.2	82.9	21.3	82.9	21.3
H22	128.1	24.9	138.5	21.4	144.6	21.1	146.7	21.0	146.7	21.0
C12	466.5	24.3	653.9	13.5	670.6	13.5	673.5	13.4	673.5	13.4
C13	632.8	10.4	586.3	7.0	608.0	7.0	615.7	7.2	616.1	7.2
C14	811.7	8.8	921.3	7.0	947.9	7.0	955.4	7.1	956.5	7.1
C15	1444.5	8.8	1507.7	6.1	1555.9	6.1	1571.2	6.3	1572.6	6.3
C16	20.0	17.2	20.2	10.5	20.7	10.6	21.6	10.4	21.6	10.4
C17	79.8	11.9	84.7	9.1	87.9	9.1	90.4	9.2	90.4	9.2
C18	99.9	11.0	104.9	8.3	108.7	8.3	112.0	8.3	112.0	8.3
F1	104.5	5.5	107.8	3.8	109.8	3.8	110.9	3.9	110.9	3.9

Table D-11: Estimates and Relative Errors for Each Estimator for Selected Survey Items in North Carolina.

ESTIMATOR / SURVEY ITEM	OPEN		OPERATIONAL WEIGHTED		ALTERNATIVE WEIGHTED		CROPLAND WEIGHTED I		CROPLAND WEIGHTED II	
	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)
H11	41.7	28.9	222.5	42.5	133.0	24.7	226.1	41.9	85.6	18.5
H12	34.9	21.7	218.4	43.2	127.1	25.2	221.0	42.7	78.2	16.4
H13	76.6	23.5	440.9	42.8	260.1	24.8	447.1	42.3	163.8	16.9
H14	36.5	25.0	204.7	45.5	115.7	24.7	208.9	44.7	73.2	18.0
H15	50.6	35.2	231.9	41.9	140.0	27.9	234.0	41.5	79.9	17.9
H16	87.1	28.7	436.7	43.5	255.7	26.2	442.8	42.9	153.2	17.4
H17	262.0	25.2	1655.2	45.5	950.7	26.6	1686.8	44.7	557.7	19.1
H18	347.1	41.8	1794.2	43.7	1072.0	31.0	1818.7	43.1	551.7	18.8
H19	609.1	32.5	3449.5	44.5	2022.7	28.8	3505.5	43.8	1109.4	18.5
H20	5.5	35.3	52.5	40.1	43.9	42.8	56.4	37.9	18.7	29.4
H21	14.9	48.9	136.7	55.6	132.4	57.3	136.1	55.8	35.9	27.4
H22	20.4	39.4	189.2	48.2	176.3	51.3	192.6	47.4	54.6	25.6
C12	0.0	71.3	6.3	38.7	6.0	36.8	4.2	30.4	4.2	30.4
C13	204.7	15.8	256.7	12.6	252.2	12.6	240.7	13.3	234.9	13.8
C14	282.1	14.9	327.0	9.1	333.2	9.7	288.1	10.8	291.9	11.0
C15	486.8	14.1	583.7	9.8	585.4	10.0	528.7	11.1	526.8	11.4
C16	5.2	27.1	6.2	18.3	6.0	17.5	4.5	17.3	4.3	17.5
C17	11.9	25.2	19.1	18.6	18.9	17.7	18.2	22.9	17.3	23.7
C18	17.1	21.7	25.3	17.0	24.9	16.1	22.7	19.9	21.6	20.6
F1	91.4	6.4	109.3	5.4	107.6	5.4	106.9	5.7	104.0	5.8

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Table D-12: Estimates and Relative Errors for Each Estimator for Selected Hog Survey Items in North Carolina with Seven Large Hog Operations Excluded.

ESTIMATOR / SURVEY ITEM	OPEN		OPERATIONAL WEIGHTED		ALTERNATIVE WEIGHTED		CROPLAND WEIGHTED I		CROPLAND WEIGHTED II	
	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)
H11	41.7	28.9	76.1	17.8	72.8	17.3	77.0	17.5	77.2	17.4
H12	34.9	21.7	72.7	16.4	68.4	16.0	73.8	16.3	72.6	16.6
H13	76.6	23.5	148.8	16.5	141.2	16.0	150.7	16.3	149.7	16.4
H14	36.5	25.0	65.4	17.0	63.1	17.7	67.5	18.0	66.5	18.1
H15	50.6	35.2	74.0	18.3	68.9	16.8	74.0	17.4	73.5	17.5
H16	87.1	28.7	139.4	17.0	132.0	16.5	141.5	17.0	140.0	17.2
H17	262.0	25.2	490.9	17.6	477.6	18.5	503.4	18.8	495.9	18.9
H18	347.1	41.8	501.3	18.2	477.3	18.4	514.1	18.8	511.0	18.9
H19	609.1	32.5	992.1	17.4	954.9	17.9	1017.5	18.3	1006.9	18.5
H20	5.5	35.3	35.3	26.4	32.3	27.5	34.0	28.4	34.0	28.4
H21	14.9	48.9	13.1	27.0	13.9	31.1	16.4	30.3	17.0	29.7
H22	20.4	39.4	48.4	23.8	46.2	25.8	50.4	26.3	51.0	26.1

Table D-13: Estimates and Relative Errors for Each Estimator for Selected Survey Items in Ohio.

