Survey Methodology & Estimation Procedure

2.1 INTRODUCTION

2.1.0 The latest survey on household consumption expenditure (previously known as household consumer expenditure survey) was conducted during the period August 2022 to July 2023 in which information was collected from each sampled household in three questionnaires, namely, Questionnaire: FDQ (Food Items), Questionnaire: CSQ (Consumables & Services) and Questionnaire: DGQ (Durable Items) in three separate monthly visits in a quarter. Apart from these, another questionnaire, namely, Questionnaire: HCQ was canvassed to collect information on household characteristics.

2.2 SAMPLING DESIGN

2.2.0 In HCES: 2022-23, a multi-stage stratified sampling design was used where villages/urban blocks or sub-units of these were regarded as the First Stage Units (FSU) and the households were the Ultimate Stage Units (USU). Both the FSUs and USUs were selected with Simple Random Sampling Without Replacement (SRSWOR). 18 sample households were canvassed within an FSU.

2.2.1 CONCEPT OF PANEL

2.2.1.0 The survey period of HCES: 2022-23 was divided into 10 panels, each consisting of three months. The compositions of the panels were as below:

Panel number	Time period	Panel number	Time period
Panel 1	August - October 2022	Panel 6	January - March 2023
Panel 2	September – November 2022	Panel 7	February - April 2023
Panel 3	October - December 2022	Panel 8	March - May 2023
Panel 4	November 2022- January 2023	Panel 9	April - June 2023
Panel 5	December 2022- February 2023	Panel 10	May - July 2023

2.2.1.1 In each of these panels, an equal number of FSUs were allotted for survey to ensure uniform spread of the sample over the entire survey period. Because of arduous field conditions, panel restriction was not strictly enforced in the Andaman and Nicobar Islands, Lakshadweep, Ladakh and rural areas of Arunachal Pradesh and Nagaland.

2.2.1.2 In the first month of any panel, Questionnaire: HCQ along with any one of the questionnaires, i.e., FDQ/CSQ/DGQ were canvassed in the selected households. During the second month of the panel, any one from the remaining two questionnaires was canvassed and in the last month, the last questionnaire was canvassed. The sequence of the questionnaires to be canvassed in each month of a panel for a particular FSU was decided randomly to eliminate bias that may arise due to the adoption of a particular sequencing for canvassing. Thus, all six possible sequences, i.e., [(Q1, Q2, Q3), (Q1, Q3, Q2), (Q2, Q1, Q3), (Q2, Q3, Q1), (Q3, Q1, Q2) and (Q3, Q2, Q1)], where Q1 refers to FDQ, Q2 refers to CSQ and Q3 refers to DGQ, were canvassed at random in the sample households.

2.2.2 CHOICE OF FIRST STAGE UNIT / SAMPLING FRAME FOR FIRST STAGE UNIT

2.2.2.0 The sampling frame for urban sector is the list of Urban Frame Survey (UFS) blocks as per latest Urban Frame Survey and for rural sector, it is the list of villages as per Census 2011 updated by removing those villages which are urbanized and included in latest UFS (till the time of sample selection). Sometimes, with a view to ensure uniformity in the size of FSUs and operational convenience, large villages/UFS blocks are notionally divided into smaller units of more or less equal size, known as sub-units depending on a pre-defined criteria based on population in the village or number of households in the UFS block. The sector-specific criteria for sub-unit formation are as below:

Rural Sector

(i) The number of SUs to be formed in the villages (with Census 2011 population of 1000 or more and except some States/UTs) are decided based on projected present population of the village. The criteria are given below:

Projected Population of the village	Number of SUs to be formed
less than 1200	1
1200 to 2399	2
2400 to 3599	3
…	…

(ii) For rural areas of Himachal Pradesh, Sikkim, Andaman & Nicobar Islands, Ladakh, Parts of Uttarakhand (except four districts Dehradun, Nainital, Haridwar and Udham Singh Nagar), Jammu and Kashmir (seven districts Poonch, Rajouri, Udhampur, Reasi, Doda, Kishtwar, Ramban) and Idukki district of Kerala; SU is formed in a village if population as per Census 2011 is more than or equals to 500. The criteria for the number of SU to be formed are as below:

Projected Population of the village	Number of SUs to be formed
less than 600	1
600 to 1199	2
1200 to 1799	3
…	…

Urban Sector:

(i) SUs are formed in those UFS blocks having more than or equal to 250 households. The number of SUs to be formed within the UFS blocks is decided by the following criteria:

Number of Households in UFS Block	Number of SUs to be formed
less than 250	1
250 to 499	2
500 to 749	3
…	…

Thus, the list of Villages / UFS Blocks / Sub-Units (for those villages or UFS blocks where sub-units are formed within) together formed the sampling frame for First Stage Unit selection.

