AN EVALUATION OF THE ANH LISTS IN WYOMING AS A SAMPLING FRAME FOR ESTIMATING LIVESTOCK INVENTORIES

by

Charles E. Caudill

and

Harold F. Huddleston

Research and Development Branch

Standards and Research Division

Statistical Reporting Service

July 1970

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For Estimating Livestock Inventories

This report provides considerably more detail on the value of the ANH list than the brief summary issues by the Research and Development Branch on the "Wyoming Multiple Frame Study" in December 1965.

I. Introduction:

The objectives of this study were:

(1) To evaluate as a sampling frame the list of livestock owners (ANH) in Wyoming compiled by personnel of the Animal Health Division, ARS in cooperation with the Wyoming Office of the Statistical Reporting Service.

(2) To investigate the use of multiple-frame surveys for livestock estimates.

II. The List:

The list of livestock owners was compiled in 1964 by the Agricultural Research Service in connection with animal disease control. The primary source for compiling the list was tax records obtained from the county assessor's office for each county in Wyoming. In addition to the name and address of each livestock owner, some supplementary information was included for each name. A geographic location (range, township, and section) and the number of animals by species (cattle, sheep, hogs, chickens, and horses) listed for tax purposes were recorded for each name. Also, for large operations in more than one county, cross-reference information was listed so that a unique headquarter could be determined for these operations. The entire list including name, address, and supplementary information was placed on punch cards in the Wyoming office of SRS. This enabled the use of ADP equipment in determining a unique headquarter for multiple unit operations and for removing duplication.

III. The Universe Covered by the List:

In order to evaluate the adequacy of the list as a sampling frame, one of the first steps was to determine the universe actually represented by the names contained in the list. An independent source of information needed to define this universe was the 1964 June Enumerative Survey in Wyoming.

Resident farm operators from the June 1964 Enumerative Survey were matched with names from the list. This provided an estimate of the population or universe, in terms of farm operators, livestock farms, and

livestock numbers, actually covered by the list. This comparison showed that the list contained about 83 percent of the farm operators in Wyoming and that these operators had about 93 percent of the cattle and 99 percent of the sheep inventories as of June 1, 1964. Results of this comparison by counties are shown in Table 1.

IV. Use of the List for Sampling:

(a) Phase I:

It was decided that a questionnaire was needed which would clearly define and locate the operation(s) of individuals selected from the list in terms of:

(i) Land operated

(ii) Livestock owned

(iii) Livestock located on land operated

A pilot study was completed in December 1964, to evaluate the content of the list and to test a proposed questionnaire. Two counties, Goshen and Platte, were selected for this study. The list for these two counties was divided into three groups based on subjective determinations concerning each name and address. Briefly, the groups were defined as follows:

Group A: This group contained:

(1) One or more headquarters listed under one name.

(2) One headquarter listed under two or more names.

Group B: This group contained all names with the following supplementary information available: "Livestock located on (some other) ranch or farm"

Group C: This group contained what appeared to be "multiple unit operations," two or more names with two or more headquarters, Companies, Corporations, etc.

Table 2 shows the total number of names on the list for Platte and Goshen Counties, the sample size for this study, rate of return by mail, the number of non-respondents interviewed, and the average acres operated.

Table 1.--Percent of all farms, livestock farms, cattle and sheep inventories from June 1964 Enumerative Survey, contained on ANH list

Counties	Percent of 1964 June farm operators included on ANH list	Percent of 1964 farm operators with livestock included on ANH list	Percent of cattle reported in June 1964 by operators included on ANH list	Percent of sheep reported in June 1964 by operators included on ANH list
Big Horn	65	65	82	98
Fremont	77	83	80	100
Hot Springs	100	100	100	100
Park	67	67	94	68
Washakie	100	100	100	100
Campbell	100	100	100	100
Crook	100	100	100	100
Johnson	100	100	100	100
Sheridan	100	100	100	100
Weston	---	---	---	---
Lincoln	93	92	99	97
Sublette	69	77	97	---
Teton	100	100	100	---
Uinta	50	50	74	84
Albany	85	78	96	---
Carbon	89	100	100	100
Natrona	100	100	100	100
Sweetwater	79	100	100	100
Converse	75	100	100	100
Goshen	74	82	62	100
Laramie	78	78	82	95
Niobrara	100	100	100	100
Platte	94	100	100	100
State	83	86	93	99

Table 2.--Results obtained from the December 1964 sample in Platte and Goshen Counties

Group	Number of names on list	Number selected in sample	Number returned by mail	Percent returned by mail	Number of non-respondents interviews	Averages acres operated
A	1,189	20	6	30.0	5	1,010
B	75	18	5	27.8	7	2,886
C	96	18	6	33.3	6	6,240
All	1,360	56	17	30.4	18	1,483

It appears, in terms of response rate by mail, that there was little difference between the three groups. The average number of acres operated appears to be quite different for the three groups; however, there was a large amount of variation within groups. The reported acres operated had a range from 0 to 2,970 for Group A; 0 to 14,000 for Group B; and 0 to 35,048 for Group C.

