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THE COMMODITY WEIGHTED ESTIMATOR - AN ANALYSIS OF 1987 JUNE AGRICULTURAL SURVEY DATA

Gretchen McClung

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ABSTRACT

A commodity weighted estimator for the nonoverlap portion of the Agricultural Surveys (AS) was investigated using data collected in 14 states in June 1987. Commodity weighted expansions were compared with those using the operational weight of tract acres/farm acres. There was too much variability in the data to detect significant differences for hogs, stocks, and grain stock capacity. Significant differences were found in number of farms and land in farms. Although the commodity weighted estimator had several procedural advantages over the operational weighted estimator, it was not recommended as a replacement for the operational weighted estimator. This was because it showed more upward bias than the operational weighted estimator in this 14-state study.

ACKNOWLEDGMENTS

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CONTENTS

SUMMARY

A commodity weighted estimator was investigated for use in the Agricultural Surveys conducted annually by the National Agricultural Statistics Service (NASS). This weighted estimator would provide expansions of various crop, livestock, and grain stock items for the nonoverlap (NOL) portion of the multiple frame estimates. The commodity weight was the ratio of tract acres of a particular commodity to farm acres of that same commodity. The commodity used for the weight was the crop of greatest farm acreage. If there were no crops on the farm, then pasture acreage was used. If there was no pasture acreage, then the weight defaulted to the proportion of the farm's agricultural income that was derived from within the tract. The operational weight was the ratio of tract acres to farm acres.

Data were collected for 14 states in the 1987 June Agricultural Survey (AS). NOL expansions for hogs, stocks, and grain stock capacity for the commodity and operational weighted estimators were compared. At the state level and the 14-state level, there were no significant differences in the commodity weighted and operational weighted expansions for these items.

NOL expansions of number of farms and land in farms were also generated using the two weighted estimators and the open (resident farm operator) estimator. Significant differences for land in farms at the 14-state level and in several individual states agreed with results from a similar study done with the 1986 December AS. As the commodity weighted expansions were significantly higher than the operational expansions, and the operational estimator was known to produce estimates for land in farms that generally correspond to official Agricultural Statistics Board (ASB) estimates, it was concluded that the commodity weighted estimator is clearly not suitable for land in farms estimates.

Results for number of farms were not consistent with the December 1986 study. In the current study, all states had commodity weighted expansions larger than the operational weighted expansions. The differences were significant in several states and for the 14-state total. These results suggested that the commodity weight had an even greater upward bias than the operational weight.

This upward bias did not result in significant differences for hogs and stocks because there was too much variability in the data to make the tests powerful enough to detect reasonable levels of differences. The commodity weighted estimator did not appear to be the solution to the search for an improved weighted estimator. A recently proposed (2), modified version of the operational weight should now be the focus of investigation.

INTRODUCTION

The National Agricultural Statistics Service (NASS) conducts the series of Agricultural Surveys (AS) annually. The AS are multiple frame surveys that use a list frame and an area frame. The area tracts that are nonoverlap (NOL) with the list provide the area frame contribution to expansions of crops, stocks, and other commodities. For the NOL domain of the AS, June is the base survey month. Thus, NOL samples for the follow-on Ag surveys are subsamples of the June survey. For expansions using a weighted estimator, the tracts are weighted by the ratio of tract acres divided by total farm acres. This operational weight has an upward bias associated with it (5). Other advantages and disadvantages of the weight have been summarized by Nealon (9).

Various weighted estimators have been studied with the goal of finding a better alternative to the weight currently in use. Nealon (8) investigated two weights, one based on cropland and the other based on total farm acres minus woods and waste. The cropland weight seemed to show some promise. Although the cropland weight did not seem to be biased, a major difficulty was that it was undefined when there was no cropland for an operation (4). In 1985, Bethel (1) proposed a new weighted estimator which was based on the crop (or other commodity) of greatest acreage on the farm. The commodity weight was the ratio of tract acres of the particular commodity to farm acres of that same commodity. His study of three states in the 1984 June Enumerative Survey indicated that the new weighted estimator did not seem to have the upward bias of the operational weighted estimator. Pafford (10) investigated the use of this new weighted estimator for PIGA (Public, Industrial, and Grazing Association) cattle. He reported some problems with its use and suggested that modifications to the weight might make it more useful for Western states.

The commodity weighted estimator is also under investigation for use in the Farm Costs and Returns Survey (FCRS). The FCRS currently uses the open, or resident farm operator (RFO), estimator instead of a weighted estimator. Research is in progress to evaluate the commodity weighted estimator for the FCRS. Initial research on the 1985 FCRS indicated that the commodity weighted estimator was more precise than the open (RFO) estimator and nearly equal in precision to the operational weighted estimator. The 1986 FCRS research compared the open (RFO) estimator with the commodity weighted estimator (3). Results favored the commodity weighted estimator. Further research is now underway on the 1987 FCRS.

The use of the commodity weighted estimator for the Agricultural Surveys was investigated in more detail (7), using data collected during the 1986 December Agricultural Survey. In this study, the commodity weighted estimator exhibited several advantages over the operational weighted estimator.

One advantage of the commodity weighted estimator related to prescreening of highly populated areas. As the operational weight is tract acres divided by farm acres, "city segments" must be screened for farm operators even though there is no agriculture within them. The amount of prescreening required would be much less for the commodity weighted estimator than for the operational weighted estimator. For most states, prescreening "city segments"

would not be necessary for the commodity weighted estimator because the numerator of the commodity weight would always be zero.

Prescreening would only be necessary in the PIGA states, where some operators have no land except PIGA land and their residence. PIGA land is not included in the total land operated by a farmer so any livestock on the PIGA land must be associated with the operator's residence. If an operator in a city segment has no land other than the city residence and PIGA land, a weight of one would be assigned when the operator's residence is in a sampled segment. If there is any other land than the city tract and the PIGA land, a commodity weight of zero would be assigned because the tract amount of the commodity would be zero, regardless of the commodity the weight is based on.

In addition to decreasing the amount of prescreening needed, use of the commodity weight would also cause a reduction in the total number of interviews completed. Any tract with a zero commodity weight from the June AS would not have to be interviewed if sampled again in a later survey. A reduction in survey costs would result. The savings involved may be substantial for the FCRS as it has a long and time-consuming questionnaire.

Results obtained for the 1986 December AS were inconclusive because of procedural differences between the December and June surveys. The procedure for obtaining the commodity weight was unnecessarily long in December and due to recent changes in the AS program, weights would not be obtained in December for the December AS but would be obtained during the June AS and frozen for use in the remaining surveys of the annual cycle. It was therefore considered necessary to investigate this commodity weighted estimator using June data. This paper presents results on the use of the commodity weighted estimator for the 1987 June Agricultural Survey.

METHODS

The Study

Data for this research were collected during the 1987 June AS. Fourteen states were included in the study-- Arizona, Colorado, Delaware, Idaho, Maryland, Montana, New Jersey, New Mexico, Oregon, Pennsylvania, South Carolina, South Dakota, Utah, and Wyoming. Commodity weighted information was collected for the nonoverlap (NOL) portion of the area frame in these states (5716 tracts in all). Commodity weighted and operational weighted NOL expansions for number of farms, land in farms, total hogs, corn stocks, soybean stocks, all wheat stocks, and grain storage capacity were tested for differences. Open (RFO) estimates were also generated for number of farms and land in farms. Formulas for the estimates of the totals and their variances can be found in Appendix A.

Univariate paired t-tests were conducted at the individual state level and for the 14-state level for each of the commodities. In addition, multivariate testing was done. A detailed description of the statistical testing procedures used can be found in Appendix B.

Definition of the Commodity Weight

The definition of the weight was simplified from the version used for the 1986 December AS study (7). The basis for the commodity weight was either the crop of greatest acreage, pasture, or agricultural income on the farm. If the farm produced any crop(s), the crop with the greatest acreage on the farm was used for the weight. The weight for a particular tract was calculated by dividing the tract acreage of the crop with the greatest acreage by the farm acreage of that same crop.

If the farm had no crops but did have pasture, the weight for the tract was the pasture acreage within the tract divided by the pasture acreage of the total farm or ranch. If the farm had neither crops nor pasture, the weight was based on agricultural income for the farm or ranch. The weight for the tract was the fraction of farm sales in 1986 that were derived from within the tract.

All of this information is not routinely collected on the June AS. Therefore, additional questions were needed. They were added as question 2 to section F of the Part A questionnaire. A copy of the questionnaire for Montana can be found in Appendix C.

It can be seen from the above definition of the weight that for a particular farm, the commodity weights will total one when summed over the tracts of that farm. This will be true regardless of the commodity that the weights are based on and provided that nonsampling errors are not correlated with the tracts.

Imputation

Question 2 in Section F of the Part A questionnaire contained a completion code box which was used to determine which tracts needed to have the commodity weight imputed. Imputation was needed when question 2 was not completed. The imputed weight was the average reported weight within state, weight basis (crops and pasture were grouped together for imputation purposes), agricultural reporting district, and land-use stratum (agricultural or nonagricultural). This imputation scheme was based on that used to impute item values operationally (11). The only exceptions to this scheme occurred when tract acres and farm acres were equal. For these tracts, both the operational and commodity weights would be one. Table 3 in the RESULTS section gives the percent of imputed weights.

