

FRAME CONSTRUCTION BY THE  
SNOWBALLING METHOD AND  
ITS EVALUATION

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by

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CONTENTS

Section		Page
I	Introduction . . . . .	1
II	Numbers of names obtained in the snowball process . . . . .	3
III	Members of population and number missed in snowball process . . .	12
IV	Comparison of assessor lists with snowball lists . . . . .	20
V	Comparison of June enumerative survey with snowball lists . . . .	25
VI	Summary and conclusions . . . . .	26
	Appendixes: Miscellaneous data from interviews with producers in the four states Questionnaires and field forms	

Frame construction by the "snowballing" method and its evaluation

Section I. Introduction

In applied sampling it may be very important to have a substantially complete list of the target population, i.e., the sample "frame". When such a list is not available, the following procedure (sometimes referred to as "snowballing") may be utilized. This procedure is most applicable in sampling for enterprises where heavy clustering is observed and a small percentage (say less than 10%) of the sampling units (farms) have a particular enterprise, e.g., turkeys, sorghum, bees, etc. Otherwise, area sampling techniques or the rural route scheme may be employed.

The general procedure for obtaining a list for some enterprises will now be presented. It is assumed that a partial list consisting of  $M$  individuals (hopefully, members of the target population) is readily available. For example, in the case of turkey raisers, the partial list might consist of subscribers (in a specified area) to a trade periodical for turkey raisers. For sorghum growers a list might be obtained from the state assessors census.

Some or all of the  $M$  individuals are then interviewed. If it is known that the partial list represents about 35% (or more) of the population, then perhaps interviewing 50% of the  $M$  individuals, chosen randomly, might yield a fairly complete list. If the partial list represents somewhat less than 35% of the population, one should probably interview most or all of the individuals in the partial list.

Those interviewed are asked to provide names of other individuals whom they believe are involved in the enterprise under investigation. Duplication with the original  $M$  individuals is removed leaving  $n_1$ , say, new list members from the first round. The new members are then interviewed and asked to provide the names of individuals they know that are involved in the enterprise under investigation. Duplication with the  $n_1$  individuals as well as the original  $M$  individuals is removed leaving  $n_2$  new list members from the second round. This "snowballing" process could be carried out for  $k(>2)$  rounds. This may be feasible when the partial list represents a small percentage of the

population; otherwise, two rounds might be sufficient. The estimate of the number of individuals in the population is

$$(1) \quad \hat{N} = M + \sum_{i=1}^k n_i - x$$

where  $x$  denotes those individuals which were incorrectly designated (by persons interviewed) as list members. The individuals corresponding to the " $x$ " term should not be removed until the process is terminated because the "nonmembership" of an individual does not necessarily preclude his contributing names to the process.

The various steps in the snowballing scheme were carried out for three different farm items in four states in 1968 and the results obtained are presented in Section II. These items are beekeepers in East Tennessee and Southwest Oklahoma, Christmas trees in Northwestern Illinois and apple growers in West Central and Northwestern New Mexico. Data collected in Iowa in 1966 for turkeys and sorghum are presented in this section of the report (having previously been reported upon in 1967) in order to provide background for an analysis of the concordance of snowball lists with those of a complete census. The data for the latter two items are given here in a slightly different form than in 1967; mainly we have confined the list to the whole counties indicated in the appendix whereas in 1967 we included some area surrounding the basic counties.

In addition to presenting the data by starter list subsample and interviewing round as was done in a previous report, we have made an effort to estimate, from data inherent in the snowball scheme, the total number of producers of a product within chosen areas. We have estimated the number of producers "missed" in the snowball process. These can be added to the starter list names and the "new" names (found in rounds after the starter list round) to form an estimated total list of names of producers in the population (see Section III).

Also in this report we give the results of a comparison of turkey and sorghum grower names on the snowball lists with assessors lists for the year 1965. In addition to comparing names we have also compared sizes of operations

(means) as given by the assessors and in the snowball process. This step is an important start in attempting to learn about possible differences in snowball lists (which will be incomplete) with census or population lists. If it can be demonstrated over a period of time that means and distributions of missed producers do not vary substantially from the means and distributions of complete populations and, if an adequate estimate of totals can be made by use of the snowball scheme it might be feasible to make estimates from data gathered from persons on snowball lists considered as a "random" sample of a known population.

## Section II. Numbers of names obtained in snowball process

The following presentation is given by farm item. The primary purpose of this section is to illustrate how many potential producers can be generated by this scheme. Section III will give the number of potential producers who are actual producers. In this section, (II) we will also give comparisons of the number of names generated by subsamples of the starter list in order to determine whether it is necessary to use the entire starter list. Unless otherwise specified, all names on the original or starter list were located inside the specified area.

### A. Apple producers in New Mexico

The starter list of apple producers in Western New Mexico was obtained from the New Mexico state office. It consisted of 245 persons thought to produce apples and who lived inside the target area. Questionnaires were sent to these persons. After three mailings 52 had responded. These 52 persons supplied information on their own operations and listed other persons they knew who had apple trees. Duplications of names on these new lists with the original 245 were removed leaving 84 unduplicated names. These 84 were personally visited; they gave 66 more new names. The 66 were then visited and resulted in 9 additional names. The total

$$N = 245 + 84 + 66 + 9 = 404$$

is an estimate of the number of apple growers produced by the 52 persons who answered by mail.

In order to learn how large the sample had to be in order to obtain a "complete" list we divided the 193 non-respondents to the mail questionnaires into three random parts of about equal size. The 65 members of Group II were interviewed and data on their operations and names of other apple tree growers were requested. Duplicates with the starter list were removed leaving 165 new names. This process was repeated for the other groups in a similar way. The results are given in Table 1. The table contains the number of "new" members at the end of a particular interviewing round. There are duplicates from group to group so these numbers cannot be checked against the figures on page 5.

Table 1. The four individual groups

Group	I	II	III	IV
Starter list	52	65	64	64
1st round	84	165	131	133
2nd round	66	77	109	97
3rd round	9	18	19	17

The four groups, individually, yield the following estimates of the population.

$$N_1 = 245 + 84 + 66 + 9 = 404$$

$$N_2 = 245 + 165 + 77 + 18 = 505$$

$$N_3 = 245 + 131 + 109 + 19 = 504$$

$$N_4 = 245 + 133 + 97 + 17 = 492$$

The estimates are about the same for all groups, taking into account that the starter list for group I is smaller than the other groups.

The information in Table 1 was pooled, first groups I and II, then I, II and III and finally all four groups. The results are given in Table 2. Duplicates in rounds 1 and 2 were removed from the list of "new" names to form the total of 229 in this table. Thus  $84 + 165 = 249$  from Table 1 does

not equal 229 and it is concluded that there were 20 duplicated names in rounds 1 and 2 when taken separately. This procedure was also followed when combining rounds 1, 2 and 3 and all other rounds and groupings.

Table 2. The pooled results

Group	I & II	I, II & III	I, II, III & IV
Starter list	117	181	245
1st round	229	321	391
2nd round	116	203	228
3rd round	18	25	34

The estimates for the pooled groups are

$$I + II = 245 + 229 + 116 + 18 = 608$$

$$I + II + III = 245 + 321 + 203 + 25 = 794$$

$$I + II + III + IV = 245 + 391 + 228 + 34 = 898$$

The gain from using successively larger groups is substantial leading to the conclusions that all 245 of the starter list should be used in order to benefit from the larger number of names brought in.

