



FINAL REPORT

Development of Data Validation Protocol Manual

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Submitted by:

**Institute of Applied Statistics and Development Studies (IASDS),
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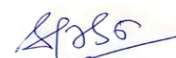
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(S.P. Singh)

Director & P.I.

Institute of Applied Statistics and Development Studies

The Report Team

Formation

- Prof. A.K. Nigam
- Dr. S.P. Singh
- Dr. Ravindra Srivastava
- Dr. B. V. S. Sisodia
- Mr. U. R. Bhave
- Dr. P.P. Tiwari
- Ms. Reeta Saxena
- Ms. Manisha Gautam
- Mr. Vishnu Kumar

Abbreviations and Acronyms

AAY	Antyodaya Anna Yojana
ABY	Ayushman Bharat Yojna
ADO	Assistant Development Officer
AI	Artificial Insemination
AICRP	All India Coordinated Research Projects
AICRP	All India Coordinated Research Projects
AIDS	Acquired Immune Deficiency Syndrome
ANM	Auxiliary Nurse Midwifery
APL	Above Poverty line)
ASHA	Accredited Social Health Activist
AWW	Anganwadi workers
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy
BDO	Block Development Officers
BDOs	Block Development Officers
BOD	Biological Oxygen Demand
BPL	Below Poverty Line
CBO	Community Based Organisations
CCE	Crop Cutting Experiments
CDB	Community Development Blocks
CDB	Community Development Blocks
CDBs	Community Development Blocks
CHCs	Community Health Centres
CMO	Chief Medical Officer
CPPGG	Centre for Policy and Good Governance
CSB	Catholic Syrian Bank
DALYs	Disability-Adjusted Life Years'
DBT	Direct Benefit Transfer
DDO	District Development Officers
DEIC	District Early Intervention Centre
DH	District Hospital
DHO	District Horticulture Officers
DISE	District Information System for Education'
DLHS	District Level Household Surveys
DRDA	District Rural Development Agency
ECA	Essential Commodities Act
EPI	Expanded Programme on Immunization
FCI	Food Corporation of India
FGD	Focus Group Discussion
FP	Family planning
FPS	Fair Price Shopkeepers
FSU	First Stage Units
GOI	Government of India
HBNC	Home-Based New-born Care
HIV	Human immunodeficiency virus
HMIS	Health Management Information System
IASDS	Institute of Applied Statistics and Development Studies
IASRI	Indian Agricultural Statistics Research Institute
ICMR	Indian Council of Medical Research

IGNOAPS	Indira Gandhi National Old Age Pension Scheme
IHD	Institute of Human Development
IRC	Indian Roads Congress
ISM&H	Indian Systems of Medicine and Homoeopathy
IUD	Intrauterine devices
JJM	Jal Jeevan Mission
LAM	Lactational Amenorrhea Method
LFPR	Labour Force Participation Rates
LPG	Liquefied petroleum gas
MDG	Millenium Development Goals
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MMR	Maternal Mortality Ratio
MNAIS	Modified National Agricultural Insurance Scheme
MOHFW	Ministry of Health and Family Welfare
MoRD	Ministry of Rural Development
MSSRF	MS Swaminathan Research Foundation
NAIS	National Agricultural Insurance Scheme
NALSA	National Legal Service Authority
NAM	National AYUSH Mission
NAS	National Achievement Survey
NCDs	Non-communicable Diseases
NDPS	Narcotic Drugs and Psychotropic Substances
NER	North Eastern Railway
NFHS	National Family Health Survey
NFSA	National Food Security Act
NGO	Non-governmental organization
NHP	National Health Policy
NIC	National Insurance Company
NIN	National Institute of Nutrition
NITI Aayog	National Institution for Transforming India
NN	Nagar Nigam
NNMB	National Nutrition Monitoring Bureau
NOAPS	National Old Age Pension Scheme
NPP	Nagar Palika Parishad
NRHM	National Rural Health Mission
NRRDA	National Rural Roads Development Agency
NSAP	National Social Assistance Programme
NSAP	National Social Assistance Programme
NSSO	National Sample Survey Office
OBC	Other Backward Caste
OPD	Outpatient Department.
PCA	Prompt Corrective Action
PDS	Public Distribution System
PH	Potential of Hydrogen
PHCs	Primary Health Centres
PHT	Pulmonary Hypertension
PMAY	Pradhan Mantri Awas Yojana
PMFBY	Pradhan Mantri Fasal Bima Yojana
PMGSY	Pradhan Mantri Gram Sadak Yojana
PMRSSM	Pradhan Mantri Rashtriya Swasthya Suraksha Mission

PNG	Piped Natural Gas
PPS	Probability proportional size
PRI	Panchayati Raj Institutions
PSU	Public Sector Undertaking
PSU	Primary Sampling Unit
PSUs	Primary sampling Units (PSUs)
PTR	Pupil-Teacher Ratio
PWDs	Public Works Departments
RBSK	Rashtriya Bal Swasthya Karyakram
RCH	Reproductive Child Health
REOs	Rural Engineering Organizations
RH	Reproductive Health
RIP	Routine Immunization Programme
RRM	Rural Roads Manual
RRT	Randomized Response Techniques
RSE	Relative Standard Errors
SAE	Small Area Estimates
SAO	Seasonal Agricultural Operations
SBD	Standard Bidding Document
SBLP	Simplified Bank Loan Participation Plan.
SBM	Swachh Bharat Mission
SC	Schedule Caste
SDG	Sustainable Development Goals
SE	Standard Error
SHG	Self-help groups
SRS	Sample Registration System
SRS	Sample Random Sampling
SRSWOR	Simple Random Sampling without Replacement
ST	Schedule Tribe
STA	State Technical Agencies
STDs	Sexually transmitted diseases
STPs	Sewage Treatment Plants
SUT	States /Union Territories
TDPS	Targeted Public Distribution System
ULB	Urban Local Body
ULB	Urban Local Bodies
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WBCIS	Weather-Based Crop Insurance Scheme
WHO	World Health Organizations
WHR	Western Himalayan Region
WPR	Windows Performance Recorder
WSHGs	Women Self Help Groups

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1 Introduction

1.1 Preamble

Good quality data is a pre-requisite to draw sound and meaningful inference from any research study involving data analysis. Poor quality data may emanate from (i) use of poor methodology, (ii) lack of sound data scrutiny and (iii) poor reporting of collected/analyzed data at different stages of reporting in-built in the system. Data validation focuses on identification of the causes of poor-quality data and taking/suggesting remedial measures thereof. We discuss these in sequel.

(i) *Poor Methodology*

Choice of proper methodology and adequate sample size is crucial for any research study. Use of poor methodology mostly includes choosing a poor study design and inadequate sample size. Both these are widespread in not only in Indian context but are also prevalent worldwide. The book by Nigam (2016) deals these issues in detail. The discussion which follows derives heavily for this book.

Among matters of concern are choice of proper survey design including adequate sample size, clarity and coverage of questionnaires, data cleaning/handling and choice of analytical techniques for obtaining valid and efficient estimates as departure from these result in wasting precious funds employed for research programs. It also often ends up with invalid and misleading estimates, which may have strong policy implications.

(ii) *Questionnaire*

Besides a proper and efficient sampling design required for obtaining efficient and valid estimates, the type and coverage of questionnaires is a crucial deciding factor in obtaining quality data. Any ill-conceived questionnaire leads to substantive non-response, incorrect and evasive responses. In many surveys, questionnaires are unduly lengthy having questions not relevant to the study. On the other hand, sometimes, these are too short to provide a satisfactory coverage. A lengthy questionnaire escalates the cost of the survey and makes management and supervision work cumbersome and time consuming. It also creates problems in editing and cleaning of data and in a decrease in efficiency. A questionnaire with insufficient coverage is likely to be less efficient because of the failure to collect some vital information.

To refine the questionnaire, it is necessary to train interviewers, data editors/cleaners, and through test data analysis. Adequate time should be allotted for field practice and the training should be evaluated. There should be effective and quality monitoring during the field work and this allows for making amends for the ambiguity and inconsistencies. Proper and effective training and pre-testing allow both the project handlers and the interviewers gain insight into the spirits underlying different questions. At data entry level also, there should be data validation employing range check, valid value check as well as internal consistency checks. The follow-up checks and corrective measures improve not only the quality of data gathered but also making the resulting estimates much more relevant and consistent. This aspect, however, is usually taken rather casually in many surveys conducted in our country.

(iii) Sample size and related issues

A close look into the research studies reveals that sample size is often arbitrarily decided, without considering the extent and nature of the variability of the character being studied and even when adequate sample size is taken, there is an attempt to present analysis by sub-groups in terms of related socio-economic, demographic, housing, or household characteristics. This practice leads to decomposition of sample size according to these sub-groups. While a smaller sample size leads to invalid estimates with unduly large standard errors, a larger sample involves avoidable wasteful expenditure. In view of this, it is worthwhile to highlight some of the observations on these issues by Nigam (2004) and Nigam and Singh (2011)

(iv) Poor Reporting of collected /analyzed data

In most of the large-scale surveys reporting of indicators is usually done by sub-groups like caste, religion, gender, age group, grades of nutritional status, grades of anemia etc. In many situations, sample size for some of these sub-groups is grossly inadequate. Examples of this, can be found in the reporting of National Family Health Survey (NFHS), NNMB, Reproductive Child Health (RCH), and District Level Household Surveys (DLHS) and others. The sample size is usually ascertained for all the groups keeping in mind the precision, complexity of the design and expected non-response. Any attempt to the reporting by sub-groups makes such estimates highly imprecise. In view of this, it may be better to go for interval estimates (confidence interval) instead of point estimates. The best alternative, however, is to develop small area estimates for the sub-groups (Chapter 13 in Nigam 2015). For examples of these types of dis-aggregated reporting one may refer to Nigam (2004) and Nigam and Singh (2011). For example, in NFHS-2, nutritional status was reported only for 77 children in Hill Region, for 57 children of ST and for 65 children of Self-employed parents. The reporting has further categorization according to grades of nutritional status. The prevalence of undernutrition ranged from 40-60 percent for below-2sd and 16-30 percent for below-3sd in these groups. Any anemia among children has been reported for 72 children in Hills, 73 in Bundelkhand and for 33 children of ST, with further division according to grades of anemia (severe, mild etc.). The reported prevalence of any anemia ranged 73-80 percent and 5-13 percent for severe anemia. One can easily notice that sample sizes were not adequate for any of these sub-group estimates.

Poor reporting of data in different stages are also widely prevalent and can be controlled through proper monitoring. Ways for controlling errors, bridging data gaps, data reduction and improving the quality of data are being discussed now. These can be applied at different stages, viz., at handling of data, sample selection and estimation. Every survey, without exception, encounters the problem of missing data or data with inconsistencies. The main reasons of missing data (i) non-collection of the responses of a sample element, (ii) deletion of some responses as they fail to satisfy certain edit checks. Inconsistencies in data may be attributed to various reasons, such as errors in tabulation, data entry or even in copying from a secondary source. In all such events, it is a norm to treat it as missing data and handle it accordingly. Whereas total non-response, i.e., when all of the responses on a unit are not available, can be handled by some form of weighting adjustment techniques, item non-responses are taken care of by imputation.

(v) *Some useful Statistical Techniques*

✓ *Imputation*

Imputation technique consists of handling non-responses by replacing each missing value with a real value. Several imputation procedures are now available for assigning values for missing responses and these are deductive imputation, overall and class-mean imputations, random imputation, hot-deck imputation, and imputation based upon regression.

✓ *Principal Components Technique*

Principal components technique can be used to reduce data. This technique uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables.

✓ *Randomized Response Technique*

In many surveys, the intention is to seek information on sensitive characteristics to which response is either false or evasive. It is therefore, useful to employ the randomized response technique in such cases. The technique ensures confidentiality to the respondent and has become popular in recent years. Detailed applications of this technique are discussed in Nigam (2016).

✓ *Small Area Estimation*

One of the areas of data gaps is related to micro-level planning, which requires estimates of different activities for 'smaller' areas having inadequate sample size. This can be achieved by using small area estimation technique which is discussed in detail in Nigam (2016).

✓ *Some other useful techniques*

Two other techniques need special, though brief, mention. Re-sampling inference is a technique which aims at finding the standard error of variance estimates of non-linear statistics, such as ratios, regression coefficient, index numbers, etc. Some other applications are the standard errors of statistics such as median (height or weight), inflation rate, wholesale price index number and the like.