RESULTS

Reporting Errors in the Commodity Weight Data

When the operational weight was equal to one, all of the farm was within the tract. Therefore, the commodity weight should also have been equal to one regardless of the commodity on which it was based. As described in the previous section, when imputation was necessary, commodity weights of one were

imputed when it was known that the weight should be one. A problem encountered in calculating the weight was that there were also tracts with reported data for question 2 which resulted in a commodity weight less than one, even though farm acres and tract acres were equal. There were several causes of this problem. The numerator for the crop-based weight was obtained by adding the acres of the greatest acreage crop reported in section D of the questionnaire (see Appendix C). These acres were obtained field-by-field and wasteland was accounted for separately. The denominator of the crop-based weight, however, was based on one figure of total acres of the crop as reported in section F. Closer investigation of the data at the tract level showed that the denominator sometimes included waste when the farm was completely contained within the tract. This resulted in a commodity weight that was less than one, which was incorrect. When tract acres and farm acres were equal, the error was obvious and easily corrected. However, this downward bias of the weight must also have occurred in other cases where the error would not be obvious and no correction could be made.

Another reason for an incorrect weight could occur in farms having PIGA land. For example, the farm acres of pasture could have incorrectly included PIGA land, but the tract acres would not have included it because they were obtained carefully on a field-by-field basis. The denominator would be inflated, thereby decreasing the commodity weight. This error could only be identified and corrected if tract acres and farm acres were equal. It was not known how often this error occurred when farm acres were greater than tract acres. Therefore, its effect on the commodity weighted expansions was not known.

The Basis of the Commodity Weights

The basis of the commodity weight created three groups within the sample. Table 1 shows that for the 14 states combined, 67.2% of the tracts had a weight based on crops, and 23.5% had a weight based on pasture. The frequency for each group was very close to that obtained in the December AS study (7). The December study values for crops and pasture were 68.1% and 22.1%, respectively (for all 48 states). In June, crops and pasture together provided weights for 90.7% of the tracts, with the remaining 9.3% based on agricultural income. Appendix D gives the frequencies at the state level. At the state level, crops plus pasture provided the basis for the commodity weight from a low of 64.2% of the time (in Arizona) to a high of 97.5% of the time (in Montana). The commodity weight basis was crops or pasture for over 80% of the tracts in all but two states (Arizona and Wyoming).

The AS are conducted several times a year. For the NOL domain, June is the base survey month, and the follow-on surveys are subsampled from the June sample. One major feature of the commodity weight is that with a frozen weight from June used for the remaining surveys in a year, any tracts with a commodity weight of 0 (obtained in June) do not need to be contacted if sampled later on. Table 2 shows the frequencies for the weight bases with weights of 0 separated out. Overall, 854 tracts, or 15%, had weights of zero. If these tracts were sampled later on in the survey year, they would not need to be contacted since they would contribute nothing to the expansions. This would also apply if the commodity weight was used for the FCRS.

TABLE 1: Frequencies for the Basis of the Commodity Weight. Data are from the 1987 June Agricultural Survey.

Basis of the commodity weight	Number of tracts	Percent	Cumulative number of tracts	Cumulative percent
Crop of greatest acreage	3841	67.2	3841	67.2
Pasture	1346	23.5	5187	90.7
Ag income	529	9.3	5716	100.0

TABLE 2: Frequencies for the Basis of the Commodity Weight with Separation of Zero Weights. Data are from the 1987 June Agricultural Survey.

Basis of the commodity weight	Positive or zero weight	Number of tracts	Percent within basis group	Percent across all basis groups
Crop of greatest acreage	+	3143	81.8	55.0
	0	698	18.7	12.2
Pasture	+	1274	94.6	22.3
	0	72	5.3	1.3
Ag income	+	445	84.1	7.8
	0	84	15.9	1.5

Comparison of Commodity Weight and Operational Weight

The distributions of the operational weight and commodity weight were compared. Figures 1 and 2 show the frequency distributions of the two weights. The commodity weight had more weights in the two end intervals than the operational weight (74% vs. 61%). Commodity weights of one occurred in 53% of the tracts while the operational weight was one for only 38% of the tracts. These results were expected since the commodity weight could be one even when the operational weight was not, and the commodity weight could also be zero which was not possible for the operational weight.

The distribution of the difference between the commodity weight and the operational weight at the tract level was also graphed. This difference can range from -1 to +1. Figure 3 shows that the majority of the differences are equal to or close to zero. There was actually no difference in the two weights for 40% of the tracts. The commodity weight tended to be higher than the operational weight, with 32% of the tracts showing a positive difference and only 28% showing a negative difference.

FIGURE 1: Frequency Chart for Operational Weight
Using Data from the 1987 June Agricultural Survey

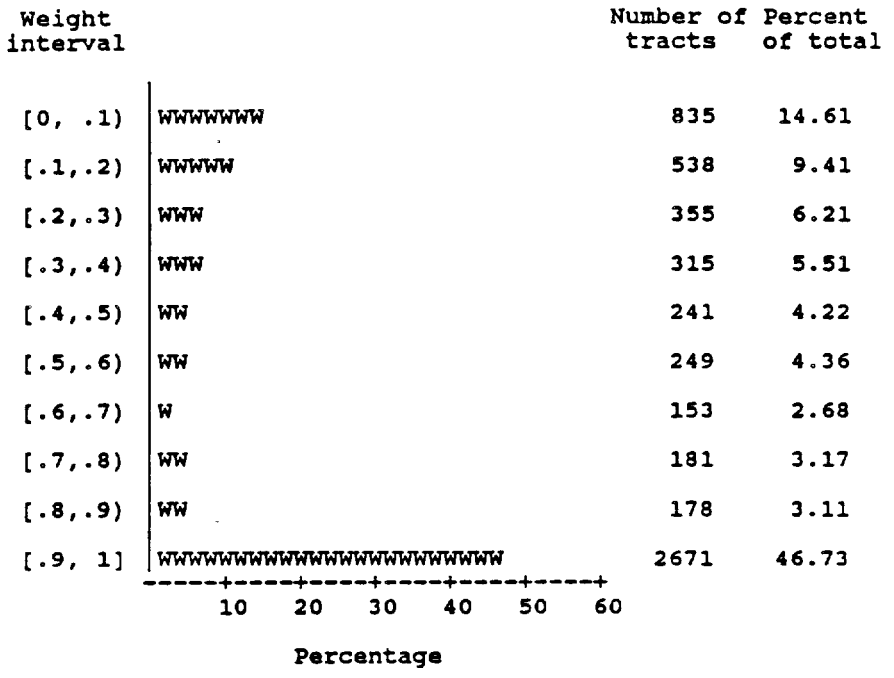
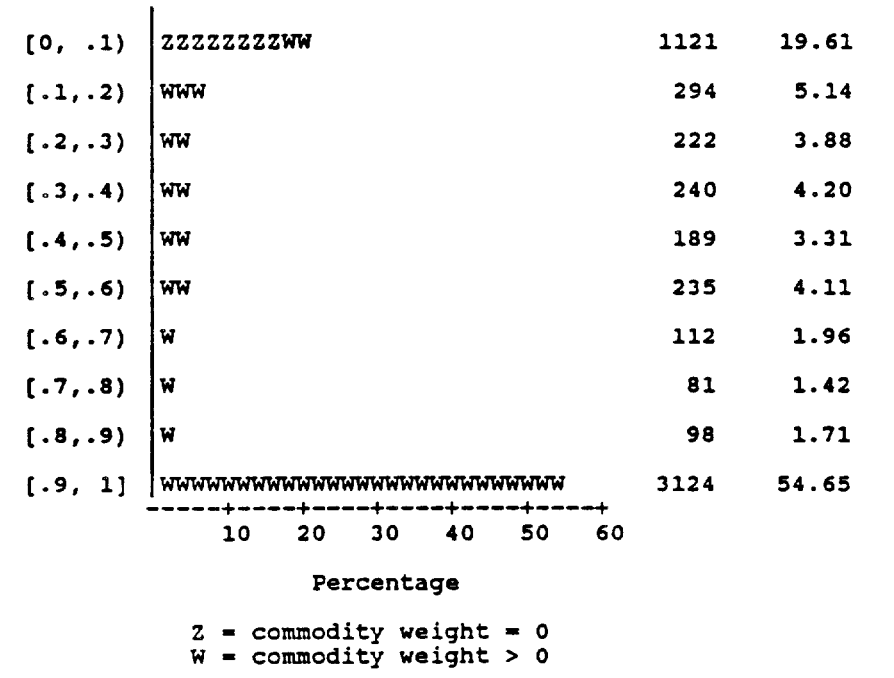
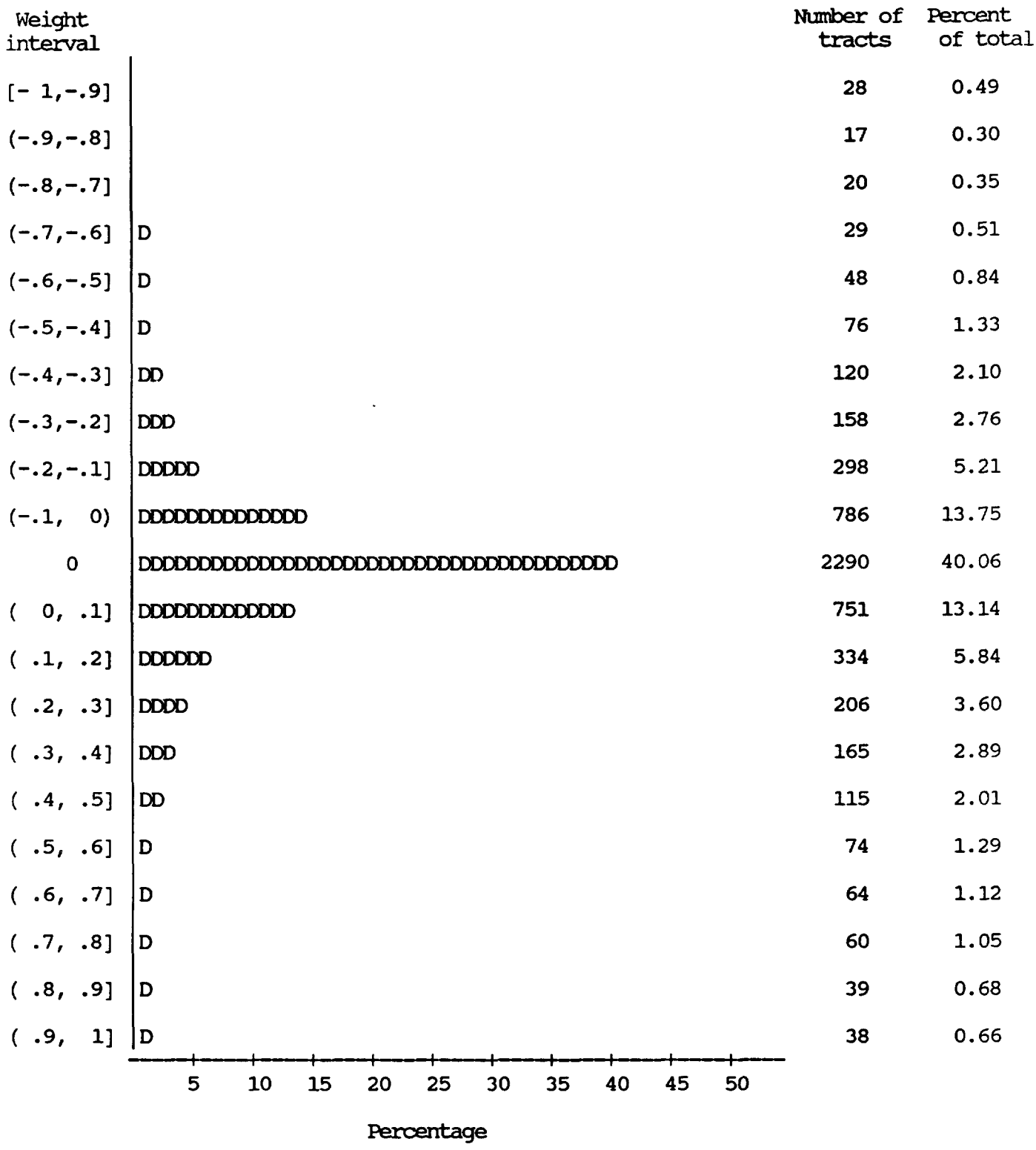