2. 2.3 STRATIFICATION OF FSUS

2.2.3.0 A State/UT is considered as a basic geographical unit for stratum formation in both the sectors for HCES:2022-23. The sector-specific stratification criteria are given below:

Rural Sector:

(i) A **Special Stratum** comprising of all the uninhabited villages as per Census 2011 is formed at All-India level.

(ii) From the remaining villages, two more strata are formed in each State/UT:

(a) Stratum 1: Comprising of the villages within a distance of 5 Kms from the district headquarter or from a city/town with more than 5 lakh population. This stratum is not formed if there are less than 50 such villages in the State/UT.

(b) Stratum 2: Rest of the villages.

Urban Sector: UFS blocks within each State/UT are divided into strata based on two criteria *i.e.*, Population as per Census 2011 and 'Affluence' status as indicated in UFS frame. The stratum compositions are as follows:

Strata Number	Strata Composition
Stratum 11:	'affluent' UFS blocks of all towns with population less than 50,000
Stratum 12:	remaining UFS blocks of all towns with population less than 50,000
Stratum 21:	'affluent' UFS blocks of all towns with population 50,000 or more but less than 3 lakhs
Stratum 22:	remaining UFS blocks of all towns with population 50,000 or more but less than 3 lakhs
Stratum 31:	'affluent' UFS blocks of all towns with population 3 lakhs or more but less than 10 lakhs
Stratum 32:	remaining UFS blocks of all towns with population 3 lakhs or more but less than 10 lakhs
Stratum 41, 42, 43…	Separate stratum for each of the Million plus towns, Odd and even numbers are given for affluent and non-affluent blocks respectively

2.2.4 SUB-STRATIFICATION OF FSUS

2.2.4.0 In the **rural sector,** three groups of villages are formed within each stratum, except special rural stratum at all-India level based on the following criteria:

Group	Population of the village (as per Census 2011)
1	less than 250
2	250 to 499
3	≥ 500

2.2.4.1 Further, the sample size for a particular rural stratum is distributed among these 3 groups in proportion to population and if the group-wise allocation is more than 20, 2 or more sub-strata are formed in each group. If the number of FSUs in a particular group is very small, no sub-stratum is formed.

2.2.4.2 In the **urban sector**, if the sample size allocated for an urban stratum is more than 20, 2 or more sub-strata are formed based on the number of FSUs within that stratum.

2.2.5 SAMPLE SIZE

2.2.5.0 8,723 FSUs in the rural areas and 6,115 in the urban areas have been surveyed in HCES:2022-23. The total sample size of 15016 FSUs has been allocated to State/UTs in proportion to Census 2011 population, subject to a minimum allocation of 40 FSUs.

2.2.6 SELECTION OF FSUS WITHIN A STRATUM/SUB-STRATUM

2.2.6.0 The required number of FSUs from each of the sub-strata is selected by SRSWOR scheme. The selected sample is divided into 10 Panels with 2 dependent sub-samples within each Panel. Three sequences of questionnaires are canvassed in the FSUs belonging to sub-sample 1 and remaining three sequences are canvassed in FSUs sub-sample 2.

2.2.7 FORMATION OF SUB-DIVISION

2.2.7.0 It has been experienced that in some of the selected FSUs, the actual present population is significantly higher than the projected population/Census population that causes operational inconvenience for listing of all the households. In such a situation, the selected FSU is notionally sub-divided into several smaller units, called Sub-division. The criteria for determining the

number of Sub-divisions to be formed in the selected rural (except areas mentioned in Point ii Para 1.2.2) /urban FSU is given below.

Approx. present population of the selected SU	Number of Sub-divisions to be formed
less than 1500	1
1500 to 2399	2
2400 to 3599	3
3600 to 4799	4
…	…

2.2.7.1 The criteria for determining the number of Sub-divisions in rural areas mentioned in Point (ii) of Para 1.2.2 is as below:

Approx. present population of the selected SU	Number of Sub-divisions to be formed
less than 750	1
750 to 1199	2
1200 to 1799	3
1800 to 2399	4
…	…

Only one Sub-division is selected randomly after forming the required number of Sub-divisions. Further, listing and selection of households are done in the selected Sub-division unit only.

