Note on Sample Design and Estimation Procedure of NSS 77th round

1. Introduction

1.1 The National Sample Surveys (NSS) are being conducted by the Government of India since 1950 to collect socio-economic data employing scientific sampling methods. Seventy-seventh round of NSS started from 1st January 2019

1.2 **Subject Coverage**: NSS 77th round covers the subjects 'Land and Livestock Holdings of Households and Situation Assessment of Agricultural Households' and 'Debt and Investment'.

2. Outline of Survey Programme

2.1 **Geographical coverage**: The survey covers whole of the Indian Union *except the* villages in Andaman and Nicobar Islands which are difficult to access.

2.2 **Survey Period and Visits:** The survey period is of one year duration.

2.3 **Schedules of enquiry:** During this round, the following schedules of enquiry are canvassed:

Schedule 0.0	:	list of households
Schedule 33.1	:	land and livestock holdings of households and situation assessment of agricultural households
Schedule 18.2	:	debt and investment

Schedule 33.1 is canvassed in rural areas only.

2.4 **Visits 1 & 2**: Each sample FSU and sample households are visited twice during this round. Since the workload of the first visit (i.e. Visit 1) is more, the first visit continues till the end of August 2019. Thus, period of the first visit (i.e. Visit 1) is January – August 2019 (duration of eight months) and that of the second visit (i.e. Visit 2) is September – December 2019 (duration of four months).

The listing schedules (Schedule 0.0) are canvassed only in Visit 1. Schedules 33.1 and 18.2 are canvassed in independent sets of sample households. Visit 1 and Visit 2 schedules are canvassed in the same set of sample households during first and second visit respectively. Contents of the schedules for the two visits are not same since the information relate to two different periods.

2.5 **Reference Period:** The reference period for the survey is the Agricultural year, i.e. July, 2018 to June, 2019. Information for the period July 2018 – December 2018 are collected in Visit 1 and the information for the second period i.e. January 2019 – June 2019 are collected during Visit 2.
The reference periods are same for both the Schedules 33.1 and 18.2.

2.6 **Sub-rounds:** The survey period of the round are divided into two sub-rounds. Sub-round one consists of the first half of the survey period of each visit i.e. January – April 2019 for Visit

1 and September – October 2019 for Visit 2 while sub-round two consists of the remaining period of the respective visits. Thus, each sub-round are four months for Visit 1 and two months for Visit 2.

In each of these two sub-rounds equal number of sample FSUs are allotted for survey with a view to ensuring uniform spread of sample FSUs over the entire survey period. Attempt will be made to survey each of the FSUs during the sub-round to which it is allotted. Because of the arduous field conditions, this restriction is not strictly enforced in *Andaman and Nicobar Islands, Lakshadweep, Ladakh region (Leh and Kargil districts) of Jammu & Kashmir and rural areas of Arunachal Pradesh and Nagaland.*

The FSUs visited in the first sub-round of Visit 1 is revisited during the first sub-round of the Visit 2. Similarly, FSUs of sub-round 2 of Visit 1 is revisited in sub-round 2 of Visit 2.

2.7 **Participation of States:** All the States and Union Territories except Andaman & Nicobar Islands, Dadra & Nagar Haveli and Lakshadweep participated. Following is the matching pattern of the participating States/ UTs.

State/UT	Extent of matching
Nagaland (U)	triple
Manipur, Telangana	double
Maharashtra (U)	one and half
Remaining States/ UTs	equal

3. **Sample Design**

3.1 **Formation of sub-units (SUs)**:

3.1.1 **Rural areas**: A rural village is notionally divided into a number of sub-units (SU) of more or less equal population during the preparation of frame. Census 2011 population of villages was projected by applying suitable growth rates and the number of SUs formed in a village was determined apriori.

3.1.2 The above procedure of SU formation was implemented in the villages with population *more than or equal to 1000 as per Census 2011*. In the remaining villages, no SU was formed.

3.1.3 The number of SUs formed in the villages (with Census 2011 population 1000 or more) of the frame was decided before selection of the samples following the criteria given below:

projected population of the village	no. of SUs formed
less than 1200	1
1200 to 2399	2
2400 to 3599	3
3600 to 4799	4
4800 to 5999	5
.....and so on	....