FIGURE 2: Frequency Chart for Commodity Weight
Using Data from the 1987 June Agricultural Survey



Z = commodity weight = 0
W = commodity weight > 0

FIGURE 3: Frequency Chart for Commodity Weight - Operational Weight, Using Data from the 1987 June Agricultural Survey



Imputation of the Weight and Nonresponse

Imputation of a weight was necessary whenever question 2 in section F of the questionnaire was not completed. Imputation rates are in Table 3. These rates do not include tracts where question 2 was not completed, but the weight was known to be one because farm acres were equal to tract acres. For the 14 states combined, 367 weights (6.4%) had to be imputed. At the state level, the imputation rate ranged from 0 in New Mexico to almost 19% in Colorado. The imputation rate for the 48 states in the December study (7) was 13.6%. The reduction in imputation in June is not surprising for several reasons. The June study used a completion code box that the December study did not have, the computer edits were more thorough, and there were fewer questions used to obtain the weight.

The questionnaire nonresponse rate by state can also be seen in Table 3. It is based on the number of tracts that were either refusals or inaccessible. The nonresponse rate was 9.6% for all of the states combined, with state levels ranging from a low of 4.3% in Montana to a high of 18.4% in Colorado. An imputation rate lower than the corresponding nonresponse rate means that the additional nonresponses were given a commodity weight of one because tract acres were equal to farm acres.

TABLE 3: Commodity Weight Imputation and Questionnaire Nonresponse Rates by State for the 1987 June Agricultural Survey.

State	Commodity weight imputation rate (%)	Questionnaire nonresponse rate (%)
AZ	2.6	14.2
CO	18.8	18.4
DE	4.4	8.7
ID	7.8	6.8
MD	7.6	14.0
MT	3.2	4.3
NJ	6.0	11.3
NM	0	7.2
OR	1.7	5.0
PA	4.4	7.0
SC	4.9	6.1
SD	8.4	13.1
UT	13.4	13.4
WY	3.4	7.7
14 State Total	6.4	9.6

Test Results

NOL expansions were generated for number of farms, land in farms, number of hogs, corn stocks, soybean stocks, all wheat stocks, and grain stock capacity. Total planted acres of various crops are not obtained in June so they could not be analyzed in this study as they were in December.

Multivariate paired t-tests on all of the above variables were performed to determine if the commodity weighted expansions were different from the operational weighted expansions. Results indicated a highly significant difference (p-value < .01) at the 14-state level. Multivariate paired t-tests were also performed on each state separately. The results are in Table 4 below. There were significant differences at α =.05 for Colorado, Idaho, Maryland, and New Jersey. Bonferroni adjustments (see Appendix B) for simultaneous testing would restrict our concern to the two most significant states (Idaho and Maryland). Nonsimultaneous tests in these states showed significant differences in either number of farms or land in farms.

TABLE 4: Significance Levels from Multivariate Tests to Compare Expansions Using the Commodity Weighted Estimator vs. the Operational Weighted Estimator for the Nonoverlap Domain. Data are from the 1987 June Agricultural Survey.

State	Significance level
AZ	0.74
CO	0.03 *
DE	0.24
ID	0.01 *
MD	0.01 *
MT	0.53
NJ	0.05 *
NM	0.34
OR	0.08
PA	0.08
SC	0.41
SD	0.72
UT	0.07
WY	0.74
Across all 14 states	< .01 *

* denotes a difference significant at α=.05.

Table 5 shows the NOL expansions, CVs, and significance levels for univariate paired t-tests on hogs, stocks, and capacity at the 14-state level. There were no significant differences between the commodity weighted and operational weighted expansions for any of the commodities even before Bonferroni adjustments. CVs for the two expansions were fairly close and low except for soybean stocks. Soybean stocks also had the largest relative difference. The large CVs for soybeans stocks were due in part to the fact that soybean stocks were estimated in only six of the 14 states. Expansions, CVs, and significance levels for the states can be found in Appendix E, Tables 1 to 5. For these five commodities, none of the state level differences were significant either.

TABLE 5: For the Nonoverlap Domain in 14 States, Expansions and CVs for Hogs, Stocks, and Capacity Using Data from the 1987 June Agricultural Survey.

Commodity	Commodity weighted expansion (1000)	CV %	Operational weighted expansion (1000)	CV %	Rel dif.1/ %	Sig. level
Total hogs	650	17.3	676	17.8	-4.0	0.53
Corn stocks	36,860	11.0	33,156	8.9	11.2	0.12
Soybean stocks	1,527	64.2	905	31.1	68.8	0.41
All wheat stocks	19,484	13.0	21,047	13.0	-7.4	0.42
Grain storage capacity	361,725	6.3	346,516	5.9	4.4	0.33

1/ Relative difference =

$$100 * \frac{\text{(commodity wtd. expansion - operational wtd. expansion)}}{\text{operational wtd. expansion}}$$

It may be of interest to examine some of the larger differences more closely. Table 3 in Appendix E shows that the large difference and CVs for soybean stocks are due mainly to South Carolina. Examination of South Carolina data at the tract level revealed that one tract accounted for the majority of the difference. It had a large expansion factor combined with a commodity weight of 1 versus an operational weight of .07, which resulted in a difference in the expansions of 604,000 bushels. The operator was the respondent and reported the crop of greatest acreage as totally within the tract, which was the reason for the commodity weight of one. This huge relative difference in South Carolina did not result in a statistically significant difference in the totals, however.

The only other noticeable (but not statistically significant) difference was that for Wyoming's corn stocks (Table 2, Appendix E). The large difference

observed was again mainly due to one tract with a large expansion factor and a large difference between the commodity weight and the operational weight. In this case, the operator reported a crop of greatest acreage which resulted in a commodity weight of .63, while the operational weight was only .02. The resulting expanded difference was 23,951 bushels.

Table 6 shows the 14-state NOL expansions, CVs, and significance levels for number of farms and land in farms. Differences between the commodity weighted and operational weighted expansions were highly significant (p-values < .01). For land in farms, this significant difference was also found in the December study. State level results for June can be found in Table 7 of Appendix E. At the α=.05 level, Colorado, Idaho, and Utah showed significant differences.

TABLE 6: For the Nonoverlap Domain in 14 States, Expansions and CVs for Number of Farms and Land in Farms Using Data from the 1987 June Agricultural Survey.