The questionnaire used for the study was designed primarily to obtain total acres operated. A series of questions concerning land owned, rented, managed, and operated in partnership with others, was used to determine total land operated or controlled by the person selected from the list. Livestock and acreage questions were then directed at obtaining data pertaining only to the total acres operated as determined by the questionnaire, i.e., if a respondent had zero acres operated, then by use of the questionnaire he had zero for all livestock and crop items even though he may have owned livestock. Results obtained by use of this questionnaire indicated that the mailed returns were adequately filled out and, from the enumerator evaluation sheets completed during the follow-up of non-respondents, it was apparent that the section on land operated was generally understood by the respondent.

Based on the preliminary test of the questionnaire some revisions were made. These changes were mainly concerned with getting livestock reported by location and by owner. This revised questionnaire was used to interview about 40 respondents during January 1965 in Niobrara and Carbon Counties. Results indicated that the revisions were unnecessary from a practical viewpoint, i. e., the additional data collected did little toward improving the overall accuracy. Consequently, for later studies the questionnaire was designed to obtain number of livestock actually present on the "acres operated" at the time of the interview, regardless of ownership.

These preliminary studies, although limited to a few counties, helped to isolate deficiencies in the list. For example, some of the less obvious types of duplication became apparent, for example a hired man who owned livestock would sometimes be listed under his employer's name as well as his own. Also, these studies indicated that the list contained names of persons who were only remotely associated with agriculture, such as absentee land owners and people with street addresses in some city who paid taxes only on a few horses. It was possible to improve the efficiency of the list by removing from the list many of these names which in effect were "zero agriculture" units using the land operated approach to define the sampling unit.

(b) Phase 2: Use of List to Define Area Sampling Units and for Multiple-Frame Sampling:

Two other studies concerning this list were completed in conjunction with the 1965 June Enumerative Survey. One of these studies was designed to investigate the use of the list in defining sampling units from the area frame, while the other was designed to investigate the joint use of the list and the area frame.

The study to define area sampling units based on the list was possible since a geographic location of the farm or ranch headquarters associated with each name was included as part of the list. Names included in the list with no location given were assigned random coordinates within the county where listed. These headquarters locations (range, township, section) were plotted on county highway maps for seven counties: Campbell, Converse, Crook, Johnson, Niobrara, Sheridan, and Weston. Within these counties "Count Units" were then established in the range stratum by delineating contiguous areas containing 6 to 24 headquarters. Roads, railroads, rivers, and trails, as shown on the county highway maps were generally used as boundaries for these count

units. Count units were established and numbered beginning in the northeastern corner of each county and continuing in a serpentine manner until the entire county was covered. After constructing the count units, they were assigned one sampling unit for each pair of headquarters in the count unit. A total of 40 of these sampling units were selected to be enumerated. Using a random start and systematic selection, the count units containing the sample segment were determined. Then, all segments within the "selected" count unit were delineated and numbered, with one chosen at random to be enumerated.

For the cultivated stratum, the regular June Enumerative Survey segments were used as random locations and "new" sampling units were constructed around these segments based on the control information (number of headquarters) from the list. A total of 24 "special" segments were constructed in this manner for the cultivated stratum.

Segments for this study in both the cultivated and range stratum were constructed to contain about two of the headquarters locations from the list frame. The headquarters preassigned to each segment were enumerated by the open segment concept, i.e., each respondent was asked for livestock numbers located on his entire operation. Additional farm or ranch headquarters found in the segment were also enumerated and were included in the segment total if they were not found on the list. This procedure was used to estimate the universe covered by the list in the seven counties used for this study. These estimates in terms of headquarters, livestock farms, number of cattle, and number of sheep are shown in Table 3. For the seven counties, the list was estimated to be four to five percent incomplete in terms of farms and only one to two percent incomplete in terms of livestock numbers.