2.2.8 FORMATION OF SECOND STAGE STRATA (SSS)

2.2.8.0 In order to ensure proper representation of households of different economic categories in the sample, all the households of a selected FSU are classified into three second stage stratum (SSS) with the following criteria:

SSS	Rural	Urban
SSS 1	Households with land possessed > X, where X is such that 5% of the households had land possessed more that X as per NSS 77th round SAS survey. This was determined at State/UT level	Households owned one or more four-wheeler cars for non-commercial use as on date of listing whose combined purchase price was more than Rupees 10 lakhs

SSS	Rural	Urban
SSS 2	Households with land possessed > Y and less than or equal to X, where Y is such that 20% of the households had land possessed more that Y as per NSS 77th round SAS survey. This was determined at State/UT level	Households owned one or more four-wheeler cars for non-commercial use as on date of listing whose combined purchase price was less than or equal to Rupees 10 lakhs
SSS 3	Remaining households	Remaining households

A total of 18 households are surveyed from each of the selected FSUs. Allocation of the sample households among the three SSS is done in proportion to the number of households listed in the respective SSS.

2.2.9 SELECTION OF HOUSEHOLDS

2.2.9.0 The sample households from each SSS are selected by the SRSWOR scheme.

3. ESTIMATION PROCEDURE

3.1 NOTATIONS:

s	Subscript for s^{th} stratum
t	Subscript for t^{th} sub-stratum
r	Panel number [r= 1(1)10]
m	Subscript for sub sample
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 under a particular second stage strata within an FSU/sub-division
D_1	Total number of sub-divisions formed in the sample FSU. D1 = 1, if no Sub-division is formed in the SU
N	Total number of sub-unit (FSU) 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

Let, $y_{stijkrm}$ be the observed value of the characteristic y for the k^{th} household of the j^{th} second stage stratum of the i^{th} FSU of r^{th} panel and m^{th} sub-sample for the t^{th} sub-stratum of s^{th} stratum. For ease of understanding, a few symbols have been suppressed in following paragraphs where they are obvious.

3.2 FORMULAE FOR ESTIMATION OF AGGREGATES FOR A STRATUM × SUB-STRATUM:

3.2.1 Questionnaire LHQ (Rural/Urban):

3.2.1.1 For estimating the number of households in a stratum × sub-stratum possessing a characteristic:

$$\hat{Y}=\sum_{r=1}^{10}\sum_{m=1}^{2}[\frac{N}{n}\times\sum_{i=1}^{n}D_1\times y_{irm}]$$

where y_{irm} is the total number of households possessing the characteristic *y* in i[th] FSU of r[th] panel and m[th] sub-sample respectively.

3.2.2 Formulae for Estimation of Aggregates for a stratum * sub-stratum Questionnaire HCQ, FDQ, CSQ and DGQ:

3.2.2.1 For j[th] second-stage stratum of a stratum × sub-stratum:

$$\hat{Y_j}=\sum_{r=1}^{10}\sum_{m=1}^{2}[\frac{N}{n_j}\sum_{i=1}^{n_j}\left[D_1*\frac{H_{ij}}{h_{ij}}\sum_{k=1}^{h_{ij}}y_{ijkrm}\right]]$$

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

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

$$\hat{Y}=\sum_{j=1}^{3}\hat{Y}_j$$

Note: Values of j for all the questionnaire is 3.

3.3 OVERALL ESTIMATE FOR AGGREGATES FOR A STRATUM× SUB-STRATUM:

3.3.1 Overall estimate for a stratum × sub-stratum ($\hat{Y}_{st}$) will be obtained as

$$\widehat{y_{st}}=\sum_{r=1}^{10}\sum_{m=1}^{2}[\sum_{i=1}^{n_{stj}}\frac{N_{st}}{n_{stj}}\times D_1\times\sum_{j=1}^{3}\frac{H_{stijrm}}{h_{stijrm}}\times\sum_{k=1}^{h_{stijrm}}y_{stijkrm}]$$

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

$$\hat{y_s}=\sum_t\widehat{y_{st}}$$

3.4 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.