	Commodity weighted expansion (1000)	CV %	Operational weighted expansion (1000)	CV %	Relative dif. 1/	Sig. level	Open expansion (1000)	CV %	Relative dif.2/
Number of farms	179	3.3	171	3.3	4.9	<.01*	148	3.8	21.2
Land in farms	106,695	8.1	78,701	4.4	35.6	<.01*	68,586	8.5	55.6

1/ Relative difference 1 =

$$100 * \frac{\text{(commodity wtd. expansion - operational wtd. expansion)}}{\text{operational wtd. expansion}}$$

2/ Relative difference 2 =

$$100 * \frac{\text{(commodity wtd. expansion - RFO expansion)}}{\text{RFO expansion}}$$

* denotes a difference significant at α=.05.

Results for number of farms were not consistent with the previous study. The relative difference (at the 14-state level) between the commodity weighted expansion and the open expansion was 21.2%, which was very close to the December study results of 20.2% for the U.S. total. However, the relative difference between the commodity weighted and operational weighted expansions was 4.9% which was highly significant (p-value < .01). The December difference at the 48-state level was not significant (p =.25).

State level expansions, CVs, and differences for number of farms are found in Table 6 of Appendix E. All of the commodity weighted expansions were larger

than the operational weighted expansions, and these differences were significant at α=.05 in five states (Maryland, New Jersey, Oregon, Pennsylvania, and Utah). In Oregon, four observations with large expansion factors and large differences between the two weights accounted for 46% of the expanded difference in number of farms for the state. In Utah, just two observations accounted for 47% of the difference in number of farms at the state level.

For hogs, stocks, and capacity, the commodity weight did not produce significantly different expansions than the operational weight. For these items, there was no evidence to suggest that the commodity weight is more or less biased than the operational weight. For number of farms and land in farms, however, an even greater upward bias in the commodity weight was observed.

Table 7 shows the relative difference for the 14-state totals for the items tested and also the difference level that would be significant given the data obtained. In general, large relative differences would be necessary for the tests for differences to be significant. This indicated lack of power due to large variability in the items.

TABLE 7: For the 14-State Level, Actual Relative Differences and Relative Differences That Would Be Significant at α=.05 level.

Commodity	Relative difference between the commodity weighted and operational weighted expansions (%) 1/	Difference that could be detected at α = .05 level (%) 2/
Total hogs	-4.0	±12.4
Corn stocks	11.2	±14.1
Soybean stocks	68.8	±162.4
All wheat stocks	-7.4	±17.9
Grain storage capacity	4.4	±8.9
Number of farms	4.9 *	±1.9
Land in farms	35.6 *	±18.8

1/ Relative difference =

$$100 * \frac{\text{(commodity wtd. expansion - operational wtd. expansion)}}{\text{operational wtd. expansion}}$$

2/ Detectable difference =

$$100 * \frac{1.96 * (\text{variance of the expanded difference})^{\frac{1}{2}}}{\text{operational wtd. expansion}}$$

* denotes a difference significant at α=.05.

CONCLUSIONS AND RECOMMENDATIONS

Both the December 1986 and June 1987 studies indicated that the commodity weighted estimator had the same problem of upward bias as the operational weighted estimator. This result contradicted Bethel (1), who found no upward bias. His study was conducted in three states only, whereas the two latter studies were conducted in 48 and 14 states. Therefore, Bethel's conclusion of no upward bias did not hold after more extensive analyses.

The commodity weighted estimator and the operational weighted estimator produced expansions that were not significantly different for hogs, stocks, and grain stock capacity. For number of farms and land in farms, however, the differences were highly significant. This was somewhat confusing because for some items the commodity weighted estimator did not seem to have any more of

an upward bias but for other items it did seem to. The reason for these results was in the frequency of occurence of these items. Not all farms had hogs, stocks, or capacity, but all farms had land and were farms. For the two items that were present for all farms (presence of a farm and land in farms), the differences were significant. However, for items that did not occur on every farm, the differences were not significant. Therefore, it appeared that the commodity weight had more of an upward bias than the operational weight, but that it was not detectable (lacked power) except for the most common items. For the items that were not common, there was much more variability, and therefore not enough power to detect significant differences. This was shown in Table 7, where for example, a difference in the hog expansions would not be statistically significant unless it was at least 12.4%. Although the differences found were not statistically significant, they may be of practical significance.

Although the commodity weighted estimator does have the advantage of less prescreening and fewer interviews, it unfortunately seems to have an even higher upward bias than the operational weighted estimator. Further consideration of the commodity weighted estimator as a potential replacement for the operational weighted estimator for the Ag Surveys is not recommended.

A new weighted estimator, which is actually a modification of the operational weighted estimator, has recently been proposed (2). It has the advantage of eliminating prescreening in the city segments, and consequently reducing the number of interviews needed. However, it has the disadvantage that it misses operations that have all land in PIGA except for the residence. The simulation study that was done used data collected during the 1987 June Ag Survey, and results indicated that this modified weighted estimator does not produce significantly different expansions than the operational weighted estimator. A more extensive study is planned for the 1989 June Ag Survey.

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APPENDIX A: FORMULAS FOR THE ESTIMATES OF TOTALS AND VARIANCES

The sample estimate of the total for the nonoverlap (NOL) domain of a state is defined as follows:

$$\hat{Y}_{state} = \sum_{l=1}^{s} \sum_{k=1}^{p_l} \sum_{j=1}^{r_{lk}} \hat{Y}'_{lkj} = \sum_{l=1}^{s} \sum_{k=1}^{p_l} \sum_{j=1}^{r_{lk}} e_{lkj} \hat{Y}_{lkj}$$

s = number of land use strata in the state

p_l = number of substrata within land use stratum l

r_{lk} = number of segments within substratum k within land use stratum l

e_{lkj} = expansion factor for segment j, within substratum k, within land use stratum l

$$\hat{Y}_{lkj} = \sum_{m=1}^{f_{lkj}} n_{mlkj} \; w_{mlkj} \; z_{mlkj}$$

where f_{lkj} = the number of agricultural tracts in segment j, within substratum k, within land use stratum l

n_{mlkj} = NOL indication for tract m, within segment j, substratum k and land use stratum l
=1 if tract is NOL, =0 if tract is OL

w_{mlkj} = weight for tract m, within segment j, substratum k and land use stratum l

= tract acres/farm acres, for the operational weighted estimate

= commodity-based weight, as defined on page 3, for the commodity weighted estimate

= 1 if Resident Farm Operator (RFO)
0 otherwise, for the RFO (open) estimate

z_{mlkj} = entire farm value of the commodity of interest for tract m, within segment j, substratum k and land use stratum l

The variance of the estimated total is defined as follows:

$$\hat{\text{var}}(Y_{state}) = \sum_{l=1}^{s} \sum_{k=1}^{p_l} \sum_{j=1}^{r_{lk}} \frac{\bar{e}_{lk.} - 1}{\bar{e}_{lk.}} \frac{r_{lk}}{r_{lk} - 1} (Y'_{lkj} - \bar{Y}'_{lk.})^2$$

where $\bar{Y}'_{lk.} = \sum_{j=1}^{r_{lk}} Y'_{lkj} / r_{lk}$

$$\bar{e}_{lk.} = \sum_{j=1}^{r_{lk}} e_{lkj} / r_{lk}$$

APPENDIX B: STATISTICAL TESTS

1. Univariate testing

Paired t-tests were conducted since commodity weighted and operational weighted estimates were generated for each tract. Differences were calculated, expanded to the state level, and a t statistic was generated for the total difference.

Using the statistics defined in Appendix A, we can also define the following:

Difference in the expansions at the segment level:

$$d_{lkj} = e_{lkj}\,\hat{Y}_{lkj,\text{commodity}} - e_{lkj}\,\hat{Y}_{lkj,\text{operational}}$$

$$= e_{lkj}\,\hat{Y}_{lkj,\text{difference}} = \hat{Y}'_{lkj,\text{difference}}$$

Difference in the state expansion totals:

$$\hat{Y}_D = \sum_{l=1}^{s} \sum_{k=1}^{p_l} \sum_{j=1}^{r_{lk}} d_{lkj}$$

Variance of the total difference is calculated using the same formula as in Appendix A, except that $\hat{Y}'_{lkj,\text{difference}}$ is used in place of $\hat{Y}'_{lkj}$.

The paired t-test is as follows:

$$Y_D = Y_{\text{commodity}} - Y_{\text{operational}}$$

To test H_O: $Y_D = 0$
H_A: $Y_D \neq 0$,

$$\text{use } t = \frac{\hat{Y}_D}{\text{s.e.}(\hat{Y}_D)} \text{ and reject } H_O \text{ if } |t| > t_\alpha$$

$$\text{where s.e.}(\hat{Y}_D) = (\text{var}(\hat{Y}_D))^{\frac{1}{2}}$$

Z tables were used to obtain significance levels since the t is approximated by the z when sample size is large. The $t_\alpha = t_{.05} = 1.96$.

2. Multivariate testing

For multivariate tests,
let the row vector of differences for q variables be:

$$\hat{D}' = (\hat{Y}_{D1}, \hat{Y}_{D2}, \ldots, \hat{Y}_{Dq})',$$

where $\hat{Y}_{Do}$ = the difference in the expansion totals for the o^{th} item of interest (number of farms, hogs, corn stocks, etc.).

Also define:

$\hat{W}$ = the variance-covariance matrix for $\hat{D}$, with the variances as the diagonal elements, and the covariances as the off-diagonal elements.