The number of actual population members (out of the 898 names) is given in Section III. The number of producers is only 68.7% ( $617 \div 898 \times 100$ ) of the total names generated.

United State census numbers of farmers having apple trees is not available due to the way the screening question is asked in the census. If a farmer has less than 20 fruit and nut trees or grapevines, he is not required to complete the question in the census.

#### B. Christmas tree growers in Illinois

The procedure followed in summarizing data collected is the same as for apple tree growers. A questionnaire and listing sheet (see appendix) was mailed to each of the 243 names on the starter list. Of these 243 names, 188 were actually located within the target area - 55 located near the target area. Seventy-four responded. These constitute the starter list for group I. The

names supplied by the 74 respondents were checked against the original 243 and after eliminating duplicates, 33 new names lying within the target area remained.\* These persons were interviewed personally. The names they gave were checked against the starter list and the 33 new names and duplicates removed, leaving 8 new names in the target area. A third round yielded only 1 new name. The total  $N_1 = 188 + 33 + 8 + 1 = 230$  is an estimate of tree growers in the area under study.

As with apple growers, three random equal sized groups were formed out of the  $188 - 74 = 114$  nonrespondents. Group II gave 28 new names in the 1st round interviewing, 23 in the second and none in the third. The same process was carried out for Groups III & IV. The results are summarized in Table 3.

Table 3. The four individual groups

Group	I	II	III	IV
Starter list	59	43	43	43
1st round	33	28	30	31
2nd round	8	23	15	24
3rd round	1	0	1	4

The four groups taken individually yield the following estimates of the population.

$$N_1 = 188 + 33 + 8 + 1 = 230$$

$$N_2 = 188 + 28 + 23 + 0 = 239$$

$$N_3 = 188 + 30 + 15 + 1 = 234$$

$$N_4 = 188 + 31 + 24 + 4 = 247$$

The differences among groups seem to be within sampling error, and the hypothesis of no difference is borne out.

\* The names among the 74 which lived outside the target area numbered 15. These names were used to produce some part of the 33 "new" names inside the target area. Thereafter names outside the target area were not used. Notice also that the 15 names are dropped from the group I starter list since we are making estimates only for the target area. The same process was performed for groups II, III and IV.



The information in Table 3 was pooled, first groups I & II, then I, II & III, and finally all four groups. The results are in Table 4.

Table 4. The pooled results

Group	I & II	I, II & III	I, II, III & IV
Starter list	102	145	188
1st round	58	82	104
2nd round	27	41	68
3rd round	1	2	2

The pooled results yield the following estimates of the population.

$$I \text{ \& \; II} = 188 + 58 + 27 + 1 = 274$$

$$I, II \text{ \& \; III} = 188 + 82 + 41 + 2 = 313$$

$$I, II, III \text{ \& \; IV} = 188 + 104 + 68 + 2 = 362$$

The gains in combining groups appear to be enough to use the entire starting list.

### C. Beekeepers in Oklahoma

The beekeeper population in Oklahoma was all persons having bee-hives in an area of Oklahoma outlined on the county map appended. Names on the starter list were obtained from the Oklahoma state office. There are 128, all inside the target area.

The same procedure was followed in summarizing data for Oklahoma. Twenty-eight persons responded by mail out of 128. These 28 people gave 37 new names; the 37 gave 13 and the 13 gave 2 new names. These together constitute Group I. All duplications were removed so that  $N_1 = 128 + 37 + 13 + 2 = 180$ , an estimate of the population of beekeepers. Three random groups of equal size were formed for the 100 non-respondents to the mail request. Table 5 summarizes the result and is to be read in the same way as Table 1.

Table 5. The four individual groups

Group	I	II	III	IV
Starter list	28	34	33	33
1st round	37	21	44	26
2nd round	13	9	10	6
3rd round	2	0	0	0

The four groups taken individually yield the following estimates.

$$N_1 = 128 + 37 + 13 + 2 = 180$$

$$N_2 = 128 + 21 + 9 + 0 = 158$$

$$N_3 = 128 + 44 + 10 + 0 = 182$$

$$N_4 = 128 + 26 + 6 + 0 = 160$$

The groups are close enough to say there is no significant difference in the numbers.

The information in Table 5 was pooled as before. The results are in Table 6.

Table 6. The pooled results

Group	I & II	I, II, & III	I, II, III & IV
Starter list	62	95	128
1st round	60	85	105
2nd round	21	28	24
3rd round	2	2	2

Groups I & II combined yield the estimate  $128 + 60 + 21 + 2 = 191$ . Groups I, II and III give  $128 + 85 + 28 + 2 = 243$  and all groups give  $128 + 105 + 24 + 2 = 259$ . The first grouping is considerably short of the other two groupings. It would seem best in this case to utilize the full starter list.

The number of producers out of the 259 names yielded by the snowball process is given in Section III.

#### D. Beekeepers in Tennessee

The beekeeper population in Tennessee is indicated by the map in the appendix. Names on the starter list were obtained from the Tennessee state office of the Statistical Reporting Service. There were 219 in the area.

The data were treated as described before. The members of the first group were respondents to the mail questionnaire, the other three groups are nonrespondents divided into equal groups at random.

Table 7. The four individual groups

Group	I	II	III	IV
Starter list	91	43	42	43
1st round	211	80	48	71
2nd round	264	120	46	57
3rd round	246	144	37	49

The four groups taken individually yield the following estimates.

$$N_1 = 219 + 211 + 264 + 246 = 940$$

$$N_2 = 219 + 80 + 120 + 144 = 563$$

$$N_3 = 219 + 48 + 46 + 37 = 350$$

$$N_4 = 219 + 71 + 57 + 49 = 396$$

Even taking into account that the starter group for Group I is about double the other three, the groups yield quite different results in this state. Perhaps the difference may stem from the fact that the population is quite large and larger differences are possible. In any event the residual in round 3 is so large that at least one more interviewing round should have been performed.

In Table 8 we summarize the results of Table 7 by pooling Groups I & II, then I, II & III and, finally, all four groups.

Table 8. The pooled results

Group	I & II	I, II & III	I, II, III & IV
Starter list	134	176	219
1st round	291	333	391
2nd round	373	405	454
3rd round	379	406	436

Groups I & II yield  $219 + 291 + 373 + 379 = 1262$

I, II & III yield  $219 + 333 + 405 + 406 = 1363$

I, II, III & IV yield  $219 + 391 + 454 + 436 = 1500$

Differences in number of "new" names obtained and number of beekeepers may be learned from Section III. In this case there is a much larger percent of producers than for other products.

#### E. Turkeys, Iowa

Data for turkey producers was presented in a previous report with the difference that the name list included parts of counties surrounding the basic counties while this data includes only names for basic counties. Data will be given for Groups I through IV first and then for the usual pooled groups.