3.1.4 **Special case**:

3.1.4.1 For rural areas of (i) Himachal Pradesh, (ii) Sikkim, (iii) Andaman & Nicobar Islands, (iv) Uttarakhand (except four districts Dehradun, Nainital, Hardwar and Udham Singh Nagar), (v) Punch, Rajouri, Udhampur, Reasi, Doda, Kishtwar, Ramban, Ladakh region (Leh and Kargil districts) of Jammu and Kashmir and (vi) Idukki district of Kerala, numbers of SUs formed in a village were determined in such a way that each SU contains 600 or less projected population. Further, SUs were not formed in the villages in the above mentioned districts/States with population less than 500 as per Census 2011. In the remaining villages, the number of SUs formed for these States/districts is as follows:

projected population of the village	no. of SUs formed
less than 600	1
600 to 1199	2
1200 to 1799	3
1800 to 2399	4
2400 to 2999	5
.....and so on	....

3.1.4.2 For rural parts of Kerala, similar procedure as mentioned in para 3.1.3 above was adopted with the modification that the SUs were formed within Panchayat Wards instead of villages.

3.1.5 **Urban areas**: SUs were formed in urban sector also. The procedure was similar to that adopted in rural areas except that SUs were formed on the basis of households in the UFS frame instead of population, since UFS frame does not have population. Each UFS block with number of households more than or equal to 250 was divided into a number of SUs. In the remaining UFS blocks, no SU was formed.

3.2 **Outline of sample design:** A stratified two stage design has been adopted for the 77th round survey. *The first stage units (FSU) are villages/UFS blocks/sub-units (SUs) as per the situation.* The ultimate stage units (USU) are households in both the sectors.

3.3 **Sampling Frame for First Stage Units:**

3.3.1 There was no SU formation in uninhabited villages and villages (Panchayat wards for Kerala) with population less than 1000 as per Census 2011 (less than 500 as per Census 2011 for the areas mentioned in para 3.1.4.1) and entire village was considered as one FSU. All such villages (Panchayat wards for Kerala) were the First Stage Units (FSUs).

3.3.2 In the remaining villages, notional sub-units (SUs) following the procedure as described in para 3.1 were formed. Such SUs were considered as First Stage Units (FSUs).

3.3.3 For the UFS blocks with less than 250 households, the entire UFS block was considered as one FSU. In the remaining UFS blocks, the SUs were considered as First Stage Units (FSUs).

3.3.4 List of FSUs as described above was the sampling frame for respective cases.

3.4 **Stratification**:

(a) Each district was a stratum. Within each district of a State/UT, generally speaking, two basic strata were formed: (i) rural stratum comprising of all rural areas of the district and (ii) urban stratum comprising of all the urban areas of the district. However, within the urban areas of a district, if there were one or more towns with population one million or more as per Census 2011, each of them formed a separate basic stratum and the remaining urban areas of the district was considered as another basic stratum.

(b) A special stratum, in the *rural areas* only, was formed at all-India level before district level strata are formed in each State/UT. This stratum comprised all the uninhabited villages as per Census 2011 belonging to all States/UTs.

3.5 **Sub-stratification:**

3.5.1 **Rural sector:** Three groups of villages were formed within each stratum (except special rural stratum):

Group 1: all villages (Panchayat wards for Kerala) with Census 2011 population less than 250

Group 2: all villages (Panchayat wards for Kerala) with Census 2011 population more than or equal to 250 but less than 500

Group 3: remaining villages

The sample size for a rural stratum was allocated among 3 groups in proportion to population. Let r_1, r_2 and r_3 be the allocations to Group 1, Group 2 and Group 3 respectively. The villages within each group were first arranged in ascending order of number of cultivators. For all the three groups within each strata, '$r_1/2$'>1, '$r_2/2$'>1 and '$r_3/2$'>1, implies formation of 2 or more sub-strata in each group. Sub-strata was demarcated in Group 1, Group 2 and Group 3 respectively in such a way that each sub-stratum comprises a group of villages (all SUs of a village considered together) of the arranged frame and have more or less equal number of cultivators.