The diagonal elements of W are then defined as:

$$\text{var}(\hat{Y}_{Do}) = \sum_{l=1}^{s} \sum_{k=1}^{p_l} \sum_{j=1}^{r_{lk}} \frac{(\bar{e}_{lk.} - 1)}{\bar{e}_{lk.}} \frac{r_{lk}}{(r_{lk} - 1)} (d_{o(lkj)} - \bar{d}_{o(lk.)})^2$$

and the off-diagonal elements are defined as:

$$\text{cov}(\hat{Y}_{Do}, \hat{Y}_{Du}) =$$

$$\sum_{l=1}^{s} \sum_{k=1}^{p_l} \frac{(\bar{e}_{lk.} - 1)}{\bar{e}_{lk.}} \frac{r_{lk}}{(r_{lk} - 1)} \sum_{j=1}^{r_{lk}} (d_{o(lkj)} - \bar{d}_{o(lk.)})(d_{u(lkj)} - \bar{d}_{u(lk.)})$$

The test statistic is Hotelling's T^2, where

$T^2 = \hat{D}' \hat{W}^{-1} \hat{D}$, which is distributed as a chi-square with q degrees of freedom.

These are the same formulas as those used by Pafford (10).

Significance levels:

Strictly speaking, when simultaneous tests are conducted, the α level should be adjusted by the number of tests that are being performed, since the probability that all of the tests fail to reject the null hypothesis when it is true is not $1-\alpha$, but $(1-\alpha)^m$, where m is the number of tests performed. The Bonferroni adjustment of the α level is based on the fact that $(1-\alpha)^m \geq (1-m\alpha)$. This inequality allows the overall error rate $(\alpha_1 + \alpha_2 + \ldots + \alpha_m)$ to be controlled at the desired level. For example, if an overall α level of .05 is desired, the simultaneous tests should be performed at the α/m level. Refer to Johnson and Wichern (6) for more details.

National Agricultural Statistics Service
U.S. Department of Agriculture
Washington, D.C. 20250

June 1987
ACREAGE & LIVESTOCK
Enumerative Survey

Form Approved
O.M.B. Number 0535-0089
Expiration Date 5/31/89
C.E. 12-0029

A—5
Montana

State	District	Segment	Tract
__	____	00000____	____ 0 0

Optional	
407	408

Response to this survey is voluntary and not required by law. However, cooperation is very important in order to establish crop acreage planted this spring and current livestock numbers. Facts about your farm or ranch will be kept CONFIDENTIAL and used only in combination with similar reports from other producers to produce statistical summaries and to measure survey completeness of sampling lists.

Segment Number: _____ **Tract Letter:** _____ **County:** _____

Starting time
296
____

	OPERATION NAME			
	LSF ID	E.I.N.	Hogs-Crops	Cattle-Sheep
0	786	466 __-_____	923	933
	COMBINATION OF INDIVIDUAL NAMES			
	LSF ID	E.I.N.	Hogs-Crops	Cattle-Sheep
1	786	466 __-_____	929	939

☐ Verify Operation Name

1. I need to make sure we have your *[the operator's]* correct name and address. *[Verify stickers if present]*

Name of Farm, Ranch or Operation: _____

Combination of Individual Names: _____ *[If partnership]*

☐ Verify Combination of Individual Names

Name of Operator: _____
(First) (Middle) (Last)

Address: _____
(Route or Street)

_____
(City) (State) (Zip)

☐ Verify Operator Name

Phone No.: (____) —

ENUMERATOR NOTE: *[If SSN/EIN is recorded on Face Page, verify with respondent then go to Section A.]*

2. To help identify duplication on our list of farm operators, I would like to record the operator **SOCIAL SECURITY NUMBER** *(SSN)* and **FEDERAL EMPLOYER IDENTIFICATION NUMBER(S)** *(EIN)* for your operation.

	OPERATOR NAME			
	LSF ID	S.S.N.	Hogs-Crops	Cattle-Sheep
2	790	470 ___-___-____	924	934

LSF CODE BOX	
NOL = 1 OL = 2	413

SECTION A — OPERATION DESCRIPTION

1. On June 1, was this **tract** of land **Individually Operated, Partnership or Jointly Operated,** or **Managed Land?**

   - ☐ *Individually Operated* - *1*
   - ☐ *Partnership or Jointly Operated* - *2*
   - ☐ *Managed Land* - *3*

   .... **Enter Code** | 845 |

   [If code is 1 or 3, go to Section B.]

   ENUMERATOR NOTE: *[Landlord-Tenant, Cash-Rent, Share Crop arrangements should not be considered a partnership operation.]*

   [If this tract is operated as a **partnership,** *continue.]*

2. How many partners are in this partnership?..........................

Number of Partners
921

[Including operator]

3. Do all parnters share equally in day-to-day decisions?

   ☐ **YES** - *[Consider the oldest as the operator.]*

   ☐ **NO** - *[The partner that makes most of the day-to-day decisions is the operator.]*

   [Operator shown on face page must be the one making most day-to-day decisions or the oldest. Make corrections if necessary.]

4. Now I need the name, address, and social security number for the other person(s) in this partnership. *[Verify stickers if present.]*

☐ *Verify Partner Name*

Name ____
(First) *(Middle)* *(Last)*

Address ____
(Route or Street)

______________________________ **Phone (**   **)**   —
(City) *(State)* *(Zip Code)* *(Area Code)*

	LSF ID	S.S.N.	Hogs-Crops	Cattle-Sheep
3	792	472 ___-__-____	925	935

☐ *Verify Partner Name*

Name ____
(First) *(Middle)* *(Last)*

Address ____
(Route or Street)

______________________________ **Phone (**   **)**   —
(City) *(State)* *(Zip Code)* *(Area Code)*

	LSF ID	S.S.N.	Hogs-Crops	Cattle-Sheep
4	794	474 ___-__-____	926	936

☐ *Verify Partner Name*

Name ____
(First) *(Middle)* *(Last)*

Address ____
(Route or Street)

______________________________ **Phone (**   **)**   —
(City) *(State)* *(Zip Code)* *(Area Code)*

	LSF ID	S.S.N.	Hogs-Crops	Cattle-Sheep
5	796	476 ___-__-____	927	937

SECTION B — RESIDENCE AND SCREENING

1. Does the operator of this tract live **INSIDE** or **OUTSIDE** the segment?

   ☐ **INSIDE** · *[Enter 5 in Code Box and go to Item (2.)]*

   ☐ **OUTSIDE** · *[Enter 6 in Code Box and go to* **Section C.***]* .... | 81 ___ 1 |

(2.) Were there any other persons living in this household on June 1 who operated a farm or ranch?

   ☐ **YES** · *Enter Names* ______________________________
   [Assign separate tract letter(s) on Part ID, then go to Item 3.]

   ☐ **NO** · *[Continue.]*

3. On June 1, did you operate land under any other name or land arrangement other than the one listed on Face Page?

   ☐ **YES** · *[Assign separate tract letter(s) on Part ID for other arrangements(s), then go to* **Section C.***]*

   ☐ **NO** · *[Continue.]*

****

SECTION C — SECTIONS TO BE COMPLETED

[Is the **HOGS-CROPS** *box at bottom of this page checked?]*... ☐ **YES** · *[Go to Section D.]*
☐ **NO** · *[Continue.]*

YES	NO	
☐	☐	1a. *[Is this Segment* **NEW** *for 1987?]*
☐	☐	1b. *[Was this Tract* **NON-AGRICULTURAL** *last year?]*
☐	☐	1c. *[Is this a* **NEW** *Tract Operator in an* **OLD** *segment?]*
☐	☐	1d. *[Is the Tract Operator* **DIFFERENT** *than the Operator shown on Face Page label?]*
☐	☐	1e. *[Was Operation Name or Combination of Individual Names* **CHANGED** *or* **CORRECTED** *on Face Page labels?]*
☐	☐	1f. *[Were any Partners* **DELETED** *or Names* **CHANGED** *or* **CORRECTED** *on labels in Section A. page 2?]*

NO → *[Go to Section D.]*

YES → *[Check* **HOGS · CROPS** *Box, Then go to Section D.]* → | Hogs · Crops |

SECTION D — CROPS AND LAND USE ON TRACT

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 1987.