Another useful technique is Snowball Sampling. This can be used in situations where large sample size is required. One such example is estimation of Maternal Mortality Ratio etc.

1.2 The Study

1.2.1 The Context

In India, data quality and reliability has long been the center of debate. Acknowledging poor data quality, several steps are now being taken at state and central levels to overcome the data quality issues. Setting up of Centre for Policy & Good Governance (CPPGG), Planning Department at Uttarakhand in partnership of UNDP and state government is one such step in this direction, to bridge the gap through studies, training, knowledge sharing and promotion of good ideas. CPPGG is deemed to act as the think tank in the State which will help in improving the research & analytics for preparing a better planning & policy framework. It is presently functioning as an autonomous body with a governing council headed by Chief Minister and Chief Secretary and has experts from various prestigious institutions as the members. The institution is mandated to identify the bottle necks in the growth trajectory of the State and firm up solutions to address the same.

UNDP will support the State Government in technical empowerment of the CPPGG, Planning Department Uttarakhand by recruiting sectoral experts in mutually agreed sectors which are beneficial for the economic growth of the State and manage the policy development for fostering economic growth and inclusive development through SDGs, under the leadership and guidance of Department of Planning.

1.2.2 Problem Statement, Overview, and Implementation plan

Policy framing and implementation is hugely dependent on the data. Thus, it becomes extremely important that good quality data is produced to have informed decisions on policy issues. Quality data includes factors such as accuracy, consistency, and reliability which is often lacking in the National/ state level data. One way to address this problem could be data triangulation and validation at different levels through robust statistical techniques.

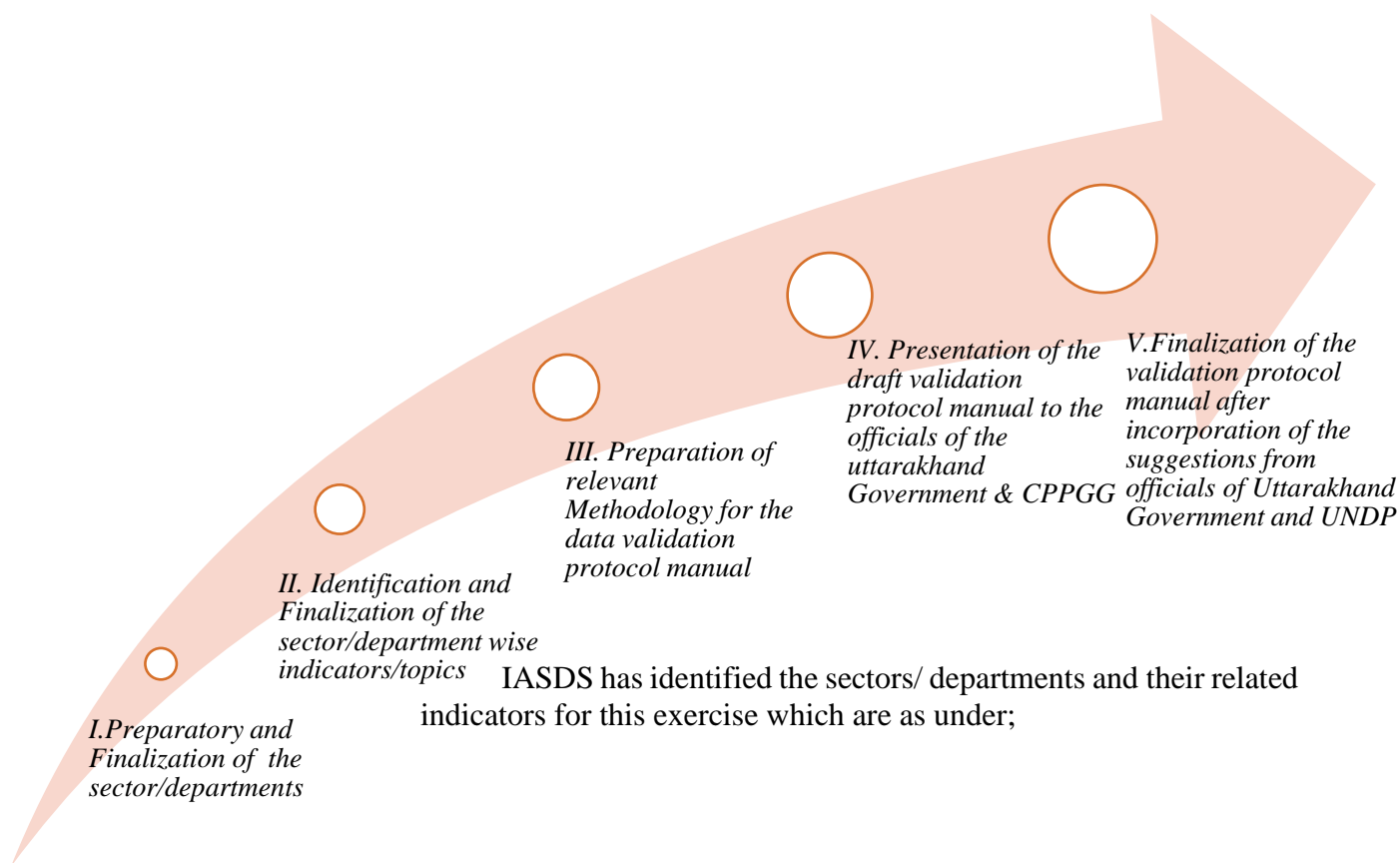
Hence, to address this issue at state level, CPPGG envisaged to formulate guidelines for fixing sample size, frequency, and levels/protocols of data validation for the State Government of Uttarakhand. The purpose of this exercise is to;

- Ensure the quality and reliability of the government data and accountability of the concerned departments towards correctness of the data.
- Fix the responsibilities of the officials towards data validation at different levels.
- Suggest the specific and simplified and precise methodology including sampling for data validation.

As the technical partner in strengthening CPPGG, UNDP has entered into an agreement with Institute of Applied Statistics and Development Studies (IASDS) Lucknow on the development of the “Development of Data Validation Protocol Manual.” IASDS will accomplish this task in the following order.

1. Identification of Sector/ Department-wise topic of data validation
2. Preparation of Sector/ Department-wise research methodology for data validation
3. Preparation of Sector/ Department-wise Data Validation Protocol Manual
4. Finalization of Data Validation Protocol Manual after suggestion from UNDP, Uttarakhand

It is proposed to adopt the following steps in order to achieve the aforementioned tasks;



<i>Table 1.1 Sectors/Departments and their related indicators</i>	
A	AGRICULTURE
1	Area, Production & Productivity of major crops
2	Area, Production & Productivity of millets and coarse grains
3	Status of farmers crop insurance
4	Post-Harvest losses of major food Crops
5	Post-Harvest losses of millets and coarse grains
6	Income of small & marginal farmers
7	Status of farm machinery and their impact on increasing farmers productivity
8	Impact of farm machinery on household Income and disburdening of women
9	Area and Productivity under organic farming
10	Status of Soil Health Card
11	Status of Agrarian Indebtedness
12	Medicinal and aromatic plants productivity and status
B	HORTICULTURE, FLORICULTURE & VEGETABLES
1	Scope and Status of Vegetable Farming
2	Production & Productivity of major fruits crop
3	Production & Productivity of major vegetable crops
4	Status and Coverage under protected cultivation (Poly houses)
5	Scope and Status of Floriculture
6	Scope and Status of Sericulture
C	ANIMAL HUSBANDRY & DAIRYING

1	Production & Productivity of milk per animal /year
2	Production & Productivity of wool per animal /year
3	Status of Milch Animal Insurance
4	Status of cattle & buffaloes covered under Artificial Insemination (AI)
5	Status of cross breeds cattle & buffaloes
6	Production & Productivity of egg per Bird
D	HEALTH AND FAMILY WELFARE
1	Status and Coverage of health insurance scheme including Ayushman Bharat Yojna
2	Health and Nutritional Status of Children U-5
3	Health and Nutrition Status of Pregnant Women and Nursing Mother
4	Maternal Mortality Rate (per 100000 live birth)
5	Child Mortality Rate (per 1000 live birth)
6	Neo-Natal Mortality Rate (per 1000 live birth)
7	Status and Coverage of Institutional Birth
8	Status of AYUSH Health Personnel's
9	Status of Immunization of Children & Pregnant Women
10	Status and Progress of Rastriya Bal Suraksha Karyakram
11	Communicable and Non communicable diseases
12	Status of Birth & Death registration
13	Status of Modern Family Planning Methods User (Currently Married women)
14	Status of Health Infrastructure and Services
E	WATER SUPPLY
1	Status of households with access to safe drinking water
2	Status of households having access to toilet facility
3	Status of water sources tested for water quality for potable water
4	Progress of Jal Jeevan Mission (JJM)
5	Progress of water sewage treatment
6	Urban households covered with sewage system
F	RURAL AND URBAN DEVELOPMENT
1	Population living below the poverty line
2	Status of P.M. Awas Yojna
3	Percentage of urban household living in slums
4	Deprived households (SECC) lifted from poverty and challenges
5	Average days of employment and challenges
6	Households including deprived households provided livelihood under different scheme
7	Employment status under MGNREGA
8	Self Help Development Groups (SHGs) formed and working
9	Village link under PMGSY
G	SOCIAL WELFARE
1	Beneficiaries under disability pension scheme
2	Beneficiaries under widows pension scheme
3	Beneficiaries under old age pension scheme
4	Status of De-addiction Centre
H	TOURISM
1	Status of Tourism Infrastructures & Services

2	Number of Tourist Arrival Annually
3	Market demand of Tourism sector
I	FOOD & CIVIL SUPPLY
1	Household using clean cooking fuel /Households using LPG or PNG
2	Availability of Food in Kg/Per capita per year
3	Available Capacity of Post-harvest storage and distribution losses of food grains
4	Evaluation of Public Distribution System
J	EDUCATION
1	Adjusted Net Enrolment Ratio at elementary (class 1-8) and secondary (class 9-10) School
2	Correct responses on learning outcomes in language, mathematics' and EVS for class 5th students
3	Correct responses on learning outcomes in language, mathematics Science and Social Science for class 8th students
4	DROP Out rates (primary, upper primary, elementary, secondary and higher secondary)
5	Schools with separate toilet facility for girls
6	Percentage of elementary and secondary schools with Pupil Teacher Ratio less than/equal to 30
7	Percentage of School Teachers Professionally Qualified
8	Proportion of computer literate adults
9	Proportion of female to male ratio in higher education
10	Female trained in vocational education

1.2.3 Process of Development of Data Validation Protocol Manual

- The information in each sector has characteristic methodology of data collection and hence for each indicator, unit of data collection and source of information will be identified, based on which validation procedures will be identified.
- These may include, but not limited to-
 - Quantitative data collection techniques (survey methodologies like random samplings (two-stage, multi-stage, stratified), probability proportional to size, randomized response techniques (RRT), Small Area Estimates etc.)
 - Qualitative data collection techniques (Key informant interviews, In-depth interviews, Focus Group Discussion (FGD) etc.)
 - Estimation of sample size
 - Interview techniques in qualitative and quantitative data collection
 - Training of teams
 - Questionnaire development and validation

In next chapters sector-wise analysis has been presented.

2 Agriculture

2.1 Preamble

Agriculture as a whole is a significant contributor to Uttarakhand's Gross State Domestic Product (23.10 percent in 2020-21 at current price). It is the chief source of livelihood for over 70 percent of its population. Commercial agriculture is practiced in the plains and the hill farmers are predominantly engaged in subsistence farming. Major crops grown in the state are rice, wheat, sugarcane, maize, soybean, pulses, oilseeds and several fruits and vegetables. Uttarakhand has four agro-climatic zones covering six altitudinal farming approaches, which means there is potential to grow a wide range of varieties of crops within the State.

To validate the situation of agriculture it is proposed to carry out the study under 7 sub-indicators:

1. Area, Production & Productivity of major crops and millets and coarse grains
2. Status of farmers crop insurance
3. Post-Harvest losses of major food crops and millets and coarse grains
4. Area and productivity under organic farming
5. Status of Soil Health Card
6. Status of Agrarian Indebtedness
7. Medicinal and aromatic plants productivity and status

2.2 Area, Production & Productivity of Major crops and millets and coarse grains

It is supposed that crop cutting experiments (CCEs) are being conducted at Panchayat level to build up first estimate of crop yield at Panchayat level. Using these estimates at Panchayat level, the estimate of crop yield / production is built up at higher level such as Nyay Panchayat, Block and District level. Validation of crop-yield based on CCEs at Panchayat level is essential because these estimates are used to build the estimate at higher level. Therefore, we envisage the following procedures for validation of estimates of crop- yield based on CCEs.