Table 9. The four individual groups

Group	I	II	III	IV
Starter list	23	22	22	21
1st round	34	37	43	27
2nd round	26	33	29	35

The estimates are:

$$N_1 = 88 + 34 + 26 = 148$$

$$N_2 = 88 + 37 + 33 = 158$$

$$N_3 = 88 + 43 + 29 = 160$$

$$N_4 = 88 + 27 + 35 = 150$$

The pooled results are:

Table 10. The pooled results

Group	I & II	I, II & III	I, II, III & IV
Starter list	45	67	88
1st round	55	61	68
2nd round	29	42	49

The estimates are:

$$\text{Groups I \& II} = 88 + 55 + 29 = 172$$

$$\text{Groups I, II, and III} = 88 + 61 + 42 = 191$$

$$\text{Groups I, II, III \& IV} = 88 + 68 + 49 = 205$$

#### F. Sorghum growers, Iowa

The data by group are given below

Table 11. The individual groups

Group	I	II	III	IV
Starter list	15	18	17	18
1st round	56	30	25	23
2nd round	12	5	6	3

The estimates are:

$$N_1 = 68 + 56 + 12 = 136$$

$$N_2 = 68 + 30 + 5 = 103$$

$$N_3 = 68 + 25 + 6 = 99$$

$$N_4 = 68 + 23 + 3 = 94$$

The pooled results are:

Table 12. The pooled results

Group	I & II	I, II & III	I, II, III & IV
Starter list	33	50	68
1st round	70	87	94
2nd round	16	20	21

The estimates are:

$$\text{Groups I \& II} = 68 + 70 + 16 = 154$$

$$\text{Groups I, II \& III} = 68 + 87 + 20 = 175$$

$$\text{Groups I, II, III \& IV} = 68 + 94 + 21 = 183$$

It is possible to arrive at some conclusions based on the above data. Since the purpose of the snowballing scheme is to generate as large a list as possible, or more desirable, the entire list, it appears that the entire starter list should be used. This is indicated by the pooled results. With the exception of Tennessee bees, the third round resulted in only a small number of new names.

### Section III. Members of population and number missed in snowballing process

#### A. Aggregate estimates

Since it appears that the snowballing procedure does not give a complete list of population members, an attempt will be made to estimate the total number of producers from data inherent in the list building scheme. The process generates several different kinds of data - some are presented on the following page.

One method of estimating total population (members having or producing a product) by means of data contained within the snowball scheme is to assume that population members in the starter list which are found (names repeated in the snowball process) are in the same proportion to the total starter list as "new" population members and "found" starter list members are to the total population.

Say  $N_0$  = Starter list  
 $N_{01}$  = Members of starter list found  
 $n_1$  = New members found in snowball process  
 $\hat{N}$  = Estimate of total population  
 $\hat{N}_1$  = Estimate of missed producers

then

$$\hat{N} = \left[ \frac{N_0}{N_{01}} \right] [ N_{01} + n_1 ]$$

The number of producers missed in the snowball process is estimated by

$$\hat{N}_1 = \hat{N} - (N_0 + n_1)$$

We will estimate the total number in the population of Christmas tree growers, in Illinois, apple producers in New Mexico, beekeepers in two states: Oklahoma and Tennessee and turkey and sorghum producers in Iowa. The areas covered within each of the states are indicated on county maps appended.

The basic data for each of the items follows. It should be noted that the number of producers obtained in the final round are estimated from the total number of names given in that round on the basis of previous rounds. This was necessary because the names given for the final round were not interviewed to determine whether or not they were actually producers.

A brief explanation of the basic data will be given using the Illinois Christmas tree data to illustrate. The 188 names (in the specified area) on the starter list were contacted, either by mail or personal interview in

round 1. From information on round 1, it was determined that 73 of the 188 names were actually producers. When the 188 members of the starter list (round 1) were asked to give names of producers, 20 of the 73 were duplicated and 45 new producers were obtained of which 9 were mentioned more than once. In round 2, the 104 new names were asked to list population members. The result was that 7 of the original producers were duplicated, 7 of the 45 producers obtained from round 1 were duplicated, and 23 new producers were obtained from 68 new names given. One of these was repeated. The data obtained in round 3 is summarized similarly.

Table 13. Basic Data, Christmas trees, Illinois, 1967

	Total Names	Total Producers
a. Starter list	188	73
Duplicates round 1	25	20
Duplicates round 2	17	7
Duplicates round 3	2	1
	<u>44</u>	<u>28</u>
b. New names round 1	104	45
Duplicates round 1	10	9
Duplicates round 2	10	7
Duplicates round 3	4	2
	<u>24</u>	<u>18</u>
c. New names round 2	68	23
Duplicates round 2	1	1
Duplicates round 3	0	0
	<u>1</u>	<u>1</u>
d. New names round 3	2	0
Duplicates round 3	0	0
Total new names (sum of b, c and d)	<u>174</u>	<u>68</u>

$$\hat{N} = \frac{73}{28} (28 + 68) = 250$$

$$\hat{N}_1 = 250 - (73 + 68) = 109$$

$$\text{Percent of Total Producers Missed} = \frac{109}{250} \times 100 = 43.6\%$$



Table 14. Basic Data, Apples, New Mexico, 1967

	Total Names	Total Producers
a. Starter list	245	199 (26)
Duplicates round 1	105	90
Duplicates round 2	54	43
Duplicates round 3	7	3
	<u>166</u>	<u>136</u>
b. New names round 1	391	232 (54)
Duplicates round 1	113	73
Duplicates round 2	90	64
Duplicates round 3	18	8
	<u>221</u>	<u>145</u>
c. New names round 2	228	159 (32)
Duplicates round 2	52	38
Duplicates round 3	16	14
	<u>68</u>	<u>52</u>
d. New names round 3	34	27* (est.)
Duplicates round 3	7	--
Total new names (sum of b, c and d)	653	418

$$\hat{N} = \frac{199}{136} (136 + 418) = 811$$

$$\hat{N}_1 = 811 - (199 + 418) = 194$$

$$\text{Percent of Total Producers Missed} = \frac{194}{811} \times 100 = 23.9\%$$

In the table for New Mexico apple producers, the numbers in parenthesis represent names that were listed as being potential producers, but it was not possible to verify whether or not they actually should have been classified as producers so they were not included in the totals. They represent names that the interviewer was not able to locate, and possibly some refusals. This poses a problem in the estimating procedure. For instance, if only half of the unaccounted for names in each round were actually producers the estimate of the total population would be 893 as compared to the 811 estimate obtained using verified producers only.

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\* The 27 producers is an estimate based on previous rounds made because the 34 new names obtained in round 3 were not interviewed.

The estimator is sensitive to small changes in the data and points out the fact that utmost care must be taken to get a complete list of verified producers. Only a few unaccounted for names can have a considerable effect on the survey results.

Table 15. Basic Data, Beekeepers, Tennessee, 1967

	Total Names	Total Producers
a. Starter list	219	197
Duplicates round 1	43	43
Duplicates round 2	35	35
Duplicates round 3	9	8
	<u>87</u>	<u>86</u>
b. New names round 1	391	325
Duplicates round 1	29	27
Duplicates round 2	36	33
Duplicates round 3	57	54
	<u>126</u>	<u>114</u>
c. New names round 2	454	385
Duplicates round 2	27	27
Duplicates round 3	45	43
	<u>72</u>	<u>70</u>
d. New names round 3	436	387* (est.)
Duplicates round 3	34	--
Total new names (sum of b, c and d)	<u>1281</u>	<u>1097</u>

$$\hat{N} = \frac{197}{86} (86 + 1097) = 2714$$

$$\hat{N}_1 = 2714 - (197 + 1097) = 1420$$

$$\text{Percent of Total Producers Missed} = \frac{1420}{2714} \times 100 = 52.3\%$$

\*The 387 producers is an estimate based on previous rounds made because the 436 new names obtained in round 3 were not interviewed.