Results of this study, in terms of estimates of totals and coefficients of variation are shown in Table 4, with comparisons from the June Enumerative Survey in the same seven counties. Estimates for cattle items are somewhat more precise than those obtained from the June Enumerative Survey for the same counties; however, sheep items are generally less precise for the special survey than for the June Enumerative Survey. Only for the estimated number of farm operators and hens and pullets of laying age is there a significant gain in precision from the special survey. This was expected since the segment size was controlled by allowing only about two known headquarters to be located in each segment. It was hoped that this procedure would also produce more presiee estimates for livestock items, however, based on results of this study, gains in precision are not great enough to justify the higher costs of this procedure

in selecting the sample. Also, segments constructed in this manner could not be used very efficiently to collect data for crops.

Table 3.--Sample size and estimated coverage of **A.N.H.** lists in Campbell, Converse, Crook, Johnson, Niobrara, Sheridan, and Weston Counties, Wyoming

Stratum	Number of segments	Headquarters		Percent of universe covered in terms of:			
		Assigned	Enumerated	Headquarters	Livestock farms	Number of cattle	Number of sheep
				Percent			
Cultivated	24	43	45	95.6	94.8	99.9	100.0
Range	40	79	82	96.3	95.0	97.8	98.5
Total	64	122	127	96.2	95.0	98.3	98.6

The multiple-frame study was done on a State-wide basis in conjunction with the 1965 June Enumerative Survey. The primary purposes were to gain experience in the use of multiple frame surveys and to complete the evaluation of the A.N.H. list when used as a sampling frame to collect agricultural data.

The list frame was divided into five strata based on the supplementary information plus a list of "extreme operators" already compiled by the Wyoming office. Operators having more than 5,000 sheep and/or more than 1,500 cattle were arbitrarily classified as "extreme". The five strata for the list frame were: (1) extreme operators which were sampled 100 percent (9,000 or more sheep, and/or 4,650 or more cattle), (2) extreme operators (5,000 or more but less than 9,000 sheep, 1,500 or more but less than 4,650 cattle), (3) known sheep operations (operators who paid tax on sheep in 1963), (4) other livestock operations (no sheep listed for taxation in 1963), and (5) other operations included in the list (taxes paid on land and/or horses only in 1963).

Table 4.--Estimates from 1965 special area survey in Campbell, Crook, Converse, Johnson, Niobrara, Sheridan and Weston County, Wyoming with comparisons from regular June Enumerative Survey 1/

Item	Special area survey 2/		June Enumerative Survey 3/	
	Estimated total	Coefficient of variation	Estimated total 4/	Coefficient of variation
	(000)	(Percent)	(000)	(Percent)
All cattle	485	14.9	(283) 382	(27.9) 17.2
Cows & heifers 2+	198	15.6	165	21.8
Heifers & heifer calves 2-	149	17.2	100	18.5
Bulls & steers	138	14.7	117	20.8
Calf crop (1965)	183	16.2	171	25.0
All sheep & lambs	804	32.6	(950) 635	(48.1) 27.0
Breeding ewes 2+	428	33.1	---	----
Lambs dropped since Oct. 1, 1964	349	31.3	354	32.4
All hogs & pigs	8	56.0	8	45.6
Hogs & pigs kept for breeding	1	60.4	1	51.0
Other hogs & pigs	7	55.4	7	44.9
Hens & pullets of laying age	44	19.4	19	29.5
Farm operators 5/	2,340	8.0	1,520	21.7

1/ Excludes extreme operators
2/ Sample size = 64
3/ Sample size = 51
4/ Numbers in parenthesis based on open segment expansion
5/ Whole numbers

A sample of 214 names, including 86 extreme operators, was selected from the list to be enumerated by mail or personal interview. The extreme operators were enumerated for the regular June Enumerative Survey and the results were combined with estimates for the remainder of the list. The questionnaire design used for this study was based on the previous experience using the list as a sampling frame. Basically, the same series of questions was used to obtain land operated with the livestock questions related to all livestock, regardless of ownership, located on the acres operated.

Excluding the extreme operators, a sample of 128 names was selected from the list for enumeration. Since some of the people selected were being enumerated for the June Enumerative Survey, the questionnaire was mailed to only 117 of this group on May 25. On May 28, reminder calls were made to 39 of the non-respondents to explain the purpose of the survey and to ask them to complete the questionnaire and return it by mail. A total of 35 questionnaires were returned by mail. All non-respondents were enumerated by personal interview except for six who refused to answer any questions.