The sub-strata in Group 1 numbered as 11, 12, 13,..... The numbering of sub-strata in Group 2 were 21, 22, 23,..... Finally, for Group 3, sub-strata numbers started from 31.

If number of FSUs in a particular Group is very small, no sub-stratum was formed in that Group. Further, in those sub-strata where allocations are very small, minimum allocation was 1 each.

3.5.2 **Urban sector**: Let 'u' be the sample size allocated for an urban stratum. For all strata, if 'u/2' >1, implying formation of 2 or more sub-strata, all the UFS blocks within the stratum were first arranged in ascending order of total number of households in the UFS blocks as per urban frame. Then sub-strata were demarcated in such a way that each sub-stratum comprised a group of UFS blocks (all SUs within the block taken together) having more or less equal number of households.

3.6 **Total sample size (FSUs):** 9954 FSUs have been allocated for the central sample at all-India level. For the state sample, there are 10630 FSUs allocated for all-India.

3.7 **Allocation of total sample to States and UTs:** The total number of sample FSUs has been allocated to the States and UTs in proportion to population as per Census 2011 subject to a minimum sample allocation to each State/UT.

3.8 **Allocation of State/ UT level sample to rural and urban sectors:** State/UT level sample size has been allocated between two sectors in proportion to population as per Census 2011 with 1.5 weightage to urban sector. A minimum of 4 FSUs, each for rural and urban sector separately, have been allocated to each State/UT. For more urbanised big States like Maharashtra, Tamil Nadu etc., the urban allocation was limited to rural sample size to avoid undue weightage to urban sector.

3.9 **Allocation to strata:** Within each sector of a State/ UT, the respective sample size has been allocated to the different strata in proportion to the population as per Census 2011. Stratum level allocation was adjusted to multiples of 2 with a minimum sample size of 2.

For special stratum formed at state level as mentioned in para 3.4(b), 4 FSUs were allocated.

3.10 **Allocation to sub-strata:**

3.10.1 **Rural:** Allocation was 2 for each sub-stratum in the rural sector (except for sub-strata formed in Group 1 and Group 2 in some cases where minimum allocation was 1).

3.10.2 **Urban:** Allocation was 2 for each sub-stratum for urban sector.

3.10.3 In certain exceptional cases, especially for some States in the North Eastern Region, bigger sub-strata were formed because of much skewed distribution of villages. In such sub-strata, the allocations were more than 2.

3.11 **Selection of FSUs within a stratum/sub-stratum:**

3.11.1 From all the sub-strata in both rural and urban sector within each stratum, required number of FSUs was selected by Simple Random Sampling Without Replacement (SRSWOR) scheme.

3.12 **Formation of sub-units and listing of households**

3.12.1 **Procedure of formation of SUs:** After identification of the boundaries of the village/ UFS block which contains the sample FSU, the village/ UFS block is divided into the number of SUs (say, D) as given in the sample list by more or less equalising the present population of the village/UFS block in which the sample FSUs are located. For villages/blocks where the number of SUs to be formed is 1 as per the sample list, no SU formation is required.

3.12.2 **Listing of households:** All the households of the sample FSU are listed. Temporarily locked households are also listed after ascertaining the temporariness of locking of households through local enquiry.

3.13 **Formation of second stage strata (SSS) and allocation of households in different SSS:**

3.13.1 **Schedule 33.1 (Rural only)**: **Land and Livestock Holdings of Households and Situation Assessment of Agricultural Households:** Five SSS are formed. The composition of the SSS and number of households to be surveyed from different SSS are as follows:

Composition	**SSS No.**	**no. of sample households allocated**
non-agricultural households	1	2
agricultural households with land possessed less than 0.250 hectare (0.618 acre)	2	2
agricultural households with land possessed equal to or more than 0.250 hectare but less than 1.000 hectare (2.471 acre)	3	2
agricultural households with land possessed equal to or more than 1.000 hectare but less than 2.000 hectares (4.942 acre)	4	2
agricultural households with land possessed equal to or more than 2.000 hectares	5	2
Total		**10**

3.13.2 **Schedule 18.2**: **Debt and Investment Survey (AIDIS):**

A cut-off points 'A' (in Rs.) has been determined determined from household's usual monthly consumer expenditure collected in Schedule 21.1: Domestic Tourism Expenditure of NSS 72nd round (July 2014 – June 2015) data (with proper adjustments using price indices) for each NSS region for both rural and urban areas separately, in such a way that top 20% of the population have MPCE more than 'A'.