Table 16. Basic Data, Beekeepers, Oklahoma, 1967

	Total Names	Total Producers
a. Starter list	128	97
Duplicates round 1	75	65
Duplicates round 2	10	8
Duplicates round 3	0	0
	<u>85</u>	<u>73</u>
b. New names round 1	105	79
Duplicates round 1	30	27
Duplicates round 2	16	13
Duplicates round 3	0	0
	<u>46</u>	<u>40</u>
c. New names round 2	24	14
Duplicates round 2	4	4
Duplicates round 3	$\frac{3}{7}$	$\frac{3}{7}$
d. New names round 3	2	0
Duplicates round 3	0	0
Total new names (sum of b, c and d)	<u>131</u>	<u>93</u>

$$\hat{N} = \frac{97}{73} (73 + 93) = 221$$

$$N_1 = 221 - (97 + 93) = 31$$

$$\text{Percent of Total Producers Missed} = \frac{31}{221} \times 100 = 14.0\%$$

Table 17, Basic Data, Turkeys, Iowa, 1965

	Total Names	Total Producers
a. Starter list	88	45
Duplicates round 1	44	37
Duplicates round 2	5	4
	<u>49</u>	<u>41</u>
b. New names round 1	68	59
Duplicates round 1	40	33
Duplicates round 2	24	22
	<u>64</u>	<u>55</u>
c. New names round 2	49	43* (est.)
Duplicates round 2	34	--
Total new names (sum of b and c)	<u>117</u>	<u>102</u>

\*The 43 producers is an estimate based on previous rounds made because the 49 new names obtained in round 2 were not interviewed.

$$\hat{N} = \frac{45}{41} (41 + 102) = 157$$

$$\hat{N}_1 = 157 - (45 + 102) = 10$$

$$\text{Percent of Total Producers Missed} = \frac{10}{157} \times 100 = 6.4\%$$

Table 18. Basic Data, Sorghum, Iowa, 1965

	Total Names	Total Producers
a. Starter list	68	57
Duplicates round 1	24	22
Duplicates round 2	15	15
	<u>39</u>	<u>37</u>
b. New names round 1	94	70
Duplicates round 1	30	29
Duplicates round 2	35	27
	<u>65</u>	<u>56</u>
c. New names round 2	21	16* (est.)
Duplicates round 2	6	--
Total new names (sum of b and c)	115	86

$$\hat{N} = \frac{57}{37} (37 + 86) = 189$$

$$\hat{N}_1 = 189 - (57 + 86) = 46$$

$$\text{Percent of Total Producers Missed} = \frac{46}{189} \times 100 = 24.3\%$$

Table 19. Summary of estimates in Section III

	Illinois Trees	N. Mexico Apples	Tennessee Bees	Oklahoma Bees	Iowa Turkeys	Iowa Sorghum
Percent of total producers missed	43.6	23.9	52.3	14.0	6.4	24.3
Percent of starter list producers duplicated	38.4	68.3	43.7	75.3	91.1	64.9
New names of pro- ducers as a percent of estimated total	27.2	51.5	40.4	42.1	65.0	45.5
Producers in starter list as a percent of estimated total	29.2	24.5	7.3	43.9	28.6	30.2

\*The 16 producers is an estimate based on previous rounds made because the 21 new names obtained in round 2 were not interviewed.

## B. Estimates of producers by size class

An approach that may be useful to estimate the total population would be to break the data down into size groups and obtain a separate estimate for each. One of the main reasons for using this approach is that the assumption of independent sampling between interviewing rounds might be closer to the mark when considering each group separately.

The estimates given below are based on the first two rounds only as size information is not available for the producers obtained on the third round. The form of the estimator is the same as that used in Section II.

Table 20. Estimates of total producers and percent missed by size class

A. New Mexico Apples	20-100 Trees	101-600 Trees	601-9999 Trees
Starter list	87	85	26
Starter list found	48	48	22
New Producers	176	226	41
$\hat{N} =$	406	485	70
Percent missed	35.5%	35.9%	10.0%
B. Illinois Christmas Trees	0-5000 Trees	5001-99,999 Trees	
Starter list	46	26	
Starter list found	10	16	
New producers	28	39	
$\hat{N} =$	175	89	
Percent missed	57.7%	27.0%	
C. Tennessee Bees x Colonies	1 - 5	6 - 20	21 - 999
Starter list	75	85	36
Starter list found	22	35	19
New Producers	330	286	92
$\hat{N} =$	1200	780	210
Percent missed	66.2%	52.4%	39.0%
D. Oklahoma Bees x Colonies	0 - 10	11 - 999	
Starter list	56	41	
Starter list found	34	37	
New producers	70	23	
$\hat{N} =$	171	66	
Percent missed	26.3%	6.1%	

The  $\hat{N}$  estimate in this section cannot be compared with the  $\hat{N}$  totals in Section II since we made no estimate of new producers derived from round 3 in Section III. This is particularly noticeable for beekeepers in Tennessee since such a large proportion of the new names occurred on the 3rd round for this group. Consequently, one should look at the tables in Section III only for the differences in percent missed by size category.

It is interesting to note that in Tennessee and Oklahoma the percent of beekeepers missed decreased considerably as the size group becomes larger; but in Illinois the percent missed in the larger size group is double that of the smaller size. In New Mexico the apple tree growers were divided into three groups. The percent missed in the smallest size group (20-100 trees) is almost identical with the medium size group (101 to 600 trees), but then there is a marked decrease in percentage missed of the larger size group (601 - 9999 trees). There is considerable difference in the percentage of missed producers by item and state from 6.4% to 52.3%. This is due to the recapture percentage, that is, the number of starter list members that were mentioned by others in the snowball procedure.

Goebel has used a number of other relationships to derive estimators of the number of producers in a population. His paper can be referred to for a detailed discussion of his estimators.\* The estimates given above generally are within the range of Goebel's estimates for each item.

#### IV. Comparison of assessor lists with snowball lists

Data were obtained in 1966 for the year 1965 for sorghum and turkey raisers in Iowa by the snowball process. Since these two products are reported in the Iowa assessor's census it is possible to compare results of the acquisition of names of 1965 producers by snowball with an actual complete census count of sorghum growers and turkey producers which was made in the spring of 1966. The snowball process was initiated in the fall of 1966 and completed late in that year.

---

\*"Estimators for the Population Size Based on a Snowballing Procedure", M.S. thesis, Iowa State University, 1969

The tables show number of names matched, those on snowball lists and not assessor's lists, and those on assessor's list but not on the snowball list. Starter list persons are indicated and, as well, the new names brought in by interviewing the starter list (1st round) and finally the new names brought in by interviewing the new persons found in the 1st round.

Table 21. Comparisons for Turkeys

Turkeys, Iowa	(1) On both assessor & snowball lists		(2) On snowball list but not assessor		(3) On assessor list but not snowball		(4) Total	
	Names	Producers	Names	Producers	Names	Producers	Names	Producers
Starter list	31	28	57	17	x	x	88	45
New Names 1st round	43	40	25	19	x	x	68	59
New Names 2nd round	17	16	32	*27	x	x	49	43
Assessor list only	x	x	x	x	38	38	38	38
Total	91	84	114	63	38	38	243	185

\* Estimated from relation of producers to names on round 1.

Table 22. Comparisons for Sorghum

Sorghum, Iowa	(1) On both assessor & snowball lists		(2) On snowball list but not assessor		(3) On assessor list but not snowball		(4) Total	
	Names	Producers	Names	Producers	Names	Producers	Names	Producers
Starter list	68	57	x	x	x	x	68	57
New names 1st round	42	38	52	32	x	x	94	70
New names 2nd round	7	*7	14	*9	x	x	21	*16
Assessor list only	x	x	x	x	76	76	76	76
Total	117	102	66	41	76	76	259	219

\* Estimated from relation of producers to names on round 1.