$$\hat{Y}=\sum\hat{y_s}$$

3.5 ESTIMATION OF MONTHLY PER CAPITA CONSUMER EXPENDITURE (MPCE) FROM THREE QUESTIONNAIRES:

3.5.0 The monthly per capita consumption expenditure (MPCE) of a household, defined as "*the total value of monthly consumption of goods & services of the household divided by the number of members of the household*" is based on the data collected from those households who provided information for all the three visits, i.e., the households from whom data pertaining to all the three questionnaires, namely, FDQ, CSQ and DGQ are available. The multiplier computed from the data of third visit is used for generation of the estimates. Household size recorded at the time of canvassing of food questionnaire (FDQ) is considered for calculating MPCE.

3.5.1 Let E_1, E_2 & E_3 be the total value of expenditure on food, consumable & services and durables items respectively for a particular sampled household, compiled from the three questionnaires, namely FDQ, CSQ & DGQ. Further, assume that P_1, P_2 & P_3 be the number of household members (i.e., size of the household) recorded during the time of canvassing FDQ, CSQ and DGQ questionnaire, respectively.

3.5.2 Then the total monthly expenditure of the household, say, *TE* is computed as:

$$TE = E_1 + (E_2/P_2) \times P_1 + (E_3/P_3) \times P_1$$

3.5.3 Consequently, the MPCE of the household is computed as:

$$MPCE = TE/P_1.$$

3.6 ESTIMATES OF RATIOS:

3.6.0 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 District/State/ UT/ all-India level.

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

3.7 ESTIMATION OF ERRORS:

3.7.1 Formula for estimated variance (for Rural/Urban)

3.7.1.1 FSUs and USU (households) are selected by SRSWOR method. If i^{th} FSU has been selected, h_i unit is selected from this particular FSU x SSS by SRSWOR method. For simplicity of formula some obvious suffixes (r^{th} panel, m^{th} sub-sample) have been suppressed in following formulas for RSE (%) calculation.

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

$\widehat{Y_{ij}} = H_{ij} * \overline{y_{ij}} * D_{1si}$ and $\overline{y_{ij}} = \sum_1^{h_{ij}} y_{ijk} \Big/ h_{ij}$

$$\hat{V}ar(\hat{Y}) = \sum_s \hat{V}ar(\hat{Y}_s) = \sum_s \sum_t \sum_j \hat{V}ar(\hat{Y}_{stj})$$

$$\widehat{var}(\widehat{Y_{stj}}) = N_{st}^2 \left(\frac{1}{n_{stj}} - \frac{1}{N_{st}}\right)(1/(n_{stj} - 1))\sum_1^{n_{stj}} (H_{stij} * D_{1sti} * \overline{y_{stij}} - \frac{1}{n_{stj}} \sum_1^{n_{stj}} H_{stij} * D_{1sti}\, \overline{y_{stij}})^2 +$$

$$\frac{N_{st}}{n_{stj}} \sum_1^{n_{stj}} H_{stij}^{\,2} * D_{1sti}^{\,2} \left(\frac{1}{h_{stij}} - \frac{1}{H_{stij} * D_{1si}}\right) s^2_{wij}$$

where $s^2_{wij} = \frac{1}{(h_{stij} - 1)} \sum_{k=1}^{h_{stij}} (y_{stijk} - \overline{y_{stij}})2$

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

It may be noted that X^2 MSE$(\widehat{R})$ is unbiasedly estimated by V$(\hat{Y} - R\hat{X})$

V$(\hat{Y} - R\hat{X}) = v(\hat{u})$ where $u_{ijk} = (y_{ijk} - R_{xijk})$, $U_i = (Y_i - R\,X_i)$ and U = (Y − RX) = 0 at domain level (State).