SURVEY ITEM / ESTIMATOR	OPEN		OPERATIONAL WEIGHTED		ALTERNATIVE WEIGHTED		CROPLAND WEIGHTED I		CROPLAND WEIGHTED II	
	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)
H11	107.9	29.2	100.7	19.6	98.0	19.7	102.1	20.8	102.0	20.8
H12	71.8	27.4	90.8	18.2	89.1	17.9	93.4	18.6	93.4	18.6
H13	179.7	27.2	191.4	18.4	187.2	18.3	195.5	19.4	195.5	19.4
H14	76.2	26.2	93.5	17.9	90.8	17.9	93.7	18.8	93.7	18.8
H15	81.3	27.3	88.6	18.1	87.1	18.0	92.2	18.8	92.1	18.8
H16	157.5	26.4	182.0	17.7	177.9	17.6	185.9	18.5	185.8	18.5
H17	652.9	26.8	761.9	18.5	741.7	18.6	768.5	19.5	768.5	19.5
H18	649.3	30.5	653.5	18.7	642.4	18.7	682.7	20.2	682.2	20.2
H19	1302.3	28.2	1415.4	18.3	1384.1	18.3	1451.2	19.5	1450.7	19.5
H20	19.1	29.7	13.5	19.2	13.2	19.6	13.0	20.2	13.0	20.2
H21	28.2	24.3	23.6	22.6	23.3	23.2	23.0	23.8	23.0	23.8
H22	47.3	25.4	37.1	20.4	36.5	20.9	36.0	21.5	36.0	21.5
C12	425.9	49.3	238.9	22.7	244.1	23.6	236.7	24.0	237.2	23.9
C13	341.1	15.3	347.3	9.6	347.8	9.7	326.6	10.0	322.5	10.1
C14	388.9	12.3	391.4	8.3	396.8	8.2	384.3	9.1	366.6	9.0
C15	730.0	12.7	738.7	7.9	744.6	7.9	710.9	8.4	689.1	8.4
C16	12.1	21.3	12.5	14.0	12.5	14.6	12.5	14.7	12.0	15.1
C17	38.9	17.8	29.6	11.3	28.6	11.6	28.5	11.9	27.6	12.0
C18	51.0	16.2	42.2	10.4	41.1	10.6	41.0	11.0	39.6	11.2
F1	82.4	5.4	88.8	4.3	89.3	4.4	88.8	4.7	88.1	4.6

Table D-14: Estimates and Relative Errors for Each Estimator for Selected Survey Items in the Five
States Combined (Excluding Hog Data from Seven Hog Operations in North Carolina).

SURVEY ITEM \ ESTIMATOR	OPEN		OPERATIONAL WEIGHTED		ALTERNATIVE WEIGHTED		CROPLAND WEIGHTED I		CROPLAND WEIGHTED II	
	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)	Est. (000)	R.E. (%)
H11	648.6	12.3	657.2	7.8	652.5	7.9	657.4	8.0	655.9	8.0
H12	546.7	11.7	612.3	7.2	611.6	7.3	620.4	7.4	618.6	7.4
H13	1195.2	11.5	1269.5	7.2	1264.0	7.3	1277.7	7.4	1274.4	7.4
H14	546.8	11.4	616.1	7.5	617.1	7.6	624.2	7.6	622.1	7.7
H15	586.4	12.8	600.9	7.5	591.6	7.5	601.2	7.5	599.6	7.5
H16	1133.3	11.6	1217.0	7.2	1208.6	7.3	1225.4	7.4	1221.6	7.4
H17	4244.6	11.9	4718.0	8.0	4730.1	8.1	4788.0	8.2	4774.3	8.2
H18	4299.9	13.5	4358.0	8.2	4309.6	8.2	4391.5	8.3	4378.7	8.3
H19	8544.5	12.3	9075.9	7.9	9039.7	8.0	9179.5	8.0	9153.1	8.1
H20	185.6	14.4	255.9	22.8	253.6	22.3	263.1	24.1	263.8	24.3
H21	128.1	14.6	177.5	31.5	178.3	30.4	187.8	32.5	187.8	32.5
H22	313.8	13.8	433.4	26.1	431.9	25.4	450.9	27.4	451.6	27.4
C12	916.5	26.1	930.3	11.1	952.3	11.3	941.1	11.4	940.9	11.4
C13	1734.0	5.9	1933.5	4.0	1942.8	4.0	1864.5	4.3	1836.8	4.4
C14	2736.9	4.9	3081.8	3.2	3127.1	3.3	2961.8	3.6	2883.2	3.6
C15	4470.8	4.9	5015.3	3.1	5069.8	3.1	4826.3	3.4	4720.0	3.5
C16	62.7	8.9	71.3	5.6	70.1	5.6	70.9	6.2	66.6	6.3
C17	198.3	7.0	213.5	5.0	215.4	5.0	214.0	5.4	208.4	5.5
C18	261.0	6.4	284.8	4.5	285.5	4.5	284.8	4.9	274.9	5.0
F1	416.2	2.6	468.8	2.1	470.2	2.1	465.4	2.2	456.3	2.2