FIELD NUMBER.....	01	02	03	04	05	06
1. Total Acres in Field	828 .	828 .	828 .	828 .	828 .	828 .
2. Crop or Land Use *(Specify)*						
3. Occupied Farmstead or Dwelling	843 .	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				
4. Woods, Waste, Roads, Ditches, etc.	841 .	841 .	841 .	841 .	841 .	841 .
5. Pasture — Permanent — Not in crop rotation	842 .	842 .	842 .	842 .	842 .	842 .
5. Pasture — Cropland — Used only for pasture	858 .	858 .	858 .	858 .	858 .	858 .
6. Two Crops Planted in this Field for harvest this year or two uses of the same crop?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
	844 .	844 .	844 .	844 .	844 .	844 .
7. Acres Left to be Planted?	61_ .	61_ .	61_ .	61_ .	61_ .	61_ .
8a. Acres Irrigated and to be Irrigated? — 1st Crop	6_ _ .	6_ _ .	6_ _ .	6_ _ .	6_ _ .	6_ _ .
8a. Acres Irrigated and to be Irrigated? — 2nd Crop	6_ _ .	6_ _ .	6_ _ .	6_ _ .	6_ _ .	6_ _ .
9. Spring Wheat — Planted and to be Planted	550 .	550 .	550 .	550 .	550 .	550 .
10. Other Than Durum — For Grain	768 .	768 .	768 .	768 .	768 .	768 .
11. Durum Wheat — Planted and to be planted	553 .	553 .	553 .	553 .	553 .	553 .
12. — For Grain	554 .	554 .	554 .	554 .	554 .	554 .
13. Winter Wheat — Planted	540 .	540 .	540 .	540 .	540 .	540 .
14. — For Grain	541 .	541 .	541 .	541 .	541 .	541 .
15. Rye — Planted and to be planted	547 .	547 .	547 .	547 .	547 .	547 .
16. — For Grain	548 .	548 .	548 .	548 .	548 .	548 .
17. Oats — Planted and to be planted	533 .	533 .	533 .	533 .	533 .	533 .
18. — For Grain	534 .	534 .	534 .	534 .	534 .	534 .
19. Barley — Planted and to be planted	535 .	535 .	535 .	535 .	535 .	535 .
20. — For Grain	536 .	536 .	536 .	536 .	536 .	536 .
21. Corn — Planted and to be planted	530 .	530 .	530 .	530 .	530 .	530 .
22. — For Grain	531 .	531 .	531 .	531 .	531 .	531 .
25. Other Uses of Grains Planted — Use						
Acres abandoned, silage, etc — Acres	.	.	.	.	.	.

FIELD NUMBER.	01	02	03	04	05	06
26. Alfalfa and Alfalfa Mixtures (Cut and to be cut for hay)	653 •	653 •	653 •	653 •	653 •	653 •
27. Grain (Cut and to be cut for hay)	656 •	656 •	656 •	656 •	656 •	656 •
28. Other Hay (Cut and to be cut for hay)	654 •	654 •	654 •	654 •	654 •	654 •
34. Dry Edible Beans Planted and to be planted	607 •	607 •	607 •	607 •	607 •	607 •
35. Sugar Beets Planted and to be planted	691 •	691 •	691 •	691 •	691 •	691 •
38. Irish Potatoes Planted and to be planted	884 •	884 •	884 •	884 •	884 •	884 •
41. Other Crops Acres planted or in use	— — — •	— — — •	— — — •	— — — •	— — — •	— — — •
42. Land in Summer Fallow	847 •	847 •	847 •	847 •	847 •	847 •
43. Idle Cropland — Idle all during 1987	857 •	857 •	857 •	857 •	857 •	857 •

Enumerator Entered Tract Acres •

FIELD NUMBER	0 0
Total Acres	
Office Use	840 •

FIELD NUMBER.	07	08	09	10
1. Total Acres in Field	828 •	828 •	828 •	828 •
2. Crop or Land Use *(Specify)*				
3. Occupied Farmstead or Dwelling	XXXXXXXXXXXXXXXXXXXXXXXXX			
4. Woods, Waste, Roads, Ditches, etc.	841 •	841 •	841 •	841 •
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?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
	844 •	844 •	844 •	844 •
7. Acres Left to be Planted?	61_ •	61_ •	61_ •	61_ •
8a. Acres Irrigated and to be Irrigated? — 1st Crop	6_ _ •	6_ _ •	6_ _ •	6_ _ •
8a. Acres Irrigated and to be Irrigated? — 2nd Crop	6_ _ •	6_ _ •	6_ _ •	6_ _ •
9. Spring Wheat — Planted and to be Planted	550 •	550 •	550 •	550 •
10. Other Than Durum — For Grain	768 •	768 •	768 •	768 •
11. Durum Wheat — Planted and to be planted	553 •	553 •	553 •	553 •
12. Durum Wheat — For Grain	554 •	554 •	554 •	554 •
13. Winter Wheat — Planted	540 •	540 •	540 •	540 •
14. Winter Wheat — For Grain	541 •	541 •	541 •	541 •
15. Rye — Planted and to be planted	547 •	547 •	547 •	547 •
16. Rye — For Grain	548 •	548 •	548 •	548 •
17. Oats — Planted and to be planted	533 •	533 •	533 •	533 •
18. Oats — For Grain	534 •	534 •	534 •	534 •
19. Barley — Planted and to be planted	535 •	535 •	535 •	535 •
20. Barley — For Grain	536 •	536 •	536 •	536 •
21. Corn — Planted and to be planted	530 •	530 •	530 •	530 •
22. Corn — For Grain	531 •	531 •	531 •	531 •
25. Other Uses of Grains Planted — Use				
Acres abandoned, silage, etc — Acres	•	•	•	•

FIELD NUMBER.	07	08	09	10
26. Alfalfa and Alfalfa Mixtures (Cut and to be cut for hay)	653 •	653 •	653 •	653 •
27. Grain (Cut and to be cut for hay)	656 •	656 •	656 •	656 •
28. Other Hay (Cut and to be cut for hay)	654 •	654 •	654 •	654 •
34. Dry Edible Beans Planted and to be planted	607 •	607 •	607 •	607 •
35. Sugar Beets Planted and to be planted	691 •	691 •	691 •	691 •
38. Irish Potatoes Planted and to be planted	884 •	884 •	884 •	884 •
41. Other Crops Acres planted or in use	— — — •	— — — •	— — — •	— — — •
42. Land in Summer Fallow	847 •	847 •	847 •	847 •
43. Idle Cropland — Idle all during 1987	857 •	857 •	857 •	857 •

SECTION E — ACRES OPERATED

[Operator Lives: *Refer to Section B, page 3 to check box.]*

☐ INSIDE ☐ OUTSIDE

[Is **HOGS-CROPS** *box checked on page 3?]*

☐ YES ☐ NO - On June 1, did this operation **own or manage cattle,** that were **located on land administered or controlled by** a Public agency, Industrial corporation, or Grazing Association, on an AUM basis?

☐ YES ☐ NO - *[Go to page 10, Section F.]*

TYPE of OPERATION........................ *[Refer to* Section A, page 2.]

- **Individually Operated** .. ☐ ..*[Go to item (1.)]*
- **Partnership or Joint** ... ☐ ..*[Go to item (1.)]*
- **Managed Land** .... ☐.....*[Go to page 9, Item 3.]*

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

On June 1, HOW MANY ACRES DID THIS OPERATION:

		Code	Acres	
a.	**Own?**..........	901	.0	
b.	**Rent from others?** *[Exclude land used on an AUM basis]*..........	902	.0	+
c.	**Use on an AUM basis,** which are **administered or controlled** by Public agency, Industrial corporation or Grazing Association? *[Include private owned/rented lands that are administered by a PIGA agency thru Exchange-of-Use.]*...	903	.0	+
d.	**Rent to others?** *[Include private owned/rented lands administered or controled by a Pubiic agency thru Exchange-of-Use]*..........	905	.0	—

Then the **total acres operated** under this arrangement are *[item a + b + c — d]*......... 900 .0

Does this include farmstead, all cropland, woodland, pastureland, wasteland and government program land?

☐ YES - *[Continue].* ☐ NO - *[Make corrections and continue].*

2. How many acres, of the total *[code box 900]* acres operated, are in a **long term** (10 years) **Conservation Reserve Program** (CRP)?.......... 704 .0

SECTION E — ACRES OPERATED (cont'd)

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

How many acres of land do **you operate** for others as a hired manager **under this land arrangement?**.................................... 904 .0

Does this include farmstead, all cropland, woodland, pastureland, wasteland and government program land?

☐ YES · *[Continue.]* ☐ NO · *[Make corrections and continue.]*

4. How many of these acres are **administered** or **controlled** by a Public agency Industrial corporation or Grazing Association, which are used on an **AUM basis?**............ 906 .0

(Include private managed lands administered by a PIGA agency thru Exchange-of-Use)

5. How many acres of land in this managed operation are in a **long term** (10 years) **Conservation Reserve Program**.................................. 706 .0

SECTION F - CROPS AND UTILIZATION ACREAGES ON ENTIRE OPERATION

Now I need to identify 1987 Crops and Land Use . . . on all land operated . . . both Inside and Outside the **BLUE LINES.**

1. On the total *(page 8-9)* acres operated, how many acres would be considered **CROPLAND**, including Hay and cropland in government programs? . . . . . 802 .0

Office use

Tract Value	Comp Code
595 .0	700

[If **CROPLAND** *is* **NONE,** *skip to item 2b.]*

2. What Crop will have the largest acreage planted and to be planted or used for 1987 Harvest? . . . _____

[If NONE, go to item 2b.]

2a. How many acres of *[crop]* will this operation have? . . . . . 537 .0

[Go to Item ③]

[Ask, if no crop]

2b. What is the total acres of **PASTURE** on the Entire Operation? . . . . . 667 .0

[If no pasture, ask item 2c.]

2c. What percentage of 1986 Farm Sales (production) came from acres **INSIDE** the **BLUE LINE?** . . . . . 738 .0

③ *[Is* **HOGS-CROPS** *box checked on page 3.]*

☐ **YES** ☐ **NO** = *[Go to Item 4.]* →

3a. *[Were Wheat, Oats, Barley, or Rye reported in the tract, on pages 4 - 7?]*
☐ **YES** - *[enter a 1 in the 161 code box, then go to item 4.]*
☐ **NO**

3b. On the total acres operated, was or will any Wheat, Oats, Barley, or Rye be planted, *(for any purpose)*, for **USE** or **HARVEST** in 1987?