3.13.3 Six SSS are formed both in rural and urban sector considering the MPCE and indebtedness of households. The composition of the SSS and number of households to be surveyed from different SSS for both rural and urban sectors is as follows:

Composition	**SSS No.**	**no. of sample households allocated**
households with MPCE > A and indebted either to institutional agencies only or to both institutional and non-institutional agencies	1	2
households with MPCE > A and indebted to non-institutional agencies only	2	2
households with MPCE > A and without any indebtedness	3	2
households with MPCE ≤ A and indebted either to institutional agencies only or to both institutional and non-institutional agencies	4	2
households with MPCE ≤ A and indebted to non-institutional agencies only	5	2
households with MPCE ≤ A and without any indebtedness	6	2
Total		**12**

3.14 **Selection of households:** The sample households from each SSS for each of the schedules are selected by SRSWOR.

4. **Estimation Procedure**

4.1 **Notations:**

s = subscript for s-th stratum
t = subscript for t-th sub-stratum
i = subscript for i-th FSU [SU/ village (panchayat ward)/ block]
j = subscript for j-th second stage stratum in an FSU
k = subscript for k-th sample household within an FSU
N = total number of FSUs in any rural/urban sub-stratum
n = number of sample FSUs surveyed including 'uninhabited' and 'zero cases' but excluding casualty for a particular sub-stratum
H = total number of households listed in a second-stage stratum of an FSU
h = number of households surveyed in a second-stage stratum of an FSU

x, y = observed value of characteristics *x*, *y* under estimation
$\hat{X}$, $\hat{Y}$ = estimate of population total X, Y for the characteristics *x*, *y*

Under the above symbols,

y_{stijk} = observed value of the characteristic y for the k-th household of the j-th second stage stratum of the i-th FSU for the t-th sub-stratum of s-th stratum.

However, for ease of understanding, a few symbols have been suppressed in following paragraphs where they are obvious.

4.2 **Formulae for Estimation of Aggregates for a stratum × sub-stratum:**

4.2.1 **Schedule 0.0 (Rural/Urban):**

(i) For estimating the number of households in a stratum × sub-stratum possessing a characteristic:

$$\hat{Y} = \frac{N}{n}\sum_{i=1}^{n} y_i$$

where y_i is the total number of households possessing the characteristic *y* in i-th FSU respectively.

(ii) For estimating the number of villages in a stratum × sub-stratum possessing a characteristic:

$$\hat{Y} = \frac{N}{n}\sum_{i=1}^{n} y_i$$

where y_i is taken as 1 for sample villages possessing the characteristic and 0 otherwise.

4.2.2 **Schedules 33.1 / 18.2 (Rural/Urban):**

4.2.2.1 For j-th second-stage stratum of a stratum × sub-stratum:

$$\hat{Y}_j = \frac{N}{n_j}\sum_{i=1}^{n_j}\left[\frac{H_{ij}}{h_{ij}}\sum_{k=1}^{h_{ij}} y_{ijk}\right]$$

Where n_j is the number of sample FSUs with non-void j-th second-stage stratum.

4.2.2.2 Aggregate $\hat{Y}$ is obtained combining all the second-stage strata:

$$\hat{Y} = \sum_j \hat{Y}_j$$

Note: i) Schedule 33.1 has been canvassed in rural sector only

ii) Values of j for different schedules are as follows:

for schedule 33.1, j = 1, 2, 3, 4 or 5 and

for schedule 18.2, j = 1, 2, 3, 4, 5 or 6

4.3 **Overall Estimate for Aggregates for a stratum**:

Overall estimate for a stratum ($\hat{Y}_s$) will be obtained as

$$\hat{Y}_s = \sum_t \hat{Y}_{st}$$

4.4 **Overall Estimate of Aggregates at State/UT/all-India level**:

The overall estimate $\hat{Y}$ at the State/ UT/ all-India level is obtained by summing the stratum estimates $\hat{Y}_s$ over all strata belonging to the State/ UT/ all-India.