The two tables above show about the same results, one being more extreme than the other. It is difficult to find an explanation of why the matching producers are such a small part of the total names (about 50% for both lists). For turkeys, if one adds the matching names of producers in col. 1 (84) to those on the snowball list but not on the assessor's list in col. 2 (63) we get 147. Adding matches in col. 1 (84) to those on assessor's list only in col. 3 (38), we get 122.

Likewise for sorghum by adding the producers in col. 1 (102) and col. 2 (41) we get 143; and adding col. 1 (102) and col. 3 (76) we get 178. The "extras" on the snowball list tend to equal the "extras" on assessor's list, leaving the total number of names on the snowball list roughly approximate to the assessor's list, but the composition of the lists is quite different and both are considerably short of the best estimate of producers (185 for turkeys and 219 for sorghum). Compare the latter two figures with the estimated totals in Section III; i.e., 185 vs. 157 and 219 vs. 189. These numbers are of the same order but enough different to cause difficulty in estimating total number of birds or number of acres. However, there is sampling error and perhaps bias in the snowball estimates of 157 and 189.

On the other hand, assessors' lists are about equal in quality and completeness to the snowball lists. It should be pointed out that the snowball lists were compiled in the crop year following 1965 while some part, at least, of the assessor's list was compiled before spring work on the 1966 crop had begun. Some larger degree of inaccuracy should therefore be expected in the snowball list.

It has been suggested that perhaps the snowball and assessors' lists could be combined to derive an estimate of the population total by regarding those on both as a "tagged" group and using the same method as in Section III.

The following tables result.



Table 23. Estimates of producers missed on both assessor and snowball

## A. Turkeys

		Assessor List		
		On	Not on	Total
Snowball on List	on	84	63	147
	Not on	38	x	66
			$\hat{X} = 28$	
Total		122	91	213 = $\hat{N}$

When estimating  $x$  by  $\hat{X} = \frac{38 \times 63}{84} = 28$  the estimated producers in the population would be  $\hat{N} = 213$  which is within the realm of possibility compared with  $N = 157$  estimated from snowballing alone.

## B. Sorghum

		Assessor List		
		On	Not on	Total
Snowball on List	on	102	41	143
	Not on	76	x	107
			$(\hat{X} = 31)$	
Total		178	72	250 = $\hat{N}$

$\hat{X} = \frac{41 \times 76}{102} = 31$ . The estimated number in the population is  $\hat{N} = 250$  compared with  $\hat{N} = 189$  from the snowball data. The estimate of 250 again looks high which possibly indicates difficulty in matching names between the snowball and assessor lists or faulty assumptions in estimating this way.

It is of some interest to compare the mean numbers of turkeys per farm and mean acres of sorghum per farm by the three categories indicated by cols. (1), (2), and (3) in the tables above. We did not get information on the variables in round 2 of the snowball process; hence numbers in the tables below do not equal the total producers given in other tables.

Table 24. Comparison of mean number of turkeys per farm by category; specified counties in Iowa, 1965

	Number Producers	Number Turkeys	Mean Per Farm
1. On both lists*	69	645,400	9354
2. On snowball only	36	295,705	8214
3. (1 & 2) all snowball	105	941,105	8963
1a. On both lists**	69	593,500	8601
2b. On assessor only	38	304,492	8013
3c. (1 & 2) all assessor	107	897,992	8392

\* Turkeys reported on snowball questionnaire.

\*\* Turkeys reported to assessor. In both cases, the data for one producer who had more than one third of the total turkeys on the matching list was excluded.

Table 25. Comparison of mean number of sorghum acres per farm by category; specified counties in Iowa, 1965

	Number Producers	Number Acres	Mean Per Farm
1. On both lists*	95	3557	37.4
2. On snowball only	32	1578	49.3
3. (1 & 2) all snowball	127	5135	40.4
1a. On both lists**	95	3666	38.6
2b. On assessor only	76	2522	33.2
3c. (1a & 1b) all assessor	171	6188	36.2

\* Acres reported on snowball questionnaire.

\*\* Acres reported to assessor.

The comparisons between the assessor and snowball data indicate larger means for the snowball data.

Section V. Comparison of selected snowball items with the June Enumerative Survey

Questions were added to the 1968 Statistical Reporting Service June Enumerative Survey in Oklahoma, Illinois, New Mexico, and Tennessee to estimate the total number of producers of the snowball items in those states. The following table gives the expansions for the areas where the snowballing was done.

Table 26. 1968 JES Estimate of Producers by Area and Item

Item	Area	Open segment estimate	Weighted segment estimate	Snowball estimate
Apples	New Mexico	570	--	811
Christmas trees	Illinois	245	342	250
Beekeepers	Oklahoma	136	218	221
Beekeepers	Tennessee	6168	4866	2714

When the June Survey farm operators' names were compared with the snowball lists (see table following), only 2 of 53 on the June Survey matched with the snowball lists. Thus due to either (1) failure to match names which should match or (2) errors in the response to the June Survey question on the snowballing item or both (1) and (2), the June Survey was not useful as a means of evaluating the completeness of the lists developed by snowballing. Later contacts with some of the June Survey respondents indicated that several had been incorrectly designated as producers.

Table 27. JES Respondents Compared with Snowball

Item	State	Number Found in Area Sampling		
		Total number	Number on final snowballing list	Percent on snowballing list
Apple producers	New Mexico	19	0	0.0
Christmas trees	Illinois	3	0	0.0
Beekeepers	Oklahoma	6	0	0.0
Beekeepers	Tennessee	25	2	8.0

## VI. Summary and Conclusions

The difficulties encountered when attempting to construct a sample "frame" for a scarce commodity are brought to light when attempting to evaluate the snowballing technique by comparing the results obtained for sorghum and turkeys in Iowa with an "actual complete census count" of these items. It turns out that the census count is not any more complete than the snowball list and can not be used to evaluate the snowball list. Similar results appeared in Oklahoma and Tennessee. The U. S. Census reported a total of 22 beekeepers in the 14 Oklahoma counties - the snowball scheme produced 190. In Tennessee, the census gave 158 beekeepers in the selected counties - snowballing gave 853 in the first three rounds.

However, the census was only concerned with farmers who sold bees or honey, while the 1967 surveys were aimed at identifying anyone who owned any bees. So the populations considered in the snowballing surveys were considerably larger than the populations considered in the census. However, the mere fact that the snowballing procedure can generate at least as many or more names as a census count supports using the procedure for list building purposes.

A critical factor to consider when attempting to sample a scarce item such as bees or Christmas trees is that a considerable proportion of the producers have a primary occupation other than farming (see appendix). For instance, in New Mexico only 29.0% of the known producers reported farming as their primary occupation, in Illinois 47.5%, in Oklahoma 51.6%, in Tennessee 21.5%. This not only affects the ease of obtaining the list, but also may require that the list be frequently brought up to date.

Since it has been concluded that the snowballing procedure usually will not give a complete list, considerable effort has been expended in deriving estimators for the number of missed producers; so the next question is how good or valid are these estimators?

The estimator considered above plus those that Goebel considered are based on several assumptions. One is that sampling between rounds

is independent. For example, it is assumed that the chance a producer appears in one round is independent of his chances of appearing in any other round. That this may be difficult to prove can be illustrated by the following Iowa turkey data.