Estimates for the list frame (excluding extreme operators) were computed from this sample and are shown by strata in Table 5 with their coefficients of variation expressed as a percent. Stratum I, as shown in Table 5, was composed of known sheep operations, Stratum II was composed of known cattle and/or hog operations, and Stratum II was composed of all remaining names on the list. This stratification was fairly effective, in that practically all of the sheep were estimated in Stratum I, most of the cattle in Stratum II, with Stratum III contributing very little to the estimates for any of the characteristics.

Table 6 contains estimates for the list frame and extreme operators as well as the combination of these estimates for those items which were comparable on the questionnaire used for the list and the extreme operator questionnaires. These estimates compare very favorably with estimates from the June Enumerative Survey. Precision of these estimates is quite good when one considers the small sample size used to generate the estimates.

To estimate incompleteness of the list as of June 1, 1965, resident farm operators from the June Enumerative Survey were matched with names from the list. Reported data for unmatched operators was expanded to an estimated number of cattle, sheep, and hogs for farms not included on the list.

Table 5a--Estimates of totals and coefficients of variation by strata from 1965 survey of livestock owners on ANH list in Wyoming

Item	Stratum I		Stratum II		Stratum III		Estimates for list frame 1/	
	Estimated total	Coefficient of variation	Estimated total	Coefficient of variation	Estimated total	Coefficient of variation	Estimated total	Coefficient of variation
	(000)	(Percent)	(000)	(Percent)	(000)	(Percent)	(000)	(Percent)
Land operated (acres)	3,434	26.2	13,644	23.4	36	33.3	17,114	19.3
All cattle & calves	179	23.7	1,063	23.7	1	100.0	1,243	20.5
Cows & heifers two years old & over	87	24.6	479	24.1	--	----	566	20.7
Heifers & heifer calves under two years old	41	25.2	326	32.5	1	100.0	368	23.0
Bulls & steers	51	28.1	258	22.3	--	----	309	19.2
Calves born since Jan. 1	58	25.0	361	27.0	--	----	419	23.6
Cows & heifers to calve between now & Dec. 31	14	38.5	45	22.0	--	----	59	19.1
All milk cows	7	58.1	8	22.5	--	----	15	29.3
Cows milked during May	4	59.9	6	26.5	--	----	10	29.4
Cows milked yesterday	4	62.3	6	26.7	--	----	10	30.8
Milk produced yesterday (Lbs.)	142	74.6	122	33.7	--	----	264	43.1

1/ Excludes "Extreme Operators".

Table 5b.--Estimates of totals and coefficients of variation by strata from 1965 survey of livestock owners on ANH list in Wyoming

Item	Stratum I		Stratum II		Stratum III		Estimates for list frame 1/	
	Estimated total	Coefficient of variation	Estimated total	Coefficient of variation	Estimated total	Coefficient of variation	Estimated total	Coefficient of variation
	(000)	(Percent)	(000)	(Percent)	(000)	(Percent)	(000)	(Percent)
All sheep & lambs	1,023	25.9	85	44.3	--	----	1,108	24.2
Ewes two years old and over	488	27.1	40	46.8	--	----	528	25.3
Lambs dropped since Oct. 1, 1964	474	25.9	40	46.3	--	----	514	24.1
Ewes expected to lamb between now and Sept. 30	11	38.3	--	----	--	----	11	38.1
Ewes lost or died since Jan. 1	34	40.9	3	37.9	--	----	37	38.1
All hogs & pigs	2	87.3	19	40.1	--	----	21	37.3
Hogs & pigs kept for breeding	--	----	3	42.6	--	----	3	39.5
Other hogs & pigs	2	85.1	16	41.0	--	----	18	38.1
Hens & pullets of laying age	46	26.3	95	35.9	2	100.0	141	25.4
Pullets & pullet chicks not of laying age	5	73.7	65	39.2	--	----	70	36.8

1/ Excludes "Extreme Operators".