- (i) We should select 0.5 to 1.00 percentage of Panchayats of the district using method of Simple Random Sampling without replacement (SRSWOR). Generally, maximum of 4 CCEs should be conducted in each Panchayat depending on its size.

We must have the following information about CCEs in the selected Panchayat:

- a) Number of CCEs
- b) Number of crop-fields
- c) Name of the owner (farmers) of the crop-field
- d) Acreage of the crop-field

After the CCEs, the farmers should be asked to provide the production of concerned crop in the entire field in which CCEs are conducted. The crop yield/production reported by the farmer should be considered as an indicator of validation of crop-yield / production on CCEs.

The procedure can be demonstrated statistically as follows:

Suppose there are 4 CCEs in four farmers field (or four fields belonging to some farmers)
Let x_i be the area of the i^{th} field in hectare, $i=1, 2, 3, 4$. Let A be the area of CCE in hectare.

Other notations are as follows:

$\bar{Y}_i \rightarrow$ Crop- yield (Q/ha) based on CCE corresponding to i^{th} field.

$Y_{pi} \rightarrow$ Crop- production based on CCE in the i^{th} field.

$Z_{pi} \rightarrow$ Crop- production reported by farmer after CCE and harvest of entire i^{th} field.

$\bar{Z}_i \rightarrow Z_{pi} / x_i$ Crop-yield (Q/ha) computed on farmer report.

Let us summarise it in the following table:

Sl.No.	Area of field (in ha)	$\bar{Y}_i = Y_{pi} / A$; yield (Q/ha) based on CCE	\bar{Y}_{pi} ; production in (Q) based on CCE ($x_i * y_i$)	Z_{pi} ; production reported by farmer	$\bar{Z}_i = Z_{pi} / x_i$; yield (Q/ha) based on farmer report
1	x_1	\bar{Y}_1	Y_{p1}	Z_{p1}	\bar{Z}_1
2	x_2	\bar{Y}_2	Y_{p2}	Z_{p2}	\bar{Z}_2
3	x_3	\bar{Y}_3	Y_{p3}	Z_{p3}	\bar{Z}_3
4	x_4	\bar{Y}_4	Y_{p4}	Z_{p4}	\bar{Z}_4

Now crop yield (Q/ha) based on CCEs in the selected Panchayat will be given by

$$\bar{Y}_P = \sum_{i=1}^4 Y_{pi} / 4A \quad (2.2.1)$$

And crop yield (Q/ha) based on farmer report will be given by

$$\bar{Y}_{PF} = \sum_{i=1}^4 Z_{pi} / \sum_{i=1}^4 x_i \quad (2.2.2)$$

Now, we may construct an index of validation as

$$VI (\%) = \frac{\bar{Y}_{PF} - \bar{Y}_P}{\bar{Y}_P} * 100 \quad (2.2.3)$$

We must decide a threshold value of VI (%). Let us say, it is 5 percent in absolute term. Hence, if VI (%) is more than 5 percent, then the estimate based on CCEs is not reliable.

(ii) It is known that NSSO also conducts CCEs for crop yield along with standard error (SE). If crop-yield based on CCEs conducted by NSSO in the selected Panchayat is available, then this can also be used as an indicator of validation using the formula given for VI (%) in equation (2.2.3)

2.3 Status of farmers crop insurance

India is in the throes of an agrarian crisis. Indebtedness, crop failures due to vagaries of nature, non-remunerative prices for crops and poor returns over cost of cultivation have led to distress in the farming sector.

The Pradhan Mantri Fasal Bima Yojana (PMFBY) replaced the National Agricultural Insurance Scheme (NAIS) and Modified National Agricultural Insurance Scheme (MNAIS). The Weather-Based Crop Insurance Scheme (WBCIS) remains in place, though its premium rates have been made the same as in PMFBY. State governments have the authority to decide whether they want PMFBY, WBCIS or both in their respective states. PMFBY is an improvement over NAIS and MNAIS and is designed to reduce the burden of crop insurance on farmers. The scheme aims to cover nearly 50 percent of the total cropped area in the country

in the next three years. Initially in 2015-16, the budget for crop insurance was fixed at Rs. 2823 crores and eventually raised to Rs. 7750 crores in 2018-19.

According to PMFBY, agriculturists need to pay the premium rate of 2 percent for their kharif crops, 1.5 percent for their Rabi crops, and the rate of 5% for their commercial and horticultural annual crops. Under this scheme, while the farmers are obligated with these rates, the government will undertake the remaining share of premium payment.

PMFBY is a technology-based crop insurance scheme launched on 13th January 2016 through Direct Benefit Transfer (DBT). Under the scheme, the farmers will also acquire monetary assistance for recovering from crop losses. The scheme will also assist the farmers in getting the policy claims settled quickly and without much bureaucratic red tapism.

1. Eligibility Criterion for PMFBY

The eligibility criteria for PMFBY are the following:

(i) No Segregation or Classification - Though there are some requirements that the farmers will have to fulfil, the rules are simple. There are no classifications or segregations. The government wants to reach out to as many beneficiaries as possible.

(ii) Does not Depend on the Ownership of Land - The policy will cater to farmers who are the real owners of the land on which the farming is done. The scheme will also cater to the needs of the farmers who farm on rented land.

(iii) Rules for the Non-loanee Farmers - According to the government, the farmers who have not applied for any agricultural credit are known as non-loanee farmers. For them, to be a part of the scheme, the production of legal land documents and other papers is a must.

2. Coverage of Farmers and Crops in PMFBY

The Government has brought all kinds of farmers under the insurance scheme. For the time being, this segment has two main components – the compulsory component and the voluntary component. Apart from these two components, the government has kept reservations for farmers who fall in the SC/ST/OBC category as well. The compulsory component includes all those agricultural workers who have already applied for another loan that has been used for raising a seasonal crop. The seasonal crop cultivation loan is also known as the SAO (Seasonal Agricultural Operations) credit. The voluntary component includes the agricultural workers who have not applied for any kind of agricultural loan that has been used for the raising a seasonal crop. They are also eligible to be a part of the PMFBY. The government has notified a list of crops, which can be insured under the PMFBY scheme. The list contains food crops as well as commercial crops. The list contains wheat, barley, maize, paddy, pulses, millets, castor, groundnut, linseed, cashew nut, guava, banana, and mangoes.

3. Overview of PMFBY in Uttarakhand

This scheme has been launched in the state from Kharif, 2016 season as per the administrative approval and operational guidelines issued by the Department of Agriculture, Ministry of Agriculture and Farmers Welfare, Government of India. The scheme has been implemented in all 13 districts of the state.

2.3.1 Methodology for validation proposed for sub-indicator Status of farmers crop insurance

Multistage random cum purposive sampling technique should be adopted for selection of districts, blocks, and farmers as first stage, second stage and third stage units, respectively.

1. Selection of Districts (First stage unit)

Three districts should be purposively selected keeping in view of their high uptake percentage, middle uptake, and low uptake of insured farmers out of land holdings in the district as given in Table-2.2. Thus, Udham Singh Nagar district in high uptake, Nainital in Middle uptake and Chamoli in low uptake of insured farmers under PMFBY should be selected at this stage. In fact, Udham Singh Nagar district represent foot hill zone, Nainital district is in middle hill zone and Chamoli district is from high hill zone.

Table-2.2: Insured farmers under PMFBY

S.No.	District	Number of Farmers Insured	Number of Holdings	Percent of Farmer Insured
1.	Almora	18970	102240	18.55
2.	Bageshwar	5984	47522	12.59
3.	Chamoli	1014	47049	2.16
4.	Champawat	1657	32257	5.14
5.	Dehradun	5623	52882	10.63
6.	Haridwar	17905	146890	12.19
7.	Nainital	9433	48733	19.36
8.	Pauri Garhwal	1737	79410	2.19
9.	Pithoragarh	6928	73744	9.39
10.	Rudraprayag	2179	21798	10.00
11.	Tehri Garhwal	4403	85204	5.17
12.	U.S. Nagar	56084	102971	54.47
13.	Uttarkashi	6336	40605	15.60
Uttarakhand Total		138253	881305	15.69

2. Selection of blocks

From each selected district, one block should be selected having highest uptake percentage of insured farmers.

3. Selection of farmers

In the selected blocks, a list of all insured farmers may be prepared and a sample of 60 loanee and 20 non-loanee farmers from each selected block may be drawn randomly by SRSWOR. Hence, total sample would have 180 loanee farmers and 60 non-loanee farmers in the state.

Loanee Farmers –All farmers who avail of Agri-credit i.e., seasonal operational loans, are by default enrolled for PMFBY and the premium amount is deducted from their loan amounts at source by the banks.

Non-Loanee Farmers – These are farmers who have not taken Agri-credit and hence do not automatically qualify for insurance under PMFBY. But they must be voluntarily enrolled for PMFBY by paying premiums.

Each selected farmers should be contacted by the investigator concerned to validate the status of insurance scheme, and in case of situation of natural vagaries/disasters, the quantum of benefits in terms of compensation of losses received or not.

2.4 Post-Harvest losses of Major food crops (including Horticulture and Vegetable crops) millets and coarse grains

For the estimation of post-Harvest losses for major crops etc., the ICAR- CIPHET, Ludhiana has been using the sampling methodology developed by ICAR-IASRI, New Delhi. The centres of All India coordinated research project (AICRP) on PHT in different state of the country are made responsible for data collection through enquiry and observations basis using the sampling design developed by ICAR-IASRI, New Delhi. As per the sampling design, the whole country is divided into 15 agro-climatic zones. The island region is not included in the survey. So, surveys are conducted in 14 agro-climatic zones. Each climatic zone is considered as stratum. Multi-stage (4 stage) stratified random sampling design is applied for the sample survey. First stage units for (fsu) are district, second stage units are blocks third stage units are village and fourth stages units are households.

2.4.1 Current methodology for estimation Post-Harvest Losses at climatic zone level and country level

The entire sampling procedure and estimation methodologies for estimation of post-harvest losses are described in Appendix- I. However, the two types of post-harvest losses

1. At Farm operational level
2. During storage and marketing channels (wholesalers, retailers, go-downs, and processing units) at district level

The farm operations consist of harvesting, collections, threshing, winnowing, drying, sorting/grading, packaging, and transportation. Hence, the estimations procedures of farm operations/ channels are different and have to be computed separately both for obtained by enquiry and observations method.

In order to estimate the loss during farm operations at district level for different crops/commodities, the loss % through inquiry and through observation were pooled using weighted estimator (eqn. A):

$$\hat{L}_i(c) = \frac{\hat{s}_i'^2 \hat{L}_i + \hat{s}_i^2 \hat{L}_i'}{\hat{s}_i'^2 + \hat{s}_i^2} \quad (A)$$

Where, $\hat{s}_i'^2$ and \hat{s}_i^2 are estimated variances of losses based on enquiry and observational method respectively.

The standard error of estimate of percent loss for the above pooled equation can be obtained by eqn. B.

$$\hat{S}_i = \sqrt{\frac{\hat{s}_i'^2 \hat{s}_i^2}{\hat{s}_i'^2 + \hat{s}_i^2}} \quad (B)$$

2.4.2 Validation of Estimates of Post-Harvest Losses of Crops/Vegetable/Horticultural Crops

Uttarakhand comes under climate zone-1 (Western Himalayan Region). This zone consists of Jammu and Kashmir, Himachal, and Uttarakhand Pradesh. Uttarakhand consists of 13 districts. This state can be categories as Upper Hill, Middle Hill and Foot Hill using sampling procedure

for selection of district, Block etc. described in Appendix- I, one district should be chosen from each category where most of the crops/vegetable crops/ horticultural crops are being grown. One block should be selected from each selected district based on the same criterion. From each selected Block, three villages should be selected based on same criterion. 10 Farmers in each selected village should be selected. The selection of field and plots for crops/horticultural crops should be carried out accordingly. The selection of wholesaler, retailer and processing units will be carried out as follows:

- i. Selection of wholesalers:* A list of market yards/mandies at the district headquarter is prepared and one grain mandi and one fruits/vegetables mandi are selected randomly. The market yard/mandi is enumerated and two wholesalers for each commodity are selected randomly from the list. Priority is given to the wholesalers handling more than one crop/commodity.
- ii. Selection of retailers:* A list of main retail markets at district headquarters including the retail fruit and vegetable markets is prepared. One market for food grains and another market for fruits and vegetables are randomly selected and enumerated. Two retailers are selected randomly for each allocated crop giving priority to the retailer handling more than one crop.
- iii. Selection of processing units:* A list of processing units for the identified crops/livestock produce is prepared for each district and two units are selected randomly for each crop/commodity. In case the processing unit is not available in the identified districts, units located in neighboring district are taken.