4.5 **Estimates of Ratios**:

Let $\hat{Y}$ and $\hat{X}$ be the overall estimates of the aggregates Y and X for two characteristics *y* and *x* respectively at the State/ UT/ all-India level.

Then the combined ratio estimate $(\hat{R})$ of the ratio $(R = \frac{Y}{X})$ will be obtained as $\hat{R} = \frac{\hat{Y}}{\hat{X}}$.

4.6 Estimates for Visit 1, Visit 2 and for the two Visits combined may be obtained separately by restricting the sample FSUs to the respective Visits.

4.7 **Estimation of Errors**:

4.7.1 **Formula for estimated variance (for Rural/Urban)**:

4.7.1.1 The sampling sheme in the current round is SRSWOR. However, if the sampling fraction is small, then the difference between variance estimates using the SRSWR and SRSWOR becomes neglible. In such case, samples can be treated as drawn with SRSWR and variance estimates becomes simpler in form and easy to calculate. It has been observed that overall sampling fraction is quite low in the current situation and hence there is not much loss in accuracy of variance estimates if SRSWR is assumed.

With this view, formulae for estimates of variances are given below based on SRSWR scheme.

(a) **Formula for aggregate $\hat{Y}$ (for Rural/Urban)**:

$$\hat{Var}(\hat{Y}) = \sum_s \hat{Var}(\hat{Y}_s) = \sum_s \sum_t \hat{Var}(\hat{Y}_{st})$$

$$\hat{Var}(\hat{Y}_{st}) = \frac{1}{n_{st}(n_{st}-1)} \sum_{i=1}^{n_{st}} (N_{st}\hat{Y}_{sti} - \hat{Y}_{st})^2$$

(b) **Formula for ratio $\hat{R}$ (for Rural/Urban)**:

$$\hat{MSE}(\hat{R}) = \frac{1}{\hat{X}^2} \sum_s \sum_t \hat{MSEst}(\hat{R})$$

where $\hat{MSE}_{st}(\hat{R}) = \frac{1}{n_{st}(n_{st}-1)} \sum_{i=1}^{n_{st}} \left[N_{st}(\hat{Y}_{sti} - \hat{R}\hat{X}_{sti}) - (\hat{Y}_{st} - \hat{R}\hat{X}_{st}) \right]^2$,

$N_{st}\hat{Y}_{sti} = \sum_j \sum_k y_{stijk} \times n_{st} \times multiplier$,

$N_{st}\hat{X}_{sti} = \sum_j \sum_k y_{stijk} \times n_{st} \times multiplier$

Multiplier is as given in the table in para 5 of Page C – 11

4.7.2 **Estimates of Relative Standard Error (RSE)**:

$$\hat{RSE}\left(\hat{Y}\right) = \frac{\sqrt{\hat{Var}\left(\hat{Y}\right)}}{\hat{Y}} \times 100$$

$$\hat{RSE}\left(\hat{R}\right) = \frac{\sqrt{\hat{MSE}\left(\hat{R}\right)}}{\hat{R}} \times 100$$

5. **Multipliers**:

The formulae for multipliers at stratum/sub-stratum/second-stage stratum level for a schedule type are given below. The formulae are applicable for both Visit1 and Visit 2.

sch type	sector	formula for multipliers
0.0	Rural/urban	$\frac{N_{st}}{n_{st}}$
33.1/18.2	Rural/urban	$\frac{N_{st}}{n_{stj}} \times \frac{H_{stij}}{h_{stij}}$
	j = 1, 2, 3, 4, 5 for Schedule 33.1 and j = 1, 2, 3, 4, 5, 6 for Schedule 18.2	

Note:

(i) For estimating any characteristic for any domain not specifically considered in sample design, indicator variable may be used.

(ii) Multipliers have to be computed on the basis of information available in the listing schedule irrespective of any misclassification observed between the listing schedule and detailed enquiry schedule.

6. **Treatment for zero cases, casualty cases etc.**:

6.1 While counting the number of FSUs surveyed (n_{st} or n_{stj}) in a stratum/sub-stratum, all the FSUs with survey codes 1 to 6 in schedule 0.0 will be considered. In addition, if no household is available in the frame then also that FSU will be treated as surveyed. However, household of a particular schedule type are available in the frame of the FSU but none of these could be surveyed then that FSU has to be treated as casualty and it will not be treated as surveyed in respect of that schedule.