Table 6.--Estimates of totals and coefficients of variation based on 1965 ANH list sample and extreme operators enumerated in Wyoming

Item	Estimates for list frame		Sampled extreme operators		Total for enumerated extreme operators	Estimates for list frame including extreme operators 1/	
	Estimated total	Coefficient of variation	Estimated total	Coefficient of variation		Estimated total	Coefficient of variation
	(000)	(Percent)	(000)	(Percent)	(000)	(000)	(Percent)
All cattle & calves	1,243	20.5	200	18.2	62	1,505	17.2
Cows & heifers two years old and over	566	20.7	94	18.5	24	684	17.3
Heifers & heifer calves under two years old	368	23.0	48	18.6	14	430	19.8
Bulls & steers	309	19.2	58	22.9	24	391	15.5
Calves born since Jan. 1	419	23.6	71	18.6	16	507	19.6
Cows & heifers to calve between now & Dec. 31	59	19.1	6	34.6	1	66	17.4
All milk cows	15	29.3	---	----	--	15	29.3
All sheep & lambs	1,108	24.2	550	18.1	632	2,290	12.5
Lambs dropped since Oct. 1, 1964	514	24.1	218	19.3	270	1,002	13.1

1/ Represents estimates of State totals, if incompleteness of list frame is ignored. (See Table 7)

Table 7.--Estimates of state totals and coefficients of variation from 1965 ANH list sample with incompleteness based on 1965 June Enumerative Survey

Item	Estimates for list frame including extreme operators		Estimates for livestock farms not included on list 1/		Estimates for state	
	Estimated total	Coefficient of variation	Estimated total	Coefficient of variation	Estimated total	Coefficient of variation
	(000)	(Percent)	(000)	(Percent)	(000)	(Percent)
All cattle & calves	1,505	17.2	81	38.2	1,586	16.4
All sheep & lambs	2,290	12.5	164	77.6	2,454	12.7
All hogs & pigs	21	37.3	5	43.5	26	31.5

1/ Based on livestock enumerated for June 1965 survey on farms not included on ANH list.

These estimates are shown in Table 7. Combining these estimates with the estimates for the list frame gives unbiased state estimates which are also shown in Table 7.

Date collected for this study and for the June Enumerative Survey were used to investigate a "multiple frame" approach for making livestock estimates in Wyoming. "Multiple frame" survey refers to the simultaneous use of more than one sampling frame for collecting sample data. Results of this study indicate that a multiple frame estimator is significantly more efficient than the direct expansion estimator for samples selected only from the area frame. A "screening" estimator, where the area frame is used only to estimate that portion of the total not included in the list frame, was also studied. The State estimates shown in Table 7 are based on the "screening" estimator. Since the cost of "screening", i.e., enumerating everyone in an area segment who is not on the list, is not much less than the cost for completely enumerating area sampling units, a multiple frame estimator will generally be more efficient than a "screening" estimator.

A comparison of estimates of cattle, sheep, and hog inventories for the direct expansion, screening, and multiple frame estimators is shown in Table 8 along with their coefficients of variation. The direct expansion involves only segment data from the area sample expanded by the reciprocal of the sampling rate, i.e., the estimated totals were computed as follows:

$$\hat{T}_i = \sum_{j=1}^{n} \frac{X_{ij}}{P_j}$$

where $\hat{T}_i$ = Estimated total for the i^{th} characteristic.

P_j = Probability of selection of the j^{th} sampling unit.

and X_{ij} = The j^{th} segment total for the i^{th} characteristic.

The "screening" estimator and the multiple frame estimator combines data from both the area and the list frame in computing the estimated totals. The "screening" estimator combines the estimated total for the list frame with an estimate of the portion not included in the list from the area frame, while the multiple frame estimator optimally combines all data collected from both frames. The multiple frame estimate was computed as follows:

$$\hat{T} = \hat{T}_a + p\,\hat{T}'_{a1} + q\,\hat{T}''_{a1}$$

where, $\hat{T}_a$ = The estimated total for the portion of the population included only in the area frame.

$\hat{T}_{a1}$ = The estimated total for the population included in both frames computed from the area sample.

$\hat{T}''_{a1}$ = The estimated total for the population included in both frames computed from the list sample.

and $p + q = 1$

The "screening" estimator has the same form as the multiple frame estimator with $p = 0$ and $q = 1$.