Let L be the estimate of post-harvest losses at district level (farm level operations) reported by ICAR-CIPHET, Ludhiana, and L' be the estimate about through suggested methodology by the Government of Uttarakhand. The validation index is to be applied for extent of losses as per formula given below:

$$VI (\%) = \frac{L' - L}{L} * 100$$

If VI is more than 5%, then it needs revisit of the data.

Similarly, it can be applied for the post-harvest losses during storage/marketing channels.

2.4.3 Data Collection by enquiry and observations

The data may be collected by enquiry and observation basis in prescribed schedules attached herewith following the procedures mentioned in Appendix- I.

2.4.4 Data analysis and estimate of losses

The method of data analysis and estimation methodology have been described in Appendix- I. Estimates of post-harvest losses should be obtained on the basis of procedure given in Appendix- I. To validate the estimates of post-harvest losses reported by AICRP on PHT, Ludhiana for the zone-1 in which state of Uttarakhand belongs, these estimates can be compared with the estimates obtained through the sample survey conducted for Uttarakhand as per procedure described in section 2.4.2.

If the estimates differ by less than 5 percent, then the estimates reported by AICRP on PHT, Ludhiana may be considered reliable one.

2.5 Area and productivity under organic farming

Government of Uttarakhand has set a target of hundred percent cultivated area under organic farming. As per recent record mentioned in the Sustainable Development Goals index Uttarakhand 2019-20, the state has covered about 25.44 percent cultivated area under organic farming. District of Rudraprayag, Uttarkashi and Chamoli have covered 52.02, 47.47 and 38.27 percent cultivated area, respectively, under organic farming whereas U.S. Nagar (1.72) percent and Haridwar (4.33) percent area covered under organic farming.

To validate the area and productivity of the organic farming, three to five farmers per crop from the list of registered farmers for organic farming should be randomly selected by SRSWOR. A detailed information in a prescribed/tested schedule should be collected by contacting the selected farmers in order to validate the area and productivity of the crops.

2.6 Status of Soil Health Card

Current system of scheme of Soil Health Card in Uttarakhand

The following procedures are applied for making Soil-Health card of the households in the villages of Uttarakhand.

- Two village are randomly selected from each block of the district
- Each household/family of the selected village is covered for taking soil-sample corresponding to each consolidated field of crop (chakk).
- Soil-sample are analysed at specified soil-testing laboratory of the district/State Government.
- Based on results of soil-sample testing, Soil- Health card is printed and dispatched to the concerned farmer /household.

This scheme was commenced from 2015-17 as cycle I and in 2017-19 as cycle –II and model-village programme in 2019-20. In cycle, two new villages are selected from each block. Total number from holding and no. of Soil- Health cards issued in these cycles and model-village programme are available on the portal of the state of Uttarakhand.

2.6.1 Validation and status of soil health card

To validate the status of Soil- Health card in the district, one block should be selected randomly from the district. 10 households from the list of households having Soil- Health card belonging to the selected block should be selected randomly. The detailed enquiry of the status of soil health card should be done to ascertain its validity.

2.7 Status of Agrarian Indebtedness

Indebtedness among farmers is a big challenge in the present agricultural scenario in India. It has been acknowledged as one of the major stumbling blocks in the way of rural prosperity. It abates agricultural production and aggravates inequalities in the distribution of socio-economic opportunities. The farmers need credit for fulfilling short-term requirements of working capital and long-term investment in capital goods for the farm sector. Further, the farming households require credit for several reasons, which include both productive purposes for income generation and unproductive purposes for non-income generation.

➤ *Present Scenario of Indebtedness*

According to a report of National Sample Survey Organisation (NSSO) in 2014 "key Indicators of Situation of Agricultural Household in India", about 52 percent of the total agricultural household in the country are in debt.

➤ *Agricultural loan to farmers*

Farmers are indebted to institutional and non-institutional sources of credit. According to NSSO Report 2014, about 60 percent of the outstanding loans were taken from institutional sources which includes the Government with 2.1 percent, Co-operative Societies with 14.8 percent and Commercial Banks with 42.9 percent. Among the non-institutional sources, agricultural/Professionally money lenders with 25.8 percent had the major share in terms of outstanding loans. Share of institutional loan increases with increase in lands possessed by the farmers. For agricultural household covered in lowest size class of land possessed less than 0.01 hectare, only about 15 percent of the outstanding loans were from institutional sources whereas, the share is about 79 percent for the households belonging to the highest size class of land possessed more than 10 hectares.

2.7.1 Methodology for validation proposed for sub-indicator Status of Agrarian Indebtedness

- 1. Geographical coverage:*** Both Garhwal and Kumaun division of Uttarakhand.
- 2. Research approach:*** Mixed method approach-using both quantitative and qualitative survey.
- 3. Sampling design:*** Multi-stage stratified random sampling.

A. Research process for quantitative survey:

Geographically the state can broadly be divided into three zones; out of the 13 districts of the State, 3 are plain districts and the remaining 10 are hill districts.

- ***Upper hills*** - Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar
- ***Middle hills*** - Tehri-Garhwal, Garhwal, Almora, Champawat and Nainital
- ***Foothills***- Dehradun, Haridwar, Udham Singh Nagar

These zones are considered as strata.

4. Selection of districts:

Two districts (first stage units) should be selected purposively in each zone on the basis of performance of district wise disbursement of agriculture loan to the farmers, district having highest and lowest number of farmers received agriculture loan in all the three zones.

The Table-2.3 shows the selection of districts in each zone as per criteria mentioned above.

S.No.	District	Crop Loan	Term Loan	Total Agriculture Loan
Upper hill zone				
1.	Bageshwar	4755	549	5304
2.	Chamoli	2901	201	3102
3.	Pithoragarh	9202	811	10013
4.	Rudraprayag	2344	7883	10227
5.	Uttarkashi	7340	1260	8600
Middle hill zone				
6.	Almora	11861	1195	12056
7.	Champawat	3428	1197	4625
8.	Nainital	16482	18251	34733
9.	Pauri Garhwal	2986	1543	4529
10.	Tehri Garhwal	7854	559	8413
Foot hill zone				
11.	Dehradun	11335	11628	22963
12.	Haridwar	37750	15360	53110
13.	U.S.Nagar	56289	13417	69706
Total of Uttarakhand		173527	73854	247381

Source: State Level Banker's Committee Report 2021 (Position as on 30 sep.2020)

5. **Selection of blocks:** From each selected district, 2 blocks as second-stage units should be selected randomly by SRSWOR.
From each selected block all existing Nationalized and Co-operative Banks should be listed for detailed inquiry about disbursement of agriculture loan, repayment of loan by farmers in previous financial year.
6. **Selection of Villages:** 5 villages as third-stage units per block will be selected randomly by SRSWOR. Thus, a total of 60 villages should be covered.
7. **Selection of Farmers:** 10 farmers as fourth-stage units per village (8 received loan from institutional sources and 2 received loan from local money lender) will be selected randomly by SRSWOR. Thus, a total of 600 farmers should be covered.

Table.2.4 presents the complete structure of selection of districts, blocks, etc.

Sl.no.	Name of Selected districts	Blocks	Banks	Villages	Farmers
1.	Chamoli	2	All existing Nationalized and Co-operative Banks in the selected block	10	100
2.	Rudraprayag	2		10	100
3.	Nainital	2		10	100
4.	Pauri Garhwal	2		10	100
5.	Dehradun	2		10	100
6.	U.S.Nagar	2		10	100
Total		12		60	600

The detailed information about the kind of loan from Banks/non-Bank institutions etc., the repayment status of pending amount, reason for pending loan etc. should be collected

in structured schedule for validating the agrarian Indebtedness of the farmers of Uttarakhand.

B. Research process for qualitative data collection

In addition to quantitative data collection, qualitative data through in-depth interviews should also be collected from stakeholders i.e., Bank Branch Manager, Bank Mitra, Local Money Lender etc.

2.8 Medicinal and aromatic plants productivity and status

List of districts in which medicinal and aromatic plants are being grown should be taken from the Directorate of Horticulture, Government of Uttarakhand. The district-wise area under these medicinal and aromatic plants must also be available in the state along with productivity of each crop.

To validate the reported data on coverage and productivity of each medicinal and aromatic plant, one district should be randomly selected from each zone of the state. The entire selected district should be completely enumerated for coverage and productivity of medicinal and aromatic plants.

If enumerated data of the selected districts are at par with data reported by the Government, then Government data are said to be reliable.

3 Horticulture, Floriculture & Vegetables

To validate the status of horticulture, floriculture, and vegetables it is proposed to carry out the study under 5 sub- indicators:

1. Scope and Status of Vegetable Farming
2. Production and Productivity of Major fruits and Vegetables crop
3. Status and coverage under protected cultivation (Poly houses)
4. Scope and Status of Floriculture
5. Scope and Status of Sericulture

3.1 Scope and Status of Vegetable Farming

India is an agriculture-based country. Number of fruits and vegetables are being grown in all parts of India. In Agriculture sector, Horticulture alone contributes 29.5 percent to Gross Domestic Product originating from agriculture from 8.5 percent of cultivable land (Singh *et al.*, 2004) and has proved beyond doubt its potentiality for gainful diversification. One of the significant developments is that horticulture has moved from rural confine to commercial production, and this changing scenario has boosted up the horticulture industry. Several initiatives taken by the Government and other stakeholders also have great impact on the development of horticulture in terms of increased production, productivity and also availability of horticultural crops.

Uttarakhand has about 13 percent of its geographic area under cultivation out of which 80 percent of the land does not have assured irrigation facilities thus making agricultural crops totally dependent on vagaries of nature. However, in these dry lands fruit plants can be grown successfully and off – season vegetable cultivation in irrigated land. At present, the area under fruits is 179.3 thousand hectares whereas the area under vegetables is nearly half i.e., 98.84 thousand hectares with much higher production of 1014.23 thousand metric tons. Table 3.1 reveals that over the years, the area, production, and productivity of vegetables has increased in spite of land fragmentation. Despite small holdings, most of the farmers have opted for a shift in production from low value food grains like wheat, paddy, and ragi to high commercial crops particularly vegetable and pulses (Uttarakhand State Perspective and Strategic Plan 2009 -2027).

Sl.N o.	Description/Year	1991-92	2001-02	2010-11	2016-17	2018-19	2019-20
1	Area (000 ha)	57.1	93.8	85.8	91.03	97.27	98.84
2	Production (000 MT)	617.6	737.3	1030.9	945.28	993.90	1014.23
3	Productivity (MT/ha)	10.8	7.9	12.0	10.36	10.22	10.26

Source: Horticulture Board, Ministry of Agriculture Government of India, New Delhi Directorate of Horticulture Uttarakhand

As one can see from the Table 3.1, the productivity of vegetable is almost constant around 10 mt/hectare since 1991-92 to 2019-20, except in 2010-11(12.00 mt/ha). It indicates that there are lot of possibilities to increase the productivity of vegetable crops using modern practices and high yielding varieties of vegetable crop in the State

3.1.1 Methodology for validation of Scope and Status of Vegetable Farming

To validate the status for Vegetable farming both quantitative and qualitative survey should be conducted.

1. **Sampling design:** Multi-stage stratified random sampling should be used.

A) Research process for quantitative survey:

The following three zones should be considered as strata.

- **Upper hills zone:** Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar
- **Middle hills zone:** Tehri-Garhwal, Garhwal, Almora, Champawat and Nainital
- **Foothills zone:** Dehradun, Haridwar, Udham Singh Nagar

2. Selection of districts

As given in Table-3.2. Uttarkashi district in Upper hill zone, Tehri Garhwal district in Middle hill zone and Dehradun district in foot hill zone will be selected purposively as first stage unit keeping in view of highest area under Vegetable farming.