☐ **YES** - 1
☐ **DON'T KNOWN** - 2
☐ **NO** - 3

. . . . . *[Enter code]* 161

[Then, go to item 4.]

SECTION F - CROPS AND UTILIZATION ACREAGES ON ENTIRE OPERATION (Cont'd)

4. Operator lives: *[Refer to Section B, page 3, to check box]*

☐ INSIDE ☐ OUTSIDE = *[Go to Section G.]* →

[Enter crop acres from item 2a, page 10 below.]

[Then continue with items 5a - 5o.]

Office use
168
Unknown = 2 Complete = 4

5. On the *[page 8-9]* acres operated, what is the **TOTAL** Acreage Planted and to be Planted *(include double cropped acres)* for 1987 Harvest /or Acres Used in 1987, for the following:

Item	Unit	Code	Value
a. **Corn** (exclude Popcorn and Sweet Corn)	Acres	170	.0
b. **Sorghum** (exclude Sorghum - Sudan Crosses	Acres	171	.0
c. **All Wheat** (include Winter, Spring, Durum Wheat	Acres	172	.0
d. **Other Grains** (include Oats, Barley, Rye, Rice)	Acres	173	.0
e. **Soybeans**	Acres	174	.0
f. **All Cotton** (include Upland, American Pima)	Acres	175	.0
g. **Alfalfa and Alfalfa Mixed Hay**	Acres	176	.0
h. **Other Hay** (exclude Afalfa & Alfalfa mixes, and Grain Hay)	Acres	177	.0
i. **Tobacco, All Types**	Acres	178	.0
j. Irish **Potatoes**	Acres	169	.0
k. **Vegetables for Sale** (Fresh and Processing)	Acres	179	.0
l. **Fruits, Citrus, Vines, Berries, Nut Trees**	Acres	180	.0
m. **Nursery products** (include Sod, Vines, Mushrooms, Vegetable Seeds, Flowers, Shrubs, Trees, etc.)	Acres	181	.0
n. **Greenhouse Products** (under glass or protective cover)	Square Feet	182	.0
o. **Other Crops** *(Specify)* ____, ____, ____, ____, ____ (Acres) ____, ____, ____, ____, ____	Total Acres	183	.0

SECTION G — GRAINS IN STORAGE ON ENTIRE OPERATION

[Is **HOGS-CROPS** *box checked on page 3.]*

☐ **YES** ☐ **NO** - *[Go to Section H.]* →

Now let's account for the whole grains on hand or in storage on June 1, 1987 on the total acres operated, whether for feed, seed, or sale. They may have belonged to you or someone else. . . or were stored under a government program *(loan, farmer owned reserve, or CCC).*

1. On the total acres operated, were any of the following whole grains on hand or in storage on June 1, 1987?

	NO	YES	
a. whole grain **CORN,** shelled or ear corn	☐	☐ - How many bushels?	121
h. **WINTER WHEAT**	☐	☐ - How many bushels?	129
i. **DURUM WHEAT**	☐	☐ - How many bushels?	127
j. **OTHER SPRING WHEAT**	☐	☐ - How many bushels?	128
k. **OATS**	☐	☐ - How many bushels?	123
l. **BARLEY**	☐	☐ - How many bushels?	124

2. On June 1, what was the **total storage capacity** of all the bins, cribs, sheds, and other structures normally used to store whole grains on the total acres operated? ..... Bushels 808

Stocks are: Incomplete	1 - HAS 2 - Unknown 3 - NO	141
Complete	4	

SECTION H — HOGS AND PIGS ON ENTIRE FARM AND TRACT

Operator lives: *[Refer to Section B, page 3, to check box.]*

☐ INSIDE · *[Complete* Red *and* Black.*]* ☐ OUTSIDE · *[Is* HOGS - CROPS box *checked on page 3.]*

☐ YES ☐ NO, Black Only

HOGS AND PIGS INVENTORY:

1. On June 1, were there any hogs or pigs, regardless of ownership, on the total ______ acres operated? *[page 8-9]*

☐ YES ☐ NO

2. Were any hogs or pigs on the total acres operated, at anytime during the period December 1, 1986 through May 31?

☐ YES · *[Enter 1 in Code Box 492, then go to Item 7, Page 15.]*

☐ NO · *[Complete Item 2a, enter code in Code Box 492, then go to Item 15, page 15.]*

1a. On June 1 were there any hogs or pigs, regardless of ownership, inside this blue tract boundary?

☐ YES · *[Complete* Column B, *then go to* Section J.*]*

☐ NO · *[Complete Item 2a, enter code in Code Box 492, then go to Section J.]*

2a. Will there be any hogs or pigs on the total acres operated from now through November 30, 1987?

☐ Yes = 1
☐ Don't know = 2 492
☐ No = 3

Let's start with the HOGS and PIGS for BREEDING on hand June 1. *[Complete* Column A *first.]*

3. How many of the breeding hogs and pigs were:		Column A On Total Acres Operated	Column B On Tract Acres
a. Sows, gilts and young gilts bred and to be bred? .... *		301	201 *
Of the sows and gilts *(reported in Item 3a)* how many are expected to farrow:			
(1) During June, July, and August 1987?	331		
(2) During September, October and November 1987?	332		
b. Boars and young males for breeding? .... *		302	202 *
c. Sows and boars no longer used for breeding? .... *		303	203 *

Now let's talk about the HOGS and PIGS for MARKET and HOME USE
[Exclude breeding hogs already reported in Item 3.]

4. How many were in each of the following four weight groups:	Column A	Column B
a. Under 60 lbs., including pigs not yet weaned? .... *	311	211 *
b. 60 — 119 lbs.? .... *	312	212 *
c. 120 — 179 lbs.? .... *	313	213 *
d. 180 lbs. and over? .... * *[Exclude hogs no longer used for breeding.]*	314	214 *
5. *[Add * Items 3 + 4:]* Then the total hogs and pigs on June 1 was?.	300	200

Is that correct? ☐ YES · *[Continue.]* ☐ NO · *[Make corrections and continue.]*

5a. Were any of the total hogs and pigs located in any of the fields and buildings inside this blue tract boundary on June 1 1987?

☐ YES · *[Complete column B, Items 3-5.]* ☐ NO = 3 · *[Enter code, go to Item 7]*... 210

SECTION H — HOGS AND PIGS ON ENTIRE OPERATION (Cont'd)

FARROWINGS:

Now let's talk about sows and gilts that farrowed in the last six months.

7. How many **sows** and **gilts** farrowed during December 1986 and January and February 1987? 322

8. How many **pigs** from these *(Item 7)* litters were:
   a. On hand June 1? 323
   b. Had been sold or slaughtered? 324

9. How many **sows** and **gilts** farrowed during March, April and May 1987? 326

10. How many **pigs** from these *(Item 9)* litters were:
    a. On hand June 1? 327
    b. Already sold? 328

PURCHASES:

Now let's talk about hogs and pigs purchased in the last six months.

11. How many hogs and pigs purchased during the period of December 1, 1986 through May 31, 1987 were on hand June 1? *[Include feeder pigs purchased.]* 317

DEATHS AFTER WEANING:

13. How many **weaned pigs** and **older hogs died** during:
    a. December 1986 and January and February of this year? 334
    b. March, April and May? 335

15. *[Complete Code Boxes for Hogs on Entire Operation, then go to* Section I] .....

DATA QUALITY
497
☐ 1 Complete
☐ 2 Estimated/*with reliable current Information.*
☐ 3 Estimated/*with no current Information* →

ENUMERATOR NOTE: *[Complete Code Box 499 only when a "3" has been checked for Code Box 497.]*

Entire Farm Hogs
PRESENCE
499
☐ 1 Has Hogs
☐ 2 Unknown
☐ 3 NO Hogs

APPENDIX D: FREQUENCIES FOR THE WEIGHT BASIS - BY STATE

# of tracts Row percent	-----Basis for weight-----			
State	Crop	Pasture	Ag income	Total tracts
AZ	189 49.74	55 14.47	136 35.79	380
CO	319 69.05	124 26.84	19 4.11	462
DE	62 67.39	14 15.22	16 17.39	92
ID	407 72.29	120 21.31	36 6.39	563
MD	363 74.85	82 16.91	40 8.25	485
MT	228 81.43	45 16.07	7 2.50	280
NJ	269 73.90	76 20.88	19 5.22	364
NM	174 52.25	121 36.34	38 11.41	333
OR	336 52.42	276 43.06	29 4.52	641
PA	568 73.39	144 18.60	62 8.01	774
SC	305 64.48	118 24.95	50 10.57	473
SD	162 84.82	22 11.52	7 3.66	191
UT	334 71.06	120 25.53	16 3.40	470
WY	125 60.10	29 13.94	54 25.96	208
14 State Total	3841 67.20	1346 23.55	529 9.25	5716

APPENDIX E: COMMODITY ESTIMATES, COEFFICIENTS OF VARIATION, AND SIGNIFICANCE LEVELS BY STATE

TABLE 1: Total Number of Hogs

State	Commodity weighted expansion	CV %	Operational weighted expansion	CV %	Relative dif. 1/ %	Sig. level
AZ	12,100	68.5	12,040	68.8	0.5	0.85
CO	23,637	33.2	38,488	35.1	-38.6	0.12
DE	2,762	47.2	4,411	36.9	-37.4	0.26
ID	10,175	44.5	11,611	40.3	-12.4	0.24
MD	49,147	49.7	46,888	48.5	4.8	0.64
MT	20,823	54.9	20,274	50.8	2.7	0.77
NJ	57,019	92.9	59,583	93.6	-4.3	0.37
NM	7,804	62.6	8,068	60.6	-3.3	0.34
OR	9,975	29.6	13,112	29.4	-23.9	0.11
PA	146,239	36.3	144,339	37.7	1.3	0.79
SC	101,351	27.2	84,097	23.3	20.5	0.45
SD	186,183	38.7	215,570	39.1	-13.6	0.38
UT	11,998	53.8	10,183	58.7	17.8	0.22
WY	10,374	73.2	7,689	66.6	34.9	0.28
Total	649,586	17.3	676,352	17.8	-4.0	0.53