6.2 *Casualty cases*: FSUs with survey code 7 as per schedule 0.0 are treated as casualties. In addition to this, an FSU, although surveyed, may have to be treated as casualty for a particular schedule type and a particular *second stage stratum* as given in the following para:

6.2.1 FSUs with survey codes 1 or 4 as per schedule 0.0 having number of households in the frame of j-th second stage stratum greater than 0 (i.e. H > 0) but number of households surveyed according to data file as nil (h =0), will be taken as casualties for j-th second stage stratum.

All the FSUs with survey codes 1 to 6 as per schedule 0.0 minus the number of casualties as identified above will be taken as the number of surveyed FSUs (n_{stj}) for that (stratum/sub-stratum) ×(second stage stratum).

7. **Treatment in cases of void second-stage strata/sub-strata /strata at FSU or household level**

7.1 A stratum/sub-stratum may be void because of the casualty of all the FSUs belonging to the stratum/sub-stratum.

7.2 When a stratum/sub-stratum is void, the following procedure is recommended:

Case(I): Stratum/Sub-stratum void cases at FSU levels (i.e. all FSUs having survey code 7):

(i) If a rural/urban sub-stratum is void then it may be merged with the other sub-stratum of the same Group of the stratum.
(ii) If a rural/urban stratum (district) is void due to all FSUs being casualty, it may be excluded from the coverage of the survey. The state level estimates will be based on the estimates of districts for which estimates are available and remarks to that effect may be added in appropriate places.

Case (II): Stratum/Sub-stratum void case at second stage stratum level (i.e. all the FSUs were casualties for a particular second stage stratum):

An FSU may be a casualty for a particular *second stage stratum* although survey code is not 7. If all the FSUs of a stratum/sub-stratum become casualties in this manner for a particular *second stage stratum*, the stratum/sub-stratum will become void.

Table 1: allocation of sample FSUs in NSS 77th round

State/UT	number of sample FSUs					
	central sample			state sample		
	total	rural	urban	total	rural	urban
(1)	(2)	(3)	(4)	(5)	(6)	(7)
ANDHRA PRADESH	398	244	154	398	244	154
ARUNACHAL PRADESH	104	72	32	104	72	32
ASSAM	304	232	72	305	233	72
BIHAR	650	518	132	650	518	132
CHHATTISGARH	192	122	70	192	122	70
GOA	20	10	10	20	10	10
GUJARAT	436	218	218	436	218	218
HARYANA	188	104	84	188	104	84
HIMACHAL PRADESH	93	67	26	92	66	26
JAMMU & KASHMIR	146	88	58	146	88	58
JHARKHAND	242	152	90	242	152	90
KARNATAKA	490	254	236	490	254	236
KERALA	304	152	152	304	152	152
MADHYA PRADESH	537	335	202	537	335	202
MAHARASHTRA	884	442	442	1106	442	664
MANIPUR	192	112	80	384	224	160
MEGHALAYA	114	78	36	114	78	36
MIZORAM	104	52	52	104	52	52
NAGALAND	80	48	32	144	48	96
ODISHA	348	258	90	349	259	90
PUNJAB	230	122	108	230	122	108
RAJASTHAN	519	337	182	518	336	182
SIKKIM	72	48	24	72	48	24
TAMIL NADU	596	298	298	596	298	298
TELANGANA	254	130	124	508	260	248
TRIPURA	192	118	74	192	118	74
UTTAR PRADESH	1181	787	394	1181	787	394
UTTARAKHAND	98	68	30	98	68	30
WEST BENGAL	724	424	300	724	424	300
A & N ISLANDS	24	14	10			
CHANDIGARH	16	4	12	16	4	12
D & N HAVELI	16	8	8			
DAMAN & DIU	16	8	8	16	8	8
DELHI	144	8	136	144	8	136
LAKSHADWEEP	16	8	8			
PUDUCHERRY	30	10	20	30	10	20
ALL - INDIA	**9954**	**5950**	**4004**	**10630**	**6162**	**4468**