Table 3.2: District wise Area Production and Productivity of Vegetables in Uttarakhand (2019-20)					
S.No.	District	Area (ha)	% Of Area Share within zone	Production (MT)	Productivity (MT/ha)
Upper hill zone					
1.	Bageshwar	5083.22	16.42	13515.60	2.66
2.	Chamoli	2707.67	8.75	18494.68	6.83
3.	Pithoragarh	7541.48	24.37	121557.15	16.12
4.	Rudraprayag	1908.60	6.17	12703.35	6.66
5.	Uttarkashi	13710.68	44.30	75446.40	5.50
Middle hill zone					
6.	Almora	7097.00	19.71	99525.00	14.02
7.	Champawat	4298.00	11.94	32980.80	7.67
8.	Nainital	7758.77	21.55	87089.45	11.22
9.	Pauri Garhwal	6058.27	16.82	62529.65	10.32
10.	Tehri Garhwal	10798.24	29.99	113344.52	10.50
Foot hill zone					
11.	Dehradun	11959.61	40.92	90001.00	7.53
12.	Haridwar	6091.00	20.84	126682.00	20.80
13.	U.S.Nagar	11174.00	38.23	160409.85	14.36
Total of Uttarakhand		96186.54		1014279.45	10.54

Source: Directorate of Horticulture Uttarakhand data 2019-20

3. Selection of blocks:

From each selected district, one block with highest area under vegetable crops should be selected for the study. Thus, a total of three blocks should be covered for the validation process.

4. Selection of Villages:

A sample of 5 villages having larger number of vegetables growing farmers should be selected from each selected block. The requisite information of villages growing vegetable should be obtained from the office of the District Horticulture Officer/ Block level officer. Thus, a total of 15 villages should be covered.

5. Selection of Vegetable grower's farmers

10 farmers per village should be selected randomly using SRSWOR. Thus, a total of 150 farmers should be covered.

A schedule may be prepared to get the information from the selected farmers to validate the status of vegetable farming in the state.

B) Research process for qualitative data collection

Qualitative data should be collected through in-depth interviews of stakeholders District Horticulture Officers (DHO), Block Development Officers (BDOs), ADO (Agriculture), Kishan Mitra etc.

3.2 Production and Productivity of Major fruits and vegetables crop

The state of Uttarakhand consists of 13 districts. These districts are classified into three zones.

1. Upper hills - Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar
2. Middle hills - Tehri-Garhwal, Pauri-Garhwal, Almora, Champawat and Nainital
3. Plains - Dehradun, Haridwar, Udham Singh Nagar

Area under major fruit crops may be obtained from the Revenue Department of the Government. However, while conducting the sample surveys for production of fruits, the area under the respective fruit crop should also be enumerated.

3.2.1 Methodology for validation estimates of Production and Productivity of Major fruits and vegetables crop

Selection of Districts: One district from each zone should be selected purposively keeping in mind that the district selected for the verification/ validation through sample survey district is having the maximum coverage of fruit / vegetable crops.

Selection of villages – Clusters are formed from the revenue villages of the selected district. A random sample of n villages should be selected using PPS (probability proportional to size) sampling. The size should be area under the crops.

3.2.2 Validation Methodology for estimate of production/productivity

Let N be the number of the revenue villages (clusters) in the selected district. Let M_i be the size of i^{th} village ($i=1, 2, \dots, N$) or in other words, M_i is the number of fruit trees (fields in case of vegetable crops). As already stated, that a random sample of the n villages should be selected out of N villages using PPS sampling with replacement.

Let y_{ij} be the final total produce of j^{th} trees in quintal (j^{th} field in case of vegetable crop); $j=1,2,\dots,M_i$, corresponding to i^{th} village.

The objective is to estimate total production and productivity of fruit/vegetable crops in the district. That means, the total production in quintal in the district is given by

$$Y_{..} = \sum_{i=1}^N \sum_{j=1}^{M_i} y_{ij} \quad (3.2.1)$$

Let x be the area in hectare under fruit trees (field in case of vegetable crops) in the district. Then, productivity in quintal/hectare of the fruit/vegetable is given in the district as

$$\bar{Y}_{..}^* = \frac{Y_{..}}{X} \quad (3.2.2)$$

We further define the following:

$$M_0 = \sum_{i=1}^N M_i ; \quad \bar{M} = \frac{M_0}{N} ; \quad \text{the average number of fruit tree/field in the district}$$

$$\bar{y}_i = \frac{1}{M_i} \sum_{j=1}^{M_i} y_{ij} ; \quad \bar{y}_i \text{ is the mean yield of fruit or vegetable per fruit tree or field}$$

$$\bar{Y}_{..} = \sum_{i=1}^N M_i \bar{y}_i / M_0 ; \quad \bar{Y}_{..} \text{ is the population mean yield (District mean) per fruit or field}$$

Define new variate as

$$Z_{ij} = \frac{M_i y_{ij}}{M_0 P_i} ; \quad j=1,2,3,\dots,M_i ; i = 1,2, \dots,N ; \quad \text{where } P_i = \frac{X_i}{X} ;$$

The P_i probability of selection of the i^{th} village, X_i is the area under fruit crop/vegetable crop in the i^{th} village and $X = \sum_{i=1}^N X_i$

$$\bar{Z}_i = \frac{M_i \bar{y}_i}{M_0 P_i}, \quad i = 1,2, \dots, N$$

It can be seen that

$$E(\bar{Z}_i) = \sum_{i=1}^N P_i \bar{Z}_i = \sum_{i=1}^N P_i \frac{M_i \bar{y}_i}{M_0 P_i} = \bar{Y}_{..}$$

Based on random sample of n village drawn using PPS sampling with replacement, we can define

$$\bar{Z}_n = \sum_{i=1}^n \bar{Z}_i / n \quad (3.2.3)$$

It can also be seen that $E(\bar{Z}_n) = \bar{Y}_{..}$

That means sample mean \bar{Z}_n is unbiased estimator of $\bar{Y}_{..}$

The estimator of total production of fruit crop/vegetable crop in the district is given as

$$\hat{Y}_{..} = M_0 \bar{Z}_n \quad (3.2.4)$$

The productivity of fruit crop/vegetable crop per hectare is given by

$$\hat{Y}_{..}^* = \frac{\hat{Y}_{..}}{X} = \frac{M_0 \bar{Z}_n}{X} \quad (3.2.5)$$

3.2.3 Estimates of production and productivity at Zone Levels/State Level

Let M_{01} , M_{02} and M_{03} be the number of fruit tree/fields of vegetable crops in all three Zone, respectively. Let \bar{Z}_{1n} , \bar{Z}_{2n} and \bar{Z}_{3n} be the estimate of population mean of yield of fruit

crop/vegetable crop per fruit tree/per vegetable field in zone 1,2 and 3, respectively. Therefore, the estimate of production of fruit crop/vegetable crop at zone i (i=1,2,3) is given by

$$\hat{Y}_{...i} = M_{oi} \bar{Z}_{in} ; \quad i=1,2,3 \quad (3.2.6)$$

The estimate of total production of fruit crop/vegetable crop in the entire state is, therefore, given by summing of zonal production, i.e.

$$\hat{Y}_s = \sum_{i=1}^3 M_{oi} \bar{Z}_{in} \quad (3.2.7)$$

The productivity of fruit crop/vegetable crop per hectare in the state is given by

$$\hat{Y}_s = \frac{\sum_{i=1}^n M_{oi} \bar{Z}_{in}}{\sum_{i=1}^3 A_i} \quad (3.2.8)$$

Where A_i is the area under fruit crop/vegetable crop in the i^{th} zone, $i=1,2,3$.

The estimates based on the aforesaid methodology can be compared with estimates reported by the State Departments for validation purpose.

Let \hat{Y}'_s and \hat{Y}'_s be the estimates of production and productivity of fruit/vegetable crops, respectively, as per record of State of Government. The validation index for production and productivity of fruit/vegetable crops can be constructed in percentage as follow

$$VI_p(\%) = \frac{\hat{Y}'_s - \hat{Y}_s}{\hat{Y}_s} * 100 \quad \text{and} \quad VI_{pt}(\%) = \frac{\hat{Y}'_s - \hat{Y}_s}{\hat{Y}'_s} * 100 ; \text{ respectively}$$

If these VI is less than 5 % in absolute term then, the estimates provided by State of Government may be considered as reliable one.

3.3 Validation of status and coverage under protected cultivation (Poly Houses).

The government of Uttarakhand publish the data in the square meter of green houses and shade net houses every year. To validate the coverage under protected cultivation (Poly Houses). One district should be chosen randomly from each zone of Uttarakhand and the data reported by the government be validated by complete enumeration of the districts selected. If the data based on completed enumeration are at par with the data reported by Government in the selected districts, then the data reported by government may be reliable.

3.4 Scope and Status of Floriculture

Floriculture is a branch of horticulture that deals with the cultivation, processing and marketing of ornamental plants vis-à-vis landscaping of small or large areas, and maintenance of gardens so that the surroundings may appear aesthetically pleasant.

Floriculture includes annual (seasonal), biennial and perennial ornamentals, such as cacti and other succulents, bromeliads, trees, shrubs, climbers, bulbous plants, lawn and ornamental grasses, etc. The Floriculture Industry in India comprises flower production and trade of flowers, nursery and potted plants, seeds and bulbs, nursery, plant rental services, propagation through tissue culture and essential oils extraction.

✓ Floriculture activities in Uttarakhand

Floriculture is fast picking up in Uttarakhand as farmers adopt it as a lucrative option as against the traditional farming. A large number of farmers are substituting traditional farming with

flower business. High altitude coupled with cold winds and moist soil makes Uttarakhand a congenial place for investment in floriculture. Farmers say that the weather conditions are conducive as flowers bloom well in low temperatures. “The cultivation takes place in polyhouses. Exquisite varieties of flowers like carnation, lily, chrysanthemum, gladiolus, gerbera and Indian red roses are in high demand in domestic as well as in European markets are produced in the state.

Uttarakhand has about 13 percent of its geographic area under cultivation out of which 80 percent of the land does not have assured irrigation facilities thus making agricultural crops totally dependent on vagaries of nature. However, in these dry lands fruit plants can be grown successfully whereas off – season vegetable and flower cultivation are mainly done in irrigated land. At present, the area under fruits is 179300 hectares whereas the area under vegetables is nearly half i.e., 98840 hectare and area under flowers is only 1609.93 hectares with production of 3022.90 metric tons and 1442.77 lakh cut flowers’. Table 3.3 reveals that over the years, the area and production of flowers has increased in spite of land fragmentation. Despite small holdings, most of the farmers have opted for a shift in production from low value food grains like wheat, paddy, and ragi to high commercial crops particularly flower cultivation.

S.No	Description/Year	2016-17	2017-18	2018-19	2019-20	2020-21	
1	Area (in ha)	1403.03	1533.29	1562.50	1635.05	1609.93	
2	Product ion	Cut flowers (Lakh)	1564.52	1549.55	1862.63	1914.13	1442.77
		Metric Tons	2072.82	2539.05	3017.41	3055.67	3022.90

Source: Directorate of Horticulture Uttarakhand

3.4.1 Methodology for validation of proposed Scope and Status of Floriculture

“Scope and status of Floriculture in Uttarakhand” should be validated with the help of following sampling methodology.

1. **Research approach:** Mixed method approach-using both quantitative and qualitative survey.
2. **Sampling design:** Multi-stage stratified random sampling.

A. Research process for quantitative survey:

Zone wise Division of Districts

- **Upper hills** - Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar
- **Middle hills** - Tehri-Garhwal, Garhwal, Almora, Champawat and Nainital
- **Foothills**- Dehradun, Haridwar, Udham Singh Nagar

All three zones are considered as strata.

3. Selection of districts

The selection of district as first stage unit should be done on the basis of highest area under floriculture.

As given in Table 3.4. Uttarkashi district in Upper hill zone, Nainital district in Middle hill zone and Haridwar district in foot hill zone should be selected as first stage unit.

Thus, study should be carried out in 3 districts (one from each zone).

<i>Table 3.4: District wise Area and Production of Flowers in Uttarakhand (2020-21)</i>					
S.No.	District	Area (ha)	% Of Area Share within zone	Production	
				Flowers in Metric Tons	Cut flowers (No. in Lakh)
Upper hill zone					
1.	Bageshwar	16.32	5.12	4.59	-
2.	Chamoli	62.10	19.49	15.50	-
3.	Pithoragarh	16.55	5.19	10.77	0.04
4.	Rudrapur	80.60	25.29	78.46	10.65
5.	Uttarkashi	143.10	44.91	94.91	3.49
Middle hill zone					
6.	Almora	25.05	19.05	10.35	49.50
7.	Champawat	8.35	6.35	2.54	14.64
8.	Nainital	42.07	31.99	133.65	54.12
9.	Pauri Garhwal	36.60	27.83	126.41	7.00
10.	Tehri Garhwal	19.43	14.78	113.38	-
Foot hill zone					
11.	Dehradun	218.55	18.84	555.37	90.42
12.	Haridwar	803.36	69.27	1417.74	1002.18
13.	U.S. Nagar	137.85	11.89	459.23	210.73
Total of Uttarakhand		1609.93		3022.90	1442.77

Source: Directorate of Horticulture Uttarakhand data 2020-21.