$\widehat{X^2 MSE}(\hat{R}) = \hat{V}(\hat{U})$ at $R = \hat{R}$

$\widehat{Y_{stij}} = \frac{1}{N_{st}} * \sum_k y_{stijk} * n_{stj} *$ multiplier *and* $\widehat{X_{stij}} = \frac{1}{N_{st}} * \sum_k x_{stijk} * n_{stj} *$ multiplier

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

$$\widehat{MSE_{st}}(\hat{R}) = \sum_j N_{st}^2 \left(\frac{1}{n_{stj}} - \frac{1}{N_{st}}\right) \frac{1}{(n_{stj}-1)} \sum_1^{n_{stj}} (H_{ij}\, D_{1si}\, \overline{u_{ij}} - \frac{1}{n_{stj}} \sum_1^{n_{stj}} H_{ij}\, D_{1si}\, \overline{u_{ij}})^2$$

$$+ \sum_j \frac{N_{st}}{n_{stj}} \sum_1^{n_{stj}} H^2{}_{ij} * D_{1si}^{\,2} \left(\frac{1}{h_{ij}} - \frac{1}{H_{ij} * D_{1si}}\right) s_{uij}^{\,2}$$

where $s_{uij}^{\,2} = \frac{1}{(h_{ij}-1)} \sum_{k=1}^{h_{ij}} (u_{ijk} - \overline{u_{ij}})^2$; $\overline{u_{ij}} = \overline{y_{ij}} - \hat{R}\,\overline{x_{ij}}$

3.7.2 Estimates of Relative Standard Error (RSE):

$$R\hat{S}E\left(\hat{Y}\right)=\frac{\sqrt{V\hat{a}r\left(\hat{Y}\right)}}{\hat{Y}}\times 100 \qquad R\hat{S}E\left(\hat{R}\right)=\frac{\sqrt{M\hat{S}E\left(\hat{R}\right)}}{\hat{R}}\times 100$$

4. MULTIPLIERS:

4.0 The formulae for multipliers at stratum/sub-stratum/second-stage stratum level for a Questionnaire type are given below.

Questionnaire	Sector	Formula for multipliers
LHQ	Rural/urban	$\frac{N_{st}}{n_{st}}$
HCQ, FDQ, CSQ and DGQ	Rural/urban	$\frac{N_{st}}{n_{stj}} * D1 * \frac{H_{stij}}{h_{stij}}$
	j = 1, 2,3	

Note: Multipliers are computed on the basis of information available in the listing Schedule LHQ, irrespective of any misclassification observed between the listing Schedule and detailed enquiry Schedule.

Table A1: Number of FSUs and number of households surveyed					
State/UT	**No. of fsu's (villages/blocks)**		**No. of sample households**		
	Rural	**Urban**	**Rural**	**Urban**	**Rural + Urban**
Andhra Pradesh	357	235	6,245	4,025	10,270
Arunachal Pradesh	158	80	2,581	1,440	4,021
Assam	338	140	6,045	2,517	8,562
Bihar	759	199	13,602	3,564	17,166
Chhattisgarh	160	120	2,867	2,141	5,008
Delhi	20	200	305	2,931	3,236
Goa	20	18	360	323	683
Gujarat	320	317	5,726	5,560	11,286
Haryana	156	139	2,796	2,472	5,268
Himachal Pradesh	80	60	1,406	1,036	2,442
Jharkhand	219	140	3,927	2,458	6,385
Karnataka	378	339	6,688	5,701	12,389
Kerala	217	199	3,870	3,507	7,377
Madhya Pradesh	479	320	8,551	5,644	14,195
Maharashtra	655	653	11,596	11,163	22,759
Manipur	143	126	2,572	2,261	4,833
Meghalaya	120	60	2,132	1,079	3,211
Mizoram	80	120	1,439	2,157	3,596
Nagaland	111	60	1,996	1,079	3,075
Odisha	379	140	6,732	2,453	9,185
Punjab	177	160	3,076	2,754	5,830
Rajasthan	497	260	8,724	4,438	13,162
Sikkim	80	40	1,411	720	2,131
Tamil Nadu	416	393	7,447	6,917	14,364
Telangana	198	180	3,553	3,233	6,786
Tripura	179	100	3,222	1,800	5,022
Uttarakhand	98	60	1,700	1,073	2,773
Uttar Pradesh	1096	598	19,611	10,627	30,238
West Bengal	599	419	10,715	7,421	18,136
Andaman & Nicobar Islands	37	20	644	356	1,000
Chandigarh	20	20	360	360	720
Dadra & Nagar Haveli and Daman & Diu	20	20	350	324	674
Jammu & Kashmir	99	100	1,761	1,772	3,533
Ladakh	20	20	359	360	719
Lakshadweep	14	20	252	355	607
Puducherry	20	40	359	711	1,070
All - India	**8,723**	**6,115**	**155,014**	**106,732**	**261,746**

Note: Special rural stratum allocation at all-India level is included in rural allocation.