Table 28. Number of times name was mentioned by number of turkeys raised in 1966.

Number of Turkeys		Number of times name mentioned			Total
		1, 2, & 3	4, 5, & 6	7, 8 & 9	
1 - 5,600	No.	16	34	20	70
	%	22.9	48.6	28.6	100.0
5,601 - 16,000	No.	12	29	31	72
	%	16.7	40.3	43.1	100.0
16,001 - 380,000	No.	3	3	8	14
	%	21.4	21.4	57.1	100.0
Total		31	66	59	156

It can be concluded that the more turkeys an individual raises, the more likely he will be mentioned very often (7-9 times) in the process. This is to be expected since a large producer is usually better known than a small one. On the other hand, it may be favorable quality to have the larger producers entering with a greater probability than the small producers.

The final result shown in Section III, where the population was estimated separately by size group, offers the possibility that some of the non-independence between rounds can be eliminated.

The density, i.e., number of producers in a given area, can also have an effect on the independence between rounds. Goebel made an attempt to measure the independence, but was unable to do so using his models. He suggested that a probability model that takes into account size and proximity characteristics may be an improvement over his models. He also suggested that a non-parametric test might be utilized for a test of randomness.

We have shown how many names can be generated by the snowballing procedure for several items and have obtained estimates of the number of "missed" producers. If it is thought that there exists a reasonable estimate of the total number of members in the population, it only remains to estimate the producer averages to obtain an estimate of the total production for the population. However, it must be remembered that data available from the snowballing survey may not be representative of the entire population. For example, the comparison of means per farm for Iowa Turkeys and Sorghum between the assessor and snowball lists indicates that the missed producers are smaller on the average than those found. The differences though, are not severe enough to discourage the use of the procedure.

Now that we are aware of the problems encountered when using the snowballing technique, the final question is whether this is a useful procedure for frame construction purposes. When considering the type of population involved, i.e., scarce items produced by a large percentage of non-farm operators, it appears to have several advantages. It has already been pointed out that the procedure yields at least as many names and usually more than a complete census. This could also result in a considerable savings from a cost standpoint. Another advantage is that it is possible to obtain an estimate of the number of "missed" population members from data produced by the sampling scheme. Despite the shortcomings of these estimates, they are a useful start and could prove to be reliable.

The estimator considered in Section III is only one of several approaches that could be considered. Goebel has considered several in his thesis, but most are based upon similar assumptions. The brief look at the estimates based on separate size groups gave some encouraging results and should perhaps be examined more closely. It has been suggested that different estimating procedures be tried. One suggestion would be to try to fit the data by using a stochastic process.

Several tables that may be of interest are in the appendix which also contains copies of the questionnaires used.

Appendix Table A.  
NUMBER OF PERSONS MENTIONING NAMES IN SNOWBALL SCHEME

Number of names mentioned	Illinois				New Mexico				Oklahoma				Tennessee			
	Round 1		Rd. 2	Rd. 3	Round 1		Rd. 2	Rd. 3	Round 1		Rd. 2	Rd. 3	Round 1		Rd. 2	Rd. 3
	Mail	Pers.	Pers.	Pers.	Mail	Pers.	Pers.	Pers.	Mail	Pers.	Pers.	Pers.	Mail	Pers.	Pers.	Pers.
0	50	104	55	51	40	79	199	166	16	22	42	16	42	48	170	171
1	8	38	28	3	2	17	22	8	2	31	25	6	9	30	72	97
2 - 3	10	19	18	7	4	27	65	74	4	23	29	2	15	30	96	129
4 - 5	5	4	6	1	1	36	78	5	1	16	6	-	11	14	21	33
6 - 10	1	4	1	0	3	19	23	1	4	5	3	-	11	5	27	22
11 - 42	0	0	1	0	2	15	9	-	1	3	-	-	3	1	5	2
Total names in this round	74	169	109	62	52	193	396	254	28	100	105	24	91	128	391	454
Total mentioning names	24	65	54	11	12	114	197	88	12	78	63	8	49	80	221	233
Total names mentioned	59	128	112	25	86	613	790	240	44	245	143	11	238	211	670	727
Average number of names per person	0.8	0.76	1.0	0.4	1.7	3.2	2.0	0.9	1.6	2.4	1.4	0.5	2.6	1.6	1.7	1.6

## Appendix Table B.

## Illinois - Christmas Trees

A total of 415 names were included in our lists of respondents in Illinois. Of these, 141 persons reported raising conifers to be used as Christmas trees, with an average of 14,276 trees per respondent. Of the 141 producers, 81 reported cutting and selling trees in 1967. The average number of trees sold per farm was 646.

Of the 141 producers, 67 reported farming as their primary occupation. The remaining 74 persons list the following occupations:

Professional	8
Manager, official, proprietor	16
Clerical and kindred workers	2
Sales workers	3
Craftsmen, foremen and kindred workers	7
Operative and kindred workers	14
Service workers (private household, hospital, waiters, etc.)	5
Laborers	2
Retired, housewife, unemployed, disabled	12
No response	3
Retired	2



## Appendix Table C.

## New Mexico - Apple Producers

Of the 1056 names on our lists in New Mexico, 641 reported having apple trees. 620 of these producers had an average of 223 "standard" trees each, while 55 of these producers had an average of 397 "dwarf" trees each.

Persons listing farming as their primary occupation totaled 186 in number, (of the 641 producers). The primary occupation of the other 455 persons was identified as follows:

Professional (school, church)	63
Manager, official, proprietor	38
Clerical and kindred workers	22
Salesmen	15
Craftsmen, foremen and kindred workers	52
Operatives and kindred workers	83
Private household and service workers	42
Farm laborers	3
Laborers, except farm	34
No response	29
Retired	74

Appendix Table D.  
Oklahoma - Beekeepers

Of the 282 persons contacted, 190 had bees either on July 1 or December 1, 1967 either on land they operated or at another location, as follows:

144 had bees on their own land  
25 had bees at another location  
21 had bees on their own land and at another location.

	Number of Beekeepers	Average number of colonies
On own land 12-1-67	163	14
On own land 7-1-67	156	15
At another location 12-1-67	45	56
At another location 7-1-67	44	58

Eight persons kept bees on their place during 1967 that belonged to others.

Of the 190 beekeepers, 91 sold honey during 1967. A total of 22 beekeepers were reported by the United States Census in the fourteen Oklahoma counties. The snowball scheme produced 190.

The primary occupations of the beekeepers fall into the following categories:

Professional	8
Farmers, tenant, share croppers	98
Manager, official, owner, proprietor	4
Clerical	1
Salesmen	4
Craftsmen, foremen and kindred workers	11
Operative and kindred workers	9
Private household and service workers	4
Farm laborers	2
Laborers, except farm	2
No response	2
Retired	44

## Appendix Table F.

## TENNESSEE - BEEKEEPERS

In 1967, the United States Census reported 158 beekeepers in the 28 counties in which the snowball scheme was carried out. In the first three rounds of interviewing 853 names were identified as having bees on their own land on December 31, 1967.

The number of colonies of bees did not seem to vary a great deal from round to round considering the number of persons interviewed. An example of this is shown in the following table.

Number of hives	Names reporting hives on hand			Total
	Round 1	Round 2	Round 3	
1	16	32	34	82
2	13	32	47	92
3	23	32	47	102
4	13	33	31	77
5	7	17	25	49
6	12	22	22	56
7	9	18	15	42
8	10	10	20	42
9	12	11	8	31
10	12	11	21	44
11 thru 15	20	31	40	91
16 thru 19	10	18	19	47
20 thru 29	14	25	22	61
30 thru 49	10	15	9	34
50 thru 99	2	4	-	6

Of 161 persons who reported no bees on December 31, 1967, 8 reported having bees on July 1, 1967.