4. Selection of blocks:

From each selected district, one block with highest area under Floriculture should be selected for the study. Thus, a total of three blocks should be covered for the validation process.

5. Selection of Villages:

A sample of 3 village having largest number of farmers cultivating flowers should be selected from each selected block. The requisite information of villages where flowers are cultivated should be obtained from the office of the District Horticulture Officer/ Block level officer. Thus, a total of 9 villages should be covered.

6. Selection of florist farmers:

10 florist farmers per village should be selected randomly. Thus, a total of 90 farmers should be covered. A suitable schedule should be developed for recording data on various aspects of cultivation of floriculture from the selected farmers to validate the status of floriculture in the state.

B. Research process for qualitative data collection

Qualitative data should be collected through in-depth interviews of stakeholders District Horticulture Officers (DHO), Block Development Officers (BDOs), Assistant Block Development Officer, Agriculture (ADO-Agri.), Kishan Mitra etc.

3.5 Scope and Status of Sericulture

Historically, the State of Uttarakhand is known for massive Silk production. In the year 1858 Captain Hutton introduced sericulture in the hills of Mussoorie and Messers Lister & Company took up commercial production of silk in a village on Dehradun - Haridwar Road, which is later named as “**ReshamMajari**”.

Uttarakhand state is the only state which is producing all four kinds of cocoon viz Mulberry, Oak tasar, Muga and Ericulture. But Uttarakhand also known as “Bowl of Bivoltine silk in India” because of its high quality Bivoltine cocoons of international grade.

In view of greater opportunities for creating employment of rural people as well as upliftment of the socio-economic condition, a separate Directorate of Sericulture Uttarakhand was established in the state under the Ministry of Horticulture in 2001.

• Strategy adopted by Department of Sericulture:

(i) Communitization of departmental farms, (ii) Formations of Self-help groups, (iii) Involvement of private sector/ NGO, (iv) Emphasis on quality production, (v) Training and skill up-gradation of departmental staff, (vi) Development of silk weaving, (vii) Exploitation of available food plants for the development of Vanya Silks, (viii) Development of sericulture through Centrally Sponsored Schemes, (ix) Cocoon markets function on open auction system, (x) A revolving fund of Rs. 2 crores with 50 percent share from CSB has been created to ensure spot and cash payment to the rearers, (xi) Computerized database of each rearer is being maintained, (xii) Rearers are ensured cash payment on the same day, (xiii) Oak tasar culture in upper hills and mulberry sericulture in Doon valley, (xiv) 31 Govt. farms have been communitized to sericulture Societies and SHGs, (xv) Formation of Uttarakhand Co-operative Resham Federation.

3.5.1 Methodology for validation is proposed for sub-indicator Scope and Status of Sericulture

Multistage stratified random as well as purposive sampling technique should be adopted in selection of districts, blocks, and beneficiaries.

All 13 districts in Uttarakhand are grouped into two divisions— Kumaun and Garhwal comprising of six districts and seven districts, respectively. The two divisions are considered as strata.

1. Selection of Districts

Sericulture is cultivated only in 12 districts of the State. The selection of district should be done based on district wise Cocoon production. District having high and low Cocoon production in both the division should be selected.

As given in Table-3.5. Nainital district in high Cocoon production and Pithoragarh in low Cocoon production in Kumaun division. Dehradun district in high Cocoon production and

Tehri Garhwal in low Cocoon production in Garhwal division should be selected at this stage.

Thus, a study should be carried out in 4 districts namely-Nainital, Pithoragarh, Dehradun and Tehri Garhwal.

<i>Table: -3.5: District wise Cocoon Production (Kg.)</i>		
S.No.	District	Cocoon Production (Kg.)
Kumaun Division		
1.	Almora	4104.10
2.	Bageshwar	3029.50
3.	Champawat	-
4.	Pithoragarh	2759.90
5.	Nainital	24900.60
6.	U.S. Nagar	23130.60
Garhwal Division		
7.	Chamoli	3280.00
8.	Dehradun	134562.00
9.	Haridwar	12670.20
10.	Pauri Garhwal	9202.20
11.	Rudraprayag	2624.50
12.	Tehri Garhwal	371.90
13.	Uttarkashi	2616.50
Uttarakhand		223252.00

Source: Statistical Abstract Uttarakhand 2015-16

2. Selection of blocks

From each selected district, 2 blocks should be selected randomly using SRSWOR. Thus, a total of 8 blocks should be covered.

3. Selection of farmers/households

Block wise list of all the farmers/households involved in the activities like oak plantation, castor raising, silkworm rearing, oak tasar seed production, oak tasar silk reeling, eri silk spinning, silk weaving, providing inputs etc. may be prepared and a sample of 20 farmers/households from each selected block should be selected on random basis. Hence, a total of 160 farmers/households should be interviewed to validate the data/estimate in the state in the prescribed schedule.

4 Animal Husbandry & Dairying

4.1 Preamble

Animal husbandry refers to livestock raising and selective breeding. It is the management and care of animals in which the genetic qualities and behaviour of animals are further developed for profit. Many farmers depend upon animal husbandry for their livelihood.

Livestock farming is quite fruitful to the State of Uttarakhand which forms an integral part of the rural economy contributing towards household income and family nutrition, besides producing the much-needed biomass and draught power for agricultural operations. This activity is carried out in millions of households across the state and provides employment to the marginal and landless farmers.

To validate the status of Animal Husbandry & Dairying a study should be undertaken under 5 sub- indicators:

1. Production & Productivity of Milk per animal /year
2. Production & Productivity of wool per animal /year
3. Production & Productivity of Egg per Bird
4. Status of cattle & buffaloes covered under Artificial Insemination (AI), along with Status of cross breeds cattle & buffaloes
5. Status of Milch Animal insurance

4.2 Validation of Estimates of Livestock Products (Milk, Yield /Production, Egg Production and Wool Production)

An integrated sampling design has been developed by Indian Agricultural Statistics Research Institute (IASRI), New Delhi, which is being adopted by State Governments for estimation of livestock products.

4.2.1 Coverage of surveys

The Survey is conducted in the entire rural and urban areas of the states/UTs. The Survey is conducted in the selected sample villages/ urban wards enlisting all households' enterprises, non- household enterprise institutions like all farmhouses pursuing animal husbandry and related activities.

4.2.2 Period of Survey

The survey is conducted from March to February. The entire year is divided into three seasons consisting of four months (i) Summer season: March to June (122 days), (ii) Rainy seasons: July to October (123 days) and (iii) Winter season: November to February (120 or 121 days)

4.2.3 Sampling Design

The sampling design is a stratified three –stage design with district as a stratum: (i) First stage units: villages / urban wards, (ii) Second stage units: Households and (iii) Third stage units: Animals

4.2.4 Selection of Villages

First Stage Units: The list of latest Livestock Census Villages/Wards constitute the sampling frame. Now, 80 Villages/Wards from each district are to be selected by simple random sampling without replacement (SRSWR). These Villages/Wards are divided into three groups as per season. In Uttarakhand the division is as follows.

Season 1 – 26 Villages/Wards

Season 2 – 27 Villages/Wards

Season 3 – 27 Villages/Wards

These selected villages corresponding to each season should be completely enumerated for livestock number and poultry population. Two independent random samples (Sub sample 1 and Sub sample 2) each of size 5 villages should be selected by simple random sampling without replacement (SRSWOR) for detailed survey.

4.2.5 Selection of Sample of the Households (II stage) and Animals (III stage)

The list of households of the sample village for detailed study serves as sampling frame. The survey is conducted in each month of the season, which has been named as 'round'. The selection of sample of households/ enterprises in the first round and subsequent rounds is as under

Round (Months)	Number of sample households (Second Stage Units)	Number of Animal (Third Stage Units)
1 st to 4 th Round (Month)	One cluster of 2 households each for exotic, crossbred, indigenous, non-descript cattle and indigenous and non-descript buffaloes. (Total 12 households fixed for every season) In case selected households are not having in milch goats, two additional Households are to be selected	Two animals in-milk from each household exotic, crossbred, indigenous, non-descript cattle and indigenous and non-descript buffaloes i.e., 24 animals to be selected In case of No exotic all crossbred may be considered. In case of No exotic and crossbred, all indigenous may be considered. In case of No exotic, crossbred and indigenous, all non-descript may be taken. Shortfall may be fulfilled from higher grade of cattle/buffalo also.

Round (Months)	Number of sample households (Second Stage Units)	Number of Animal (Third Stage Units)
1 st to 4 th Round (Month)	Clusters of 5 households each Total 10 households fixed for every season	All laying birds

Table 4.3: Wool

Round (Months)	Number of sample households (Second Stage Units)	Number of Animal (Third Stage Units)
1 st to 4 th Round	8 households fixed for every season	Two rams/wethers, two ewes, two lambs (Total 48 sheep) or as available in the selected sample.

Note: Recording of wool yield is done in the shearing season in the selected villages/ward and invariably be recorded during the season.

4.2.6 Commercial poultry farms- for egg and meat production

State Animal Husbandry Departments may obtain the information on number of layers maintained and average yield per layer per season from all the commercial poultry farms for estimation of egg production in the commercial farms.

In addition, the information on broiler and layer chicks placed in all the commercial poultry farms during the season from hatcheries /poultry farm associations/ supplying agents in the State for estimation of meat production in the commercial farms may also be obtained by the State Animal Husbandry Departments.

4.3 Estimation of Milk Yield/Production

Table 4.4: Notation for Estimation of Milk

T	Total number of districts in the State.
N_h	Total number of village/urban wards in the h th district.
n_h	Number of selected villages in the h th district in Sub-sample-1 for complete enumeration of livestock numbers in a season.
v_h	Number of sample villages selected from n _h villages in the h th district for detailed study.
M'_h	Number of animals in milk in the h th district both in rural / urban areas according to the latest Livestock Census.
M'_{hi}	Number of animals in milk in i th village of h th district according to the latest Livestock Census.
M_{shi}	Number of animals in milk as enumerated in the i th village of h th district during s th season as per Schedule -II.
u_{shi}	Number of sample households selected in i th sample village selected for detailed study in the h th district during s th season
m_{shij}	Number of animals in milk for which a day's milk yield is recorded from the j th household in the i th village of the h th district during the s th season.

4.3.1 Relative Standard Error (RSE)

As mentioned in chapter one, for the estimation of livestock numbers, 15 percent of the villages may be selected in the form of two independent sub-samples in a State for complete enumeration of livestock and poultry population (5% in each season) by using Simple Random Sampling Without Replacement (SRSWOR). This would facilitate in calculating Relative Standard Errors (RSE) using the simple formula

$$RSE = \frac{\text{Positive value of } (\hat{R}_1 - \hat{R}_2)}{\hat{R}_1 + \hat{R}_2} * 100$$

where, \hat{R}_1 = Estimates of the character under study from sub sample of 1

\hat{R}_2 = Estimates of the character under study from sub sample of 2

4.3.2 Estimates of Milk Production

- **Estimates of number of Animals in milk in hth district in season.**

$$\hat{M}_{sh} = \hat{R}_{sh} * M'_h \quad ; \quad \hat{R}_{sh} = \frac{\sum_{i=1}^{n_h} M_{shi}}{\sum_{i=1}^{n_h} M'_{hi}}$$

- **Estimation of Average Yield per animal per day in the hth district**

Let y_{shijk} = milk yield of kth animal in the jth household of ith village in hth district during the sth season.