1/ Relative difference =

$$100 * \frac{\text{(commodity wtd. expansion - operational wtd. expansion)}}{\text{operational wtd. expansion}}$$

TABLE 2: Corn Stocks

State	Commodity weighted expansion (1000)	CV %	Operational weighted expansion (1000)	CV %	Relative dif. 1/ %	Sig. level
AZ	23	53.9	25	48.4	-8.8	0.59
CO	1,415	32.0	1,605	34.3	-11.8	0.68
DE	384	67.7	413	41.2	-7.2	0.78
ID	121	47.9	111	45.7	8.9	0.61
MD	2,782	17.0	2,741	16.0	1.5	0.84
MT	0	.	0	.	.	.
NJ	667	32.5	597	19.0	11.7	0.67
NM	1	78.1	1	70.1	-24.8	0.30
OR	143	80.6	159	71.8	-10.1	0.52
PA	16,693	17.5	13,982	13.1	19.4	0.13
SC	3,170	38.1	3,010	23.2	5.3	0.88
SD	11,313	21.5	10,463	19.8	8.1	0.43
UT	2	92.1	2	92.3	-17.2	0.28
WY	147	56.2	47	42.0	216.4	0.19
Total	36,860	11.0	33,156	8.9	11.2	0.12

1/ Relative difference =

$$100 * \frac{\text{(commodity wtd. expansion - operational wtd. expansion)}}{\text{operational wtd. expansion}}$$

TABLE 3: Soybean Stocks

State	Commodity weighted expansion (1000)	CV %	Operational weighted expansion (1000)	CV %	Relative dif. 1/ %	Sig. level
DE	222	65.3	202	51.6	9.5	0.73
MD	60	73.2	35	53.2	72.6	0.33
NJ	53	86.6	50	86.7	5.9	0.25
PA	33	58.8	33	54.6	-2.2	0.78
SC	996	96.8	342	68.8	190.9	0.38
SD	164	49.0	241	41.5	-32.2	0.31
Total	1,527	64.2	905	31.1	68.8	0.41

1/ Relative difference =

$$100 * \frac{\text{(commodity wtd. expansion - operational wtd. expansion)}}{\text{operational wtd. expansion}}$$

TABLE 4: All Wheat Stocks

State	Commodity weighted expansion (1000)	CV %	Operational weighted expansion (1000)	CV %	Relative dif. 1/ %	Sig. level
AZ	0	.	0	.	.	.
CO	2,248	57.1	2,222	40.6	1.1	0.97
ID	3,280	23.3	4,792	25.2	-31.5	0.14
MD	13	55.0	13	60.7	0.0	1.00
MT	9,839	19.1	9,743	21.9	1.0	0.94
NJ	3	69.4	4	79.1	-34.4	0.31
NM	72	42.4	417	71.0	-82.7	0.24
OR	212	67.0	519	61.0	-59.0	0.25
PA	71	39.1	80	36.5	-10.5	0.14
SC	92	49.8	96	38.7	-4.3	0.89
SD	2,940	26.3	2,615	23.4	12.4	0.57
UT	344	50.8	226	27.8	52.2	0.35
WY	370	53.6	322	55.8	14.9	0.62
Total	19,484	13.0	21,047	13.0	-7.4	0.42

1/ Relative difference =

$$100 * \frac{\text{(commodity wtd. expansion - operational wtd. expansion)}}{\text{operational wtd. expansion}}$$

TABLE 5: Grain Stock Capacity

State	Commodity weighted expansion (1000)	CV %	Operational weighted expansion (1000)	CV %	Relative dif. 1/ %	Sig. level
AZ	48	46.0	33	32.3	45.3	0.39
CO	40,863	22.3	51,591	24.0	-20.8	0.24
DE	1,780	43.5	2,117	37.3	-15.9	0.25
ID	37,017	15.6	37,055	15.5	-0.1	0.99
MD	19,124	19.2	17,257	17.9	10.8	0.06
MT	87,744	17.6	77,430	13.6	13.3	0.26
NJ	3,847	31.1	3,882	28.7	-0.9	0.94
NM	849	40.9	828	40.4	2.5	0.81
OR	9,261	30.8	9,790	27.8	-5.4	0.80
PA	57,076	9.3	53,610	9.4	6.5	0.23
SC	23,671	27.0	21,374	21.3	10.7	0.67
SD	56,718	13.3	54,793	11.8	3.5	0.60
UT	14,449	26.4	8,888	14.9	62.6	0.08
WY	9,280	27.3	7,867	29.5	18.0	0.25
Total	361,725	6.3	346,516	5.9	4.4	0.33

1/ Relative difference =

$$100 * \frac{\text{(commodity wtd. expansion - operational wtd. expansion)}}{\text{operational wtd. expansion}}$$

TABLE 6: Number of Farms

State	Commodity weighted expansion	CV %	Operational weighted expansion	CV %	Relative dif. 1/ %	Sig. level	RFO expansion	CV %	Relative dif. 2/
AZ	5,595	16.5	5,542	16.5	1.0	0.46	6,084	18.7	-8.0
CO	17,157	11.8	16,277	11.9	5.4	0.08	13,531	14.8	26.8
DE	1,908	13.2	1,882	13.2	1.4	0.70	1,653	17.3	15.4
ID	14,357	13.7	13,756	13.4	4.4	0.09	12,161	14.5	18.1
MD	9,982	7.1	9,235	7.3	8.1	<.01*	7,763	7.9	28.6
MT	12,823	19.0	11,899	18.7	7.8	0.06	10,298	20.8	24.5
NJ	4,372	8.0	4,148	7.8	5.4	0.01*	3,369	9.1	29.8
NM	5,640	19.1	5,538	19.1	1.8	0.43	4,300	22.0	31.2
OR	28,117	9.3	26,763	9.5	5.1	0.02*	25,197	9.9	11.6
PA	37,254	6.4	35,170	6.3	5.9	0.02*	32,606	7.1	14.3
SC	22,373	8.4	21,747	7.8	2.9	0.41	17,795	10.0	25.7
SD	8,797	10.9	8,714	10.3	1.0	0.81	6,589	16.9	33.5
UT	6,898	12.2	6,367	11.9	8.3	0.03*	4,122	14.4	67.3
WY	4,152	27.0	3,982	36.3	4.3	0.69	2,601	20.4	59.6
Total	179,425	3.3	171,018	3.3	4.9	<.01*	148,069	3.8	21.2

1/ Relative difference 1 =

$$100 * \frac{\text{(commodity weighted expansion - operational weighted expansion)}}{\text{operational weighted expansion}}$$

2/ Relative difference 2 =

$$100 * \frac{\text{(commodity wtd. expansion - RFO expansion)}}{\text{RFO expansion}}$$

* denotes differences that are significant at $\alpha = .05$.

TABLE 7: Land in Farms

State	Commodity weighted expansion (1000)	CV %	Operational tract expansion (1000)	CV %	Relative dif. 1/ %	Sig. level	RFO expansion	CV %	Relative dif. 2/ %
AZ	21,761	4.6	20,782	3.2	4.7	0.21	23,770	7.0	-8.5
CO	20,109	17.8	11,703	10.3	71.8	0.01*	6,790	24.1	196.2
DE	160	18.9	162	15.6	-0.8	0.93	134	32.3	19.5
ID	4,277	12.4	3,272	11.9	30.7	<.01*	2,718	17.1	57.3
MD	1,021	9.3	927	8.0	10.1	0.09	790	14.0	29.2
MT	17,776	30.5	12,309	14.7	44.4	0.26	10,902	39.9	63.1
NJ	337	10.5	301	8.7	12.0	0.06	224	15.0	50.2
NM	6,285	28.9	5,850	30.1	7.4	0.31	3,649	38.4	72.2
OR	10,464	40.3	5,377	22.8	94.6	0.18	5,246	23.2	99.5
PA	4,186	16.6	3,106	6.8	34.8	0.09	4,175	27.0	0.3
SC	3,361	16.1	2,684	8.3	25.2	0.17	2,330	31.4	44.2
SD	6,261	20.9	5,882	14.1	6.5	0.73	5,248	33.6	19.3
UT	2,639	30.7	1,175	25.4	124.6	0.02*	558	26.6	373.2
WY	8,058	32.1	5,172	23.2	55.8	0.22	2,051	46.3	292.8
Total	106,695	8.1	78,701	4.4	35.6	<.01*	68,586	8.5	55.6

1/ Relative difference 1 =

$$100 * \frac{\text{(commodity weighted expansion - operational tract expansion)}}{\text{operational tract expansion}}$$

2/ Relative difference 2 =

$$100 * \frac{\text{(commodity wtd. expansion - RFO expansion)}}{\text{RFO expansion}}$$

* denotes differences that are significant at $\alpha = .05$.