ESTIMATION OF APPLE PRODUCTION IN KULLU DISTRICT OF HIMACHAL PRADESH

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Abstract: The results of the study amply suggest that the stratified random sampling method of estimation, together with equalization of strata total rule be used for estimating the production of apple in Kullu district of Himachal Pradesh.

Keywords: Multi-stage sampling, Stratification methods, Relative efficiency, Neyman allocation, Gain in efficiency.

Introduction: Apple is the most important fruit crop of Himachal Pradesh and it plays a unique role in the socio-economic transformation of rural masses in the state. Apples constitute a major part of the economy of Himachal Pradesh, with a turnover of over Rs. 3000 crore and accounting for almost 10 percent of the gross domestic product. In the post-independence period, especially after the statehood in 1971, there has been a strong backing from the state for apple industry. Consequently the area under apple cultivation has increased substantially from a mere 400 hectares in 1950's to 114939 hectares in 2011-12. Proper assessment of production estimates is a prerequisite for effective horticultural planning. The accuracy of basic statistics has direct bearing on success of various horticultural developmental plans; and this is more so in case of apples which account for around 80 percent of the total fruit acreage. There exist discrepancies in the estimates of area and production of apple made by state agencies; viz. Directorate of Land Records and Department of Horticulture of the state. Moreover, there is growing demand for the accurate and reliable data on area and production of apple from various quarters in the context of state, district and lower level planning and evaluation of various horticultural development schemes.Various studies conducted for survey of fruit crops for estimation of acreage and production, however, did not discuss the methodological issues (Singh *et al*; Goel*et al.,*2002 etc.).At present, no proper statistical based estimation technique specifically designed for the estimation of area and production of fruit crops is being used in Himachal Pradesh. The presently followed stratification method is convenience based which leads to either over or under estimates and in turn having repercussions for the horticultural planning process. The present study aims at constructing the optimum strata boundaries and other related aspects of optimum stratification with a view to improve upon efficacy over current methods in use.

Material And Methods: The Kullu district of Himachal Pradesh has been selected for the study as it is a prominent apple producing area in the state and not much statistical investigations for apple production estimation have been undertaken for this area. In the first instance, a complete listing of the development blocks in the apple growing areas of the district was done from the records of the concerned revenue office. The selection of sample was made through the process of multistage random sampling (Cochran, 1963). The selection of sample was made through the process of multistage random sampling (Cochran, 1963). At first stage, Banjar block (containing 12 apple producing panchayats) was chosen randomly out of the five blocks(Kullu, Banjar, Naggar, Anni and Nirmand) in Kulludistrict and was divided into two groups; viz(i) panchayats having more than 30% area under cultivation and (ii) panchayats having less than 30% area under cultivation, as per the practice in vogue.

The observed field data revealed that 40% random sample from each group covered all the cross-sections of the two groups as formed in stage I. Thus, in the second stage, a 40% random sample from each group was selected aggregating to 4 apple producing panchayats which were again divided into two conventional groups (i) villages having more than 30% area under cultivation and (ii) villages having less than 30% area under cultivation.

Thereafter, a representative random sample (40%) of the villages from each group was selected for the purpose of field survey. Finally, a random sample of 100 respondents (orchardists) was selected through a two-step approach as suggested by Stein (1945) and Cox (1952).

The information concerning area and production of apples were collected from the selected respondents. Table 1 gives the frequency distribution of the respondents according to the area under apple. The table reveals that this distribution of holdings is highly skewed and most of the units are located in the first two intervals. The correlation coefficient (Chandel, 1984) between area and production under

apple was found to be highest (r=0.95). Hence, for estimating production of apple, this highly correlated variable, area under apple, has been considered as the stratification variable.

The optimum points of stratification were determined by using the four standard stratification methods (Sukhatme, 1983), namely equalization of stratatotal, equalization of cum √f equalization of cum 1/2 {r(y) +f(y)} and equalization of cum.√f, for varying number of strata

Results And Discussion:

Comparison of efficiencies of different methods of stratification: The relative efficiencies of above stratification methods are examined for number of strata (L) = 2, 3 and 4 when the total sample size is allocated to different strata by three allocation methods (Cochran, 1963), namely equal, proportional and Neyman allocations. The variances under these allocations reveal that the variance term goes on decreasing with the increase in number of strata. Also, the variance term decreases uniformly when the sample size increases. The variance term worked out to be least in case of Neyman allocation and hence this allocation method was retained for further investigations. The critical examination of the results suggested that for L = 2 and for varying sample size the two methods namely, equalization of strata total and equalization of cum. y provide least and equal variance; suggesting thereby that any of the two methods can be efficiently used for estimating apple production in the state. However, for the number of strata greater than 2 the equalization of cum. method yield the least variance and hence is the most suitable method in this case.

Gain in efficiency due to stratification To gauge the gain in efficiency of stratification (L > 1) over no stratification (L - 1), variances and then efficiencies were calculated and the results have been presented to Table 2. The table indicates that there is a considerable gain due to stratification; but the maximum gain in efficiency is observed when the strata are constructed through equalization of strata total method. It also indicates that this gain in efficiency increases with the increase in number of strata and sample size.

Hence, it is concluded that the stratified random sampling method of estimation, together with equilization of strata total be used for greater efficiency in estimating the production of apple in Himachal Pradesh.

TABLE 1 DISTRIBUTION OF RESPONDENTS ON THE BASIS OF AREA UNDER APPLE

Class intervals (area in ha)	No. of respondents (N_h)
0.25-0.75	28
0.75-1.25	41
1.25-1.75	22
1.75-2.25	0
2.25-2.75	0
2.75-3.25	0
3.25-3.75	9

TABLE 2 PERCENTAGE GAIN IN FFICIENCY DUE TO STRATIFICATION: NEYMANN ALLOCATION

Sample Sizes	Equalization of strata total method			Equilization of cum √f method		
	2	3	4	2	3	4
10	300.811	608.708	1289.600	98.857	330.880	1245.450
20	150.904	449.813	1200.290	79.177	138.926	564.184
30	222.629	1314.710	1181.170	156.091	240.426	890.358
Sample Sizes	**Equilization of cum $\frac{1}{2}\{r(y)+f(y)\}$ method**			**Equilization of cum $\sqrt[3]{f}$ method**		
	2	3	4	2	3	4
10	69.602	311.664	273.363	96.060	308.337	1199.290
20	71.121	124.134	561.421	69.456	137.621	557.698
30	140.275	239.257	1135.450	140.275	279.040	727.160

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