Average milk yield per animal per day in the ith village of the hth district during sth season is $\bar{y}_{shi} = \frac{\sum_{j=1}^{u_{shi}} \sum_{k=1}^{m_{shij}} y_{shijk}}{\sum_{j=1}^{u_{shi}} m_{shij}}$

Estimate of Average milk yield per animal per day in hth district during sth season.

$$\bar{y}_{sh} = \frac{\sum_{i=1}^{v_h} M_{shi} * \bar{y}_{shi}}{\sum_{i=1}^{v_h} M_{shi}}$$

- **Estimate of Total milk production**

Estimate of Total milk production per day in the hth district and in the sth season is given by.

$$\hat{P}_{sh} = \hat{M}_{sh} * \bar{y}_{sh}$$

- **Estimate of total production per day in a season overall district in state is given by**

$$\hat{P}_s = \sum_{h=1}^T \hat{P}_{sh}$$

- **Estimate of average milk yield per animal per day pooled over all the districts is given by**

$$\bar{y}_s = \frac{\hat{P}}{\hat{M}_s} = \frac{\sum_{h=1}^T \hat{P}_{sh}}{\sum_{h=1}^T \hat{M}_{sh}}$$

4.3.3 Pooling of the estimates over the different seasons:

Let \hat{M} , \bar{y} and \hat{P} be the estimates of animal in milk, average milk yield per day per animal in milk animal and the total production of milk per day in the entire year. Then, we have $\hat{M} = \sum_{s=1}^3 Q_s \hat{M}_s$

Q_s is the relative period of season, and $Q_s = \frac{D_s}{D_y}$

Where D_s is the number of days in the s^{th} season and D_y is the number of days in the y^{th} year

Naturally, $\sum_{s=1}^3 Q_s = 1$; Similarly, we have

$$\hat{P} = \sum_{s=1}^3 Q_s \hat{P}_s, \quad \text{and} \quad \bar{y} = \frac{\hat{P}}{\hat{M}} = \frac{\sum_{s=1}^3 \hat{M}_s * \bar{y}_s}{\sum_{s=1}^3 Q_s \hat{M}_s}$$

4.4 Estimates of egg production

Table 4.5: Notations for Estimates of egg production

L'_h	Number of layers in h^{th} district both in rural and urban areas according to the latest Livestock Census
L'_{hi}	Number of layers in i^{th} village of h^{th} district according to the latest Livestock census
L_{shi}	Number of layers in the i^{th} village of h^{th} district during s^{th} season as per Schedule -II

- **Estimates of number of layers in h^{th} district in a season**

$$\hat{L}_{sh} = \hat{R}_{sh} * L'_h \quad \text{and} \quad \hat{R}_{sh} = \frac{\sum_{i=1}^{n_h} L_{shi}}{\sum_{i=1}^{n_h} L'_{hi}}$$

- **Estimation of Average Egg production per layer per day in the h^{th} district**

Suppose, l_{shij} =number of layers on the day of visit in j^{th} household of i^{th} village in h^{th} district during s^{th} season

Y_{shij} = number of eggs laid by l_{shij} layers in the j^{th} household of i^{th} village in h^{th} district during the s^{th} season.

Average egg production per layer per day in the i^{th} village of the h^{th} district during

$$s^{\text{th}} \text{ season is } \bar{y}_{shi} = \frac{\sum_{j=1}^{u_{shi}} y_{shij}}{\sum_{j=1}^{u_{shi}} l_{shij}}$$

Estimate of Average egg production per layer per day in h^{th} district during s^{th} season is

$$\bar{y}_{sh} = \frac{\sum_{i=1}^{v_h} L_{shi} * \bar{y}_{shi}}{\sum_{i=1}^{v_h} L_{shi}}$$

- **Estimate of Total egg production in the h^{th} district**

Estimate of Total egg production per day in the h^{th} district in the s^{th} season is given by

$$\hat{P}_{sh} = \hat{L}_{sh} * \bar{y}_{sh}$$

- **Estimate of total egg production per day in a season over all district s in the state is given by**

$$\hat{P}_s = \sum_{h=1}^T \hat{P}_{sh}$$

- **Estimate of average egg production per layer per day pooled overall the districts is given by**

$$\bar{y}_s = \frac{\hat{P}_s}{\hat{L}_s} = \frac{\sum_{h=1}^T \hat{P}_{sh}}{\sum_{h=1}^T \hat{L}_{sh}}$$

- **Pooling of estimates over the different seasons**

Let \hat{L} , \hat{P} and \bar{y} be the estimates of number of layers, total egg production per day in the entire year and the average egg production per layer per day and. These are obtained from the following formula

$$\hat{L} = \sum_{s=1}^3 Q_s \hat{L}_s \quad ; \quad \hat{P} = \sum_{s=1}^3 Q_s \hat{P}_s \quad ; \quad \bar{y} = \frac{\sum_{s=1}^3 \hat{L}_s \bar{y}_s}{\hat{L}} \quad \text{or} \quad \bar{y} = \frac{\hat{P}}{\hat{L}}$$

4.5 Estimates of wool production

Table 4.6: Notations for Estimates of wool production

X'_h	Number of sheep (Rams/Ewes/Lambs) in the h th district both rural and urban areas according to the latest Livestock census
X'_{hi}	Number sheep (Rams/Ewes/Lambs) in i th village of the h th district according to the latest Livestock census
X_{shi}	Number of sheep (Rams/Ewes/Lambs) as enumerated in the i th village of h th district during s th season as <i>Village Schedule II</i>

- **Estimates of sheep (Rams/Ewes/Lambs) population in hth district in a season**

$$\hat{X}_{sh} = \hat{R}_{sh} * X'_h \quad , \quad \hat{R}_{sh} = \frac{\sum_{j=1}^{n_h} X_{shij}}{\sum_{i=1}^{n_h} X'_{hi}}$$

- **Estimate of average wool yield per sheep in ith village of hth district during sth season**

From each selected flock in a sample of 29 flocks in a selected sample village for detailed study two rams, two ewes and two lambs are selected for recording wool yield in the shearing season.

Let x_{shij} be the number of sheep selected from the jth flock in the ith village, hth district and sth season and f_{shi} be the number of flocks selected in the ith village

Y_{shijk} be the wool yield from kth sheep in jth flock in ith village of hth district in sth season. Then, the average wool yield per sheep in the ith village of hth district during sth season is given by $\bar{y}_{shi} = \frac{\sum_{j=1}^{f_{shi}} \sum_{k=1}^{x_{shij}} Y_{shijk}}{\sum_{j=1}^{f_{shi}} x_{shij}}$

- **Estimates of wool production in hth district in a season.**

The estimate of wool production in ith village of hth district is given by

$$\hat{P}_{shi} = X''_{shi} * \bar{y}_{shi} \quad ; \quad X''_{shi} = (\% \text{ Sheep shorn}) * X_{shi}$$

Where the X_{shi}'' is the number of sheep shorn in the i^{th} village This is obtained by multiply X_{shi} with percentage of Sheep shorn in the i^{th} village i.e., $(= \frac{\sum_{j=1}^{f_{shi}} b_j}{\sum_{j=1}^{f_{shi}} a_j})$, where

b_j is number of sheep sheared in j^{th} flock and a_j is number of sheep in the j^{th} flock Estimate of average wool yield per sheep in the h^{th} district in s^{th} season is given

$$\text{by } \bar{y}_{sh} = \frac{\sum_{i=1}^{v_h} \hat{P}_{shi}}{\sum_{i=1}^{v_h} X_{shi}''}$$

- **Estimate of total wool production in h^{th} district in a season is given by**

$$\hat{P}_{sh} = \hat{X}_{sh}'' * \bar{y}_{sh}$$

Where \hat{X}_{sh}'' be the estimated number of Sheep shorn in the h^{th} district during the s^{th} season and is obtained by multiplying \hat{X}_{sh} with the percentage of sheep shorn in the h^{th} district $(= \frac{\sum_{i=1}^{v_h} X_{shi}''}{\sum_{i=1}^{v_h} X_{shi}})$

- **Estimate of annual wool production in h^{th} district (added over three seasons)**

$$\hat{P}_h = \sum_{s=1}^3 \hat{P}_{sh}$$

- **Estimate of annual wool yield per sheep (added over three seasons) in h^{th} district**

$$\bar{y}_h = \sum_{s=1}^3 \bar{y}_{sh}$$

- **Estimate of number of sheep shorn in h^{th} district**

$$\hat{X}_{sh}'' = \frac{\hat{P}_h}{\bar{y}_h}$$

- **Estimate of total wool production (P_{sh}^*) in the h^{th} district in s^{th} season and is obtained by adding the estimated wool production for rams, ewes and lambs.**

The estimated total wool production in the State during s^{th} season is given by

$$P_s^* = \sum_{h=1}^T P_{sh}^*$$

- **Estimate of average wool yield per sheep in the entire State during s^{th} season is given by**

$$\bar{y}_s = \frac{\sum_{h=1}^T \hat{P}_{sh}}{\sum_{h=1}^T \hat{X}_{sh}''}$$

4.6 Validation of data/ estimates of milk-yield/production per days etc at district level.

Using the same frame of sampling being used by the Directorate of Animal Husbandry Department of the Government, two number of sample villages one from each sub sample corresponding to 26/27 villages in the district should be selected randomly for detailed study.

We further define the following:

U'_{shi} : 12 households from each selected village to be selected ensuring coverage of all breeds milk of animals.

$M'_{shi} = 2$ animals in milk from each selected households to be selected ensuring coverage of all breeds.

4.6.1 For milk yield/ production at district level

Let \hat{M}' , \bar{y}' and \hat{P}' be the estimates of animal in milk, average milk yield per day per animal in milk animal and total milk production per day in the entire year, respectively. These estimates are obtained using the procedures described in Section 4.3.

$$\hat{M}' = \sum_{s=1}^3 Q_s \hat{M}'_s ; Q_s = \frac{D_s}{D_y} \quad (\text{Defined earlier})$$

$$\hat{P}' = \sum_{s=1}^3 Q_s \hat{P}'_s \quad \text{and} \quad \bar{y}' = \hat{P}' / \hat{M}'$$

Using those above estimates, the estimates reported by Directorate by Animal Husbandry can be validated through the following validation index.

$$VI_M (\%) = \left(\frac{\hat{M}' - \bar{M}}{\bar{M}} \right) * 100$$

$$VI_P (\%) = \left(\frac{\hat{P}' - \bar{P}}{\bar{P}} \right) * 100$$

$$VI_{\bar{y}} (\%) = \left(\frac{\bar{y}' - \bar{y}}{\bar{y}} \right) * 100$$

Where VI_M , VI_P and $VI_{\bar{y}}$ are validation indices for animals in milk, average milk yield per day per animal in milk and total milk production in the entire year, respectively.

If these VI (%) are more than 5 percent, then one may infer that estimate reported by Government may not be valid.

4.6.2 Validation of Egg Production

Following the procedure of selection of sample villages in Section 4.4, one cluster of two household should be selected from selected sample village in each season. All layer's birds should be enumerated in the selected households.

Let \hat{L}' , \bar{y}' and \hat{P}' be the estimates of number of layers, average egg production per layer per day and total egg production per day in the entire years respectively, based on methodology described in Section 4.4. These are given as

$$\hat{L}' = \sum_{s=1}^3 Q_s \hat{L}'_s ; \quad Q_s = \frac{D_s}{D_y} \quad (\text{Defined earlier}); \quad \hat{P}' = \sum_{s=1}^3 Q_s \hat{P}'_s$$

$$\text{and } \bar{y}' = \sum_{s=1}^3 \hat{L}'_s \bar{y}'_s / \hat{L}' = \hat{P}' / \hat{L}'$$

$$\text{where } \hat{L}'_s = \sum_{h=1}^T \hat{L}'_{sh}$$

$$\hat{P}'_s = \sum_{h=1}^T \hat{P}'_{sh} = \sum_{h=1}^T \hat{L}'_{sh} \bar{y}'_{sh}$$

$$\bar{y}'_s = \hat{P}'_s / \hat{L}'_s = \frac{\sum_{h=1}^T \hat{P}'_{sh}}{\sum_{h=1}^T \hat{L}'_{sh}}$$

Using the above estimates, the estimates reported by Directorate of Animal Husbandry can be validated through the following validation index

$$VI_L (\%) = \left(\frac{\hat{L}' - \bar{L}}{\bar{L}} \right) * 100$$

$$VI_P (\%) = \left(\frac{\hat{P}' - \bar{P}}{\bar{P}} \right) * 100$$

$$VI_{\bar{y}} (\%) = \left(\frac{\bar{y}' - \bar{y}}{\bar{y}} \right) * 100,$$

where VI_L (%), VI_P (%) and $VI_{\bar{y}}$ (%) are validation index for number of layers, total egg production and average egg production per layer per day, respectively.

If these validation indices are more than 5 percent, then one can infer that the estimates reported by Government may not be valid.

4.7 Validation for wool production

Following the procedure of selection of sample villages, two households should be selected from the selected village in shearing season.