## TENNESSEE - BEEKEEPERS (cont.)

Of the 153 who had no bees on their own land on either date, 46 had bees at another location on December 1, 1967, as follows:

5 persons reported having 1 colony  
 5 persons reported having 2 colonies  
 2 persons reported having 3 colonies  
 5 persons reported having 4 colonies  
 6 persons reported having 5 colonies  
 4 persons reported having 6 - 8 colonies  
 10 persons reported having 10 - 17 colonies  
 5 persons reported having 25 - 37 colonies  
 4 persons reported having 50 - 61 colonies

A total of 908 persons reported having bees either on July 1 or December 1, 1967, either on land they operated or at another location, as follows:

735 had bees on their own land  
 46 had bees at another location  
 127 had bees on their own land and at another location

	Number of beekeepers	Average number of colonies
On own land 12-1-67	835	9.2
On own land 7-1-67	845	9.4
At another location 12-1-67	168	17.8
At another location 7-1-67	172	17.7

Appendix Table F. Percent of producers yielded by names mentioned once and more than once in snowball process

Christmas trees, Illinois List	Names mentioned once	Producers	Percent Producers	Names mentioned more than once	Producers	Percent Producers
Starter	144	45	31.3	44	28	63.6
Round 1	80	27	33.8	24	18	75.0
Round 2	67	22	32.8	1	1	100.0
Round 3	2	xx	xx	0	xx	xx
Apples, New Mexico						
Starter	79	63	79.7	166	136	81.9
Round 1	170	87	51.2	221	145	65.6
Round 2	160	107	66.9	68	52	76.5
Round 3	27	xx	xx	7	xx	xx
Bees, Tennessee						
Starter	132	111	84.1	87	86	98.9
Round 1	265	211	79.6	126	114	90.5
Round 2	382	315	82.5	72	70	97.2
Round 3	402	xx	xx	34	xx	xx
Bees, Oklahoma						
Starter	43	24	55.8	85	73	85.9
Round 1	59	39	66.1	46	40	87.0
Round 2	17	7	41.2	7	7	100.0
Round 3	2	xx	xx	0	xx	xx
Turkeys, Iowa						
Starter	39	4	10.3	49	41	83.7
Round 1	4	4	100.0	65	55	84.6
Round 2	15	xx	xx	34	xx	xx
Sorghum, Iowa						
Starter	68	20	29.4	39	37	94.9
Round 1	29	14	48.3	65	56	86.2
Round 2	15	xx	xx	6	xx	xx

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If address should be updated, please  
complete the following:

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zip Code \_\_\_\_\_

County \_\_\_\_\_

ILLINOIS CHRISTMAS TREE PRODUCERS INQUIRY

1. In what township and section is your residence located?

a. Township \_\_\_\_\_

b. Section \_\_\_\_\_

(Check none or give acres)

2. a. How many acres of land did you own in 1967? None  \_\_\_\_\_ acres

b. How many acres of land did you rent from others or work on shares for others in 1967? None  \_\_\_\_\_ acres

c. How many acres did you rent to others, including land worked on shares for you in 1967? None  \_\_\_\_\_ acres

3. Did you, or anyone else living at this address in 1967, have:

a. Any crops? ----- Yes  No

b. Any cattle, sheep or hogs? ----- Yes  No

c. 30 or more chickens, turkeys, geese or other poultry? ----- Yes  No

d. 20 or more fruit trees, grapevines, or planted nut trees? ----- Yes  No

e. Any vegetables, berries, nursery or greenhouse products grown for sale? ----- Yes  No

4. a. What is your principal occupation? \_\_\_\_\_

b. Do you have a secondary occupation? ----- Yes  No

If YES, what is this secondary occupation? \_\_\_\_\_

5. In 1967, did you have any planted tracts of Conifer (evergreen) trees on your land?

a. Yes \_\_\_ If yes, how many acres? \_\_\_\_\_

b. No \_\_\_ If no, skip to page 3.

6. For what uses are these trees now intended? (Check one or more)

a. Sales as Christmas trees -----

b. Sales as pulpwood -----

c. Permanent reforestation -----

d. Other, specify ( \_\_\_\_\_ ) -----

(If you checked Item 6a, please complete the remainder of this inquiry. If you did not have any evergreen trees being grown for sale as Christmas trees, please skip to page 3.)

7. For the last three years, 1965, 1966, and 1967, where did you obtain your seedlings?

- a. Illinois Department of Conservation ----- Yes  No
- b. Please list any other sources:

Name	Address	City and State

8. Number of Christmas trees sold by you in 1967 by species:

	<u>Number Sold</u>		<u>Number Sold</u>
Scotch pine	_____	Norway and White Spruce	_____
White pine	_____	Douglas and other fir	_____
Red pine	_____	Other	_____
Jack pine	_____		_____
Other pines	_____	Total	_____

(If none were sold, check here and skip to item 10) None sold

9. Type of outlet for Christmas trees sold in 1967.

Number  
of trees

a. Retail sales on your farm -----

b. Wholesale:

    Retail Merchants -----

    Charitable Organization (Church, Scout group, etc.) -----

    Trucker -----

    Other: Specify \_\_\_\_\_

Total \_\_\_\_\_

10. Did you sell greenery and/or wreathes?      Yes      No

11. Please estimate for the land you operate the number of Christmas trees growing at the beginning of the 1967 cutting season and the number of these that were cut:

	<u>Number growing at beginning of 1967 season</u>	<u>Number cut and sold in 1967</u>
2 years old	_____	_____
3 years old	_____	_____
4 years old	_____	_____
5 years old	_____	_____
6 years old	_____	_____
7 years old	_____	_____
8 years old	_____	_____
9 years old and over	_____	_____
Total	_____	_____

12. In 1967 did you use any of the following practices?

a. Shearing ----- Yes  No

b. Spraying for insect and/or disease control ----- Yes  No

c. Fertilizing ----- Yes  No

d. Controlling weeds and/or brush ----- Yes  No

e. Spraying with artificial coloring agent ----- Yes  No

SEE PAGE 4



## LIST OF PERSONS WHO RAISED CHRISTMAS TREES IN 1967

Please list all persons you know who raised Christmas trees in 1967 in your county and any other county in your part of Illinois. If owner's name and address are unknown, please enter farm name; show location from nearest town and approximate acres in Christmas trees.

No.	Name	Address (Street or RFD)	City	County
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				

NEW MEXICO APPLE PRODUCERS INQUIRY

Name \_\_\_\_\_ City \_\_\_\_\_

Address \_\_\_\_\_ County \_\_\_\_\_

(Street or RFD)

(Check none or give acres)

1. a. How many acres of land did you own in 1967? None  \_\_\_\_\_ acres

b. How many acres of land did you rent from others or work on shares for others in 1967? None  \_\_\_\_\_ acres

c. How many acres did you rent to others, including land worked on shares for you in 1967? None  \_\_\_\_\_ acres

2. Did you, or anyone else living at this address in 1967, have:

a. Any crops?----- Yes  No

b. Any cattle, sheep or hogs?----- Yes  No

c. 30 or more chickens, turkeys, geese or other poultry? Yes  No

d. 20 or more fruit trees, grapevines or planted nut trees?----- Yes  No

e. Any vegetables, berries, nursery or greenhouse products grown for sale?----- Yes  No

3. a. What is your principal occupation? \_\_\_\_\_

b. Do you have a secondary occupation?----- Yes  No

If Yes, what is this secondary occupation? \_\_\_\_\_

4. In 1967, did you have 20 or more apple trees of any age on your land?

\_\_\_ Yes (continue with Question 5)

\_\_\_ No (skip to Question 13)

5. How many apple trees of bearing age did you have on August 1, 1967?-----

6. a. How many non-bearing (young trees) did you have on August 1, 1967?-----

Number of trees	
Standard	Dwarf

b. When do you expect these young trees to be in production?