Table 8.--Estimates of livestock inventories from 1965 Wyoming multiple frame survey

Item	Direct expansion		Screening estimator		Multiple frame estimator	
	Estimate	Coefficient of variation	Estimate	Coefficient of variation	Estimate	Coefficient of variation
	(000)	(Percent)	(000)	(Percent)	(000)	(Percent)
All cattle	1,209	15.7	1,586	16.4	1,335	11.6
All sheep	2,893	31.0	2,454	12.7	2,503	13.0
All hogs & pigs	45	32.7	26	31.5	30	24.1

Table 8(a).--Estimates of livestock inventories based on open segment expansion from 1965 Wyoming multiple frame survey

Item	Direct expansion		Screening estimator		Multiple frame estimator	
	Estimate	Coefficient of Variation	Estimate	Coefficient of variation	Estimate	Coefficient of variation
	(000)	(Percent)	(000)	(Percent)	(000)	(Percent)
All cattle	1,209	15.7	1,586	16.4	1,335	11.6
All sheep	2,893	31.0	2,454	12.7	2,503	13.0
All hogs & pigs	45	32.7	26	31.5	30	24.1

Table 8(b).--Estimates of livestock inventories based on closed segment expansions from 1965 Wyoming multiple frame survey

Item	Direct expansion		Screening estimator		Multiple frame estimator	
	Estimate	Coefficient of variation	Estimate	Coefficient of variation	Estimate	Coefficient of variation
	(000)	(Percent)	(000)	(Percent)	(000)	(Percent)
All cattle	1,691	10.7	1,653	15.8	1,726	10.5
All sheep	3,036	33.3	2,476	12.0	3,336	10.8
All hogs & pigs	47	31.6	26	31.1	46	31.8

The weights (p, q) used for combining the two independent estimates of the total for that portion of the population contained in both frames were based on the inverse variances. If W_A and W_L are the inverse variance of the two estimates (T'_{a1} and T''_{a1}) then

$$p = \frac{W_A}{W_A + W_L}$$

and $q = 1 - p$

The actual weights used for computing the multiple frame estimates in Table 8 are listed in Table 9. Also, in Table 9 are optimum weights (p*, q*) for the case of simple random sampling from these frames, along with the cost and variance ratios used to compute the optimum weights. These optimum weights can be used to determine the optimum sample sizes for each frame for a given total cost or for a specified level for precision

Table 9.--Weights used for computing the multiple frame estimates in Table 8, and estimates of cost and variance ratios from 1965 Wyoming multiple frame study

Item	p	q	C_A/C_L	S_a^2/S_{a1}^2	p*	q*
All cattle	.658	.342	5	.281	.101	.899
All sheep	.113	.887	5	.759	.166	.834
All hogs & pigs	.219	.781	5	.131	.069	.931

The values of p* were computed from the following formula derived by Hartley[1],

$$p^* = \sqrt{\frac{\phi\ (1 - a)}{r - a}}$$

where $\phi = S_a^2 / S_{a1}^2$; $r = C_A / C_L$; $a = .85$

and S_a^2, S_{a1}^2 are the estimated "within domain" variances,

C_A = The cost of enumerating sampled units from the area frame.

C_L = The cost of enumerating sampled units from the list frame.

a = The fraction of total farms included in the list.

V. Conclusions and Recommendations:

Based on results from this study it appears that significant gains in efficiency for livestock estimates can be achieved by using the ANH List as a sampling frame in combination with the area frame. In order to use the list as a sampling frame over an extended time period, some effort will be required to maintain and keep the list up-to-date. (Corrections and additions have been made by ARS personnel since the 1965 Multiple Frame Study.) Some additional work to remove duplication and to eliminate as many as possible of the "Zero Agriculture" units would also improve the efficiency of the list. These minor deficiencies are not very serious and can be compensated for even if they are not corrected before samples are selected from the list. (The Wyoming Office has already started to correct these deficiencies.)

Based on the comparisons with the 1964 and 1965 June Enumerative Surveys, it appears that the ANH List in Wyoming is about as complete as one could ever hope for in terms of livestock farms and numbers except for hogs and pigs. Some improvement in the coverage of the list would be desirable if the primary concern was to make estimates of hogs and pigs. It is felt that the 15 percent of the farm operators not included in the list might have considerably more than 15 percent of the total hogs in Wyoming.

This study showed that a fairly complex questionnaire can be adequately completed and returned by mail. While it appears to be necessary to use several probing type questions to obtain total land operated for the small and medium operators, it may not be too important to use this approach for extreme operators in Wyoming. The major concern in

enumerating extreme operators should probably be to obtain names of owner(s), manager(s), and possible farm or ranch name, so that duplication of data can be avoided.

It is recommended for future livestock surveys in Wyoming that a multiple frame approach be seriously considered. The ANH List is deemed a completely adequate sampling frame for use in conjunction with the general purpose area frame. Optimum use of the list and area frames will yield livestock estimates with very small sampling errors, e.g., for the same total cost sampling errors for the June Enumerative Survey can be greatly reduced for livestock items by reallocating part of the resources from the area sample to be used for sampling the list.