Number	Date
_____	by August 1, 1968
_____	by August 1, 1969
_____	by August 1, 1971
_____	by August 1, 1973

7. How many acres did you have planted to apple trees in 1967? \_\_\_\_\_ (acres)

8. Do you irrigate any of your apple orchards? \_\_\_ Yes \_\_\_ No

If Yes, how many acres? \_\_\_\_\_ (acres)

(Please continue on reverse side)

9. What was the total quantity of apples harvested for all purposes during 1967?-----  
(bushels)

10. For the apples you sold in 1967, how many were sold in the following types of containers?

	Number units sold in 1967
(a) bushel baskets	_____ bushels
(b) bushel boxes	_____ bushels
(c) 10 lb. sacks	_____ sacks
(d) 5 lb. sacks	_____ sacks
(e) _____ (Other - specify)	_____

11. In 1967, were any of your apples marketed at the orchard or roadside stands?  Yes  No.

If Yes, approximately how many bushels were sold in this manner? \_\_\_\_\_  
(bushels)

12. In what other ways did you market your apples?

Person(s) or firms who buy your apples	Type of outlet (examples: grocery chain, cooperative, fruit processing plant, packing shed)
1. Name _____ Address _____	
2. Name _____ Address _____	
3. Name _____ Address _____	
4. Name _____ Address _____	

13. In what township and section is your residence located? Township \_\_\_\_\_  
 Date \_\_\_\_\_ Section \_\_\_\_\_

LIST OF PERSONS WHO PRODUCED APPLES IN 1967

Please list all persons you know who raised apples in 1967 in your county and any other county in your part of New Mexico.

No.	Name	Address Street or RFD	City	County	Check approximate number of apple trees	
					20-99	100 or more
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						
21.						
22.						
23.						
24.						
25.						

BEEKEEPERS INQUIRY

Name \_\_\_\_\_ City \_\_\_\_\_
Address \_\_\_\_\_ County \_\_\_\_\_
(Street or RFD)

- 1. Do you operate a farm, that is, actually manage and work on a farm? Yes [ ] No [ ]
a. If Yes, do you have a secondary occupation?----- Yes [ ] No [ ]
(1) If Yes, what is that occupation? \_\_\_\_\_
(2) If retired, please check [ ]

b. If you do not operate a farm, what is your occupation? \_\_\_\_\_
2. If you are a farmer, how many acres of land do you operate? (Include all land rented from others and land that you own and operate)----- acres

- 3. Bees you own:
a. Did you own any bees in 1967?----- Yes [ ] No [ ]
(If No, go to item 5)

Table with 2 columns: Number of colonies on hand, December 1, 1967, July 1, 1967

- b. If Yes, please supply the following:
(1) Colonies you owned located on land you operated-----
(2) Colonies you owned at any other location-----

c. If not on the land you operated, give name and address where bees were kept:
Name \_\_\_\_\_ Address \_\_\_\_\_
Name \_\_\_\_\_ Address \_\_\_\_\_
Name \_\_\_\_\_ Address \_\_\_\_\_
Name \_\_\_\_\_ Address \_\_\_\_\_
Name \_\_\_\_\_ Address \_\_\_\_\_
Name \_\_\_\_\_ Address \_\_\_\_\_
Name \_\_\_\_\_ Address \_\_\_\_\_
Name \_\_\_\_\_ Address \_\_\_\_\_

- 4. Processing and marketing honey
a. Do you usually process your own honey? (Check one) All [ ] Part [ ] None [ ]
b. Do you sell honey?----- Yes [ ] No [ ]
(1) If Yes, in what form? (Check all forms in which sold, and if more than one rank as to importance, e.g. 1, 2, 3)
Comb [ ] Strained [ ] Other [ ] Specify \_\_\_\_\_

- (2) How do you market your honey? (Check one)
(a) Retailed by you at roadside stands or sold house to house----- [ ]
(b) Through cooperatives----- [ ]
(c) Direct to retail store or restaurant----- [ ]
(d) To wholesaler----- [ ]
(e) Other (Specify) \_\_\_\_\_ [ ]

(Please continue on reverse side)

BEEKEEPERS INQUIRY

Name \_\_\_\_\_ City \_\_\_\_\_  
Address \_\_\_\_\_ County \_\_\_\_\_  
(Street or RFD)

- 1. Do you operate a farm, that is, actually manage and work on a farm? Yes  No 
  - a. If Yes, do you have a secondary occupation?----- Yes  No 
    - (1) If Yes, what is that occupation? \_\_\_\_\_
    - (2) If retired, please check
  - b. If you do not operate a farm, what is your occupation? \_\_\_\_\_
- 2. If you are a farmer, how many acres of land do you operate? (Include all land rented from others and land that you own and operate)----- \_\_\_\_\_ acres
- 3. Bees you own:
  - a. Did you own any bees in 1967?----- Yes  No  (If No, go to item 5)

Number of colonies on hand	
December 1, 1967	July 1, 1967

- b. If Yes, please supply the following:
  - (1) Colonies you owned located on land you operated-----
  - (2) Colonies you owned at any other location-----
- c. If not on the land you operated, give name and address where bees were kept:
 

Name _____	Address _____
Name _____	Address _____
Name _____	Address _____
Name _____	Address _____
Name _____	Address _____
Name _____	Address _____
Name _____	Address _____
Name _____	Address _____

- 4. Processing and marketing honey
  - a. Do you usually process your own honey? (Check one) All  Part  None
  - b. Do you sell honey?----- Yes  No 
    - (1) If Yes, in what form? (Check all forms in which sold, and if more than one rank as to importance, e.g. 1, 2, 3)
      - Comb  Strained  Other  Specify \_\_\_\_\_
    - (2) How do you market your honey? (Check one)
      - (a) Retailed by you at roadside stands or sold house to house-----
      - (b) Through cooperatives-----
      - (c) Direct to retail store or restaurant-----
      - (d) To wholesaler-----
      - (e) Other (Specify) \_\_\_\_\_

(Please continue on reverse side)

4. b. (3) If not retailed by you, to whom did you sell in 1967?

Name _____	Address _____
Name _____	Address _____
Name _____	Address _____
Name _____	Address _____
Name _____	Address _____
Name _____	Address _____

5. Bees you do not own:

a. Were any bees belonging to others kept on your place at any time during 1967?----- Yes  No

(1) If Yes, were these bees brought in for the growing season from other states?----- Yes  No

(2) Were these bees placed on your farm by someone in your area?----- Yes  No

(3) If Yes to a(1) and/or a(2), please give name and address of owner:

Name \_\_\_\_\_ Address \_\_\_\_\_

Name \_\_\_\_\_ Address \_\_\_\_\_

b. What months did you have these bees on your land? From \_\_\_\_\_ to \_\_\_\_\_