One ram /wethers, one ewes and one lamb are to be selected from each household for recording wool yield in the shearing season. That means there will be in all 24 sheep or as available in the selected household.

Following the procedure laid down in Section-4.5, we have the following estimates.

4.7.1 Estimate of total wool production in the state

$$P'_s = \sum_{h=1}^T \hat{P}'_{sh}$$

4.7.2 Estimate of average wool yield per sheep in the state during s^{th} season

$$\bar{y}'_s = \frac{\sum_{h=1}^T \hat{P}'_{sh}}{\sum_{h=1}^T \hat{N}_{sh}}$$

The estimate reported by Directorate of Animal Husbandry can be validated by computing the validation Index as follows.

$$\text{For } P'_s \quad ; \quad VI_{P'_s} (\%) = \left(\frac{P'_s - P_s^*}{P_s^*} \right) * 100$$

$$\text{For } \bar{y}'_s \quad ; \quad VI_{\bar{y}'_s} (\%) = \left(\frac{\bar{y}'_s - \bar{y}_s}{\bar{y}_s} \right) * 100$$

If VI (%) is more than 5% then the estimate reported by the Government may not be valid.

4.8 Status of cattle and buffalos covered under artificial insemination, along with status of cross breed cattle and buffalos.

As per information available in the Sustainable Development Goals index Uttarakhand 2019-20, three districts viz. Haridwar, Udham Singh Nagar and Uttarkashi achieved hundred percent target of insemination. For validation of data, two district one among the above-mentioned district and one district from the remaining districts having moderate or low percentage of insemination should be selected. Three to five artificial centres of BAIF/Block may be selected from the selected district depending upon the size of the number of BAIF/Block artificial centres.

To validate the data of A I centre along with status of cross breed cattle and buffalos, verification of beneficiary should be done on complete enumeration basis.

4.9 Status of Milch Animal insurance

The proposal for Animal Insurance is submitted by Block level veterinary / State veterinary Hospitals to Insurance Regulatory Department Authority of India, which is Intermediary Body for Animal Insurance through recognized/ selected National Insurance Company. After payment of premium and other related formalities, the policy documents are issued to concerned farmers/ dairy farms etc. by Insurance Company.

To validate the status of animal insurance, 25 policy holders should be selected randomly from the list available with insurance company for ground level verification in each district.

5 Health and Family Welfare

5.1 Preamble

Adequate nutrition is crucial for health. This is closely associated with food intake for leading healthy life. Proper and well-balanced diet is essential for survival of child, health, and developmental activities.

Well-nourished children are likely to be more healthy, productive, and receptive to learning process. Undernutrition, however, acts adversely. It retards intellectual growth, reduces productivity, and perpetuates poverty. It decreases children's chance of survival and increases their susceptibility to childhood infections, such as pneumonia, diarrhea, and malaria. Undernutrition is an outcome of insufficient intake and/or inadequate absorption of energy, protein or vitamins and minerals (micronutrients) that in turn lead to nutritional deficiencies.

For early childhood, undernutrition is more harmful. In adulthood, over nutrition is also equally harmful. In the long run, however, both forms of nutrition are harmful. Disease like obesity is caused due to excess energy intake while anemia is caused due to insufficient intake of iron. Deficiency in iodine intake leads to thyroid problem while impaired vision is caused due to inadequate intake of vitamin A.

To validate various aspects of health, nutrition and family welfare, studies can be carried out under following 11 indicators.

1. Status and Coverage of health insurance scheme Including Ayushman Bharat Yojna
2. Health and Nutrition Status of Children Under-5 and Health and Nutritional Status of Pregnant women and Nursing Mothers
3. Maternal Mortality Rate (per 100000 live birth) as well as causes of mortality
4. Child Mortality Rate (per 1000 live birth) and Neo-Natal Mortality Rate (per 1000 live birth) as well as causes of mortality
5. Status and Coverage of Institutional Birth
6. Status of Immunization of Children & Pregnant Women
7. Status of AYUSH Health Personnel
8. Status and Progress of Rastriya Bal Suraksha Karyakram
9. Status of Birth & death registration
10. Communicable and Non-communicable diseases
11. Status of Modern Family Planning Methods User (Currently Married women)

Besides health and nutrition, this chapter also focuses on other aspects of health and family welfare. These are subsequently discussed at appropriate places.

5.2 Status and Coverage of health insurance scheme Including Ayushman Bharat Yojna

Life of an individual and the family is generally normal until health issues arise which cannot be predicted till its occurrence. Unforeseen medical obligations or requirements impact the savings of the family adversely.

Financial commitments on medical grounds can certainly ruin long term financial status of the family impacting education or marriage of children or social security. Most likely solution to

overcome such situations is none other than health insurance which helps in covering the cost likely to be incurred on health-related problems of an individual and the family.

Health insurance is an outcome of general insurance that covers expenses related to medication and other related expenses on health issue.

5.2.1 Health insurance products available in India

Various kinds of health insurance plans and policies whether in public sector or private sector are available in India. These are briefly described as under.

- (i) Individual health insurance plan**
This plan covers an individual towards hospitalization and other incidental expenses during hospitalization subject to the sum insured.
- (ii) Family floater health insurance plan**
This plan covers all the family members in one policy.
- (iii) Group medical plan**
These plans are adopted by business owners, private companies, government companies and departments, to provide a financial cover to the employees and the dependent family members on nominal deduction from salary towards premium.
- (iv) Unit linked health plan (ULHP)**
In this form of health insurance, the insured person gets the benefit of investment along with health care coverage. In this plan, a part of premium paid is invested and the balance is used to buy health cover. The return enables the insured to pay medical expenses over and above the sum assured.
- (v) Critical illness plan**
The expenses involved in treating a life-threatening diseases like cancer, organ failure, severe paralysis etc. are covered under a critical illness policy. The insured individual is paid a lump sum amount on the diagnosis of any of the serious diseases covered in the policy document.
- (vi) Super top up plan**
These policies provide additional coverage to an insured person over the regular policy and thus help in increasing the sum insured. Super top up policies can be availed only after the sum assured in the basic policy gets exhausted.
- (vii) Senior citizen health insurance plan**
Many types of health issues arise in old age particularly above 65 that involve expensive treatments. Keeping this in view, health insurance companies have designed special health insurance plans for senior citizens above the age of 65 years. The rate of premium in senior citizen health insurance plans is generally higher as compared to other insurance policies.
- (viii) Hospital daily cash benefit plan**
This type of policy pays a definite sum of money for everyday of hospitalization irrespective of the actual cost incurred by the insured.
- (ix) Maternity insurance plan**
These plans are designed to help women planning to have a child or are bearing one. This covers all expenses before and after the pregnancy, natal and post-natal care, expenses for delivery, nursing, and consultation etc. The policy also covers congenital or a critical disease diagnosed in the new-born child.
- (x) Personal accident plan**
A personal accident insurance policy is designed to cover the expenses incurred on medical treatment of injuries occurred due to an accident.

(xi) Ayushman Bharat Yojna (ABY)

India's National Health Policy 2017 (NHP-2017) is totally committed to the concept of Universal health coverage. The Ayushman Bharat Program has two initiatives/components viz; Health and Wellness Centres, and National Health Protection Scheme that aims for increased accessibility, availability and affordability of primary-, secondary- and tertiary-care health services in India. Afterwards, the second component has been renamed as Pradhan Mantri Rashtriya Swasthya Suraksha Mission.

As can be seen from above, ABY is the only GOI run scheme while rest are run by corporate/private sector. We limit ourselves to assess the status of this scheme.

5.2.2 Methodology for validation is proposed for sub-indicator Status and Coverage of health insurance scheme including Ayushman Bharat Yojna

Information regarding status of ABY implementation is to be accessed for the beneficiaries using the following sampling scheme.

Multistage stratified random as well as purposive sampling technique should be adopted in selection of districts, blocks, and beneficiaries

All 13 districts in Uttarakhand are grouped into two divisions— Kumaun and Garhwal comprising of six districts and seven districts respectively.

For validation, both the divisions should be considered for further selection of districts and thereafter blocks and beneficiaries from each selected district.

1. Selection of Districts

From, each division two districts one with high percentage of health scheme/ health insurance coverage and other with low percentage of health scheme/ health insurance coverage in the both divisions may be selected for the study as given in Table-5.1. Thus, Pithoragarh district is in high percentage of health scheme/ health insurance coverage and U.S. Nagar is in low percentage of health scheme/ health insurance coverage in Kumaun division and Dehradun district is in high percentage of health scheme/ health insurance coverage, and Haridwar is in low percentage of health scheme/ health insurance coverage in Garhwal division selected at this stage.

Table 5.1: Percentage of Household covered by a health scheme/ health insurance

Sl.No.	District	Percentage of Household with any individual member covered by a health scheme/ health insurance including Atal Ayushman Yojna
Kumaun Division		
1.	Almora	27.80
2.	Bageshwar	28.75
3.	Champawat	27.89
4.	Pithoragarh	36.31
5.	Nainital	33.67
6.	U.S. Nagar	25.71
Garhwal Division		
7.	Chamoli	34.95
8.	Dehradun	40.37
9.	Haridwar	26.05

10.	Pauri Garhwal	33.35
11.	Rudraprayag	33.28
12.	Tehri Garhwal	39.45
13.	Uttarkashi	40.34
Uttarakhand		32.65

2. Selection of blocks

In each selected district, Community Development Blocks (CDBs) should be divided into two groups of high and low performance, based on the information on key indicators of development. The indicators used should be literacy level, percentage of villages electrified, percentage of villages having safe drinking water facility and percentage of villages having health centres. One block from each of the two groups should be selected on random basis. Accordingly, 8 blocks should be selected from the four selected districts of both the divisions. Details about the schemes should be collected from the offices of Chief Medical Officer (CMO) /Medical Officer in charge of Block PHC/CHC and concerned Block Development Officers.

3. Selection of Beneficiary

Block wise list of all beneficiaries may be prepared and a sample of 30 beneficiaries from each selected block be selected on the random basis. Hence, total sample would consist of 240 beneficiaries for in-depth interview to validate the access of facilities to beneficiaries.

5.3 Health and Nutrition Status of Children Under-5 and Health and Nutritional Status of Pregnant women and Nursing Mothers

(i) Health and Nutrition Status of Children Under-5

As per the NFHS-5 data of Uttarakhand the percentage of children who are stunted (low height-for-age), wasted (low weight-for-height) and underweight (low weight-for-age) has gone down. There is, however, a slight increase in the percentage of severely wasted and overweight children.

As seen in NFHS- 5 report, the children suffering from anemia is 8 percent higher as compared to the data of NFHS- 4 survey report. In view of the discussions above it is pertinent to assess the nutritional status of children under 5 years of age. Data on dietary intake and anthropometric measurement may be collected using the suggested methodology.

(ii) Health and Nutritional Status of Pregnant women and Nursing Mothers

Nutrition coupled with lifestyle plays a significant role during pregnancy, lactation, infancy and early childhood. Under nutrition in the long run induces long-term effects on later health of the child, including the risk of common Non-communicable diseases such as obesity, diabetes and cardiovascular disease. At national level, it is observed that diets of women from the low socioeconomic groups are essentially similar during pre-pregnant, pregnant and lactating periods.

As a result, there is widespread maternal malnutrition leading to high prevalence of low birth weight infants and very high maternal mortality. Additional nutritive foods are needed to improve weight gain in pregnancy (10-12 Kg) and birth weight of infants (about

3 Kg). It is therefore important to ensure provision of extra food and healthcare to pregnant and lactating women

5.3.1 The methodology would be similar for both sub-indicators Health and Nutrition Status of Children U-5 and Health and Nutritional Status of Pregnant women and Nursing Mother:

1. **Research Approach:** Mixed method approach using both quantitative and qualitative data collection is recommended.
2. **Sampling Design:** There are two divisions in Uttarakhand, namely, Kumaun and Garhwal. Stratified random sampling should be used in selecting two districts from each of the divisions randomly. Thus, four districts should be covered for the purpose. A total of 250 households may be surveyed in each of the selected district. Of these 250 households, 200 households are to be covered from rural PSUs (village) and 50 households from urban PSUs (wards). From these households, mothers with at least one pre-school child may be interviewed for their knowledge and practices on breast feeding, child-rearing and socio-cultural aspects with referenece to food consumption.
3. **Selection of PSUs:**
 - **Rural PSUs (villages):** 20 villages per district may be selected, giving due representation to all the blocks/ taluks in the district by adopting systematic sampling procedure, coupled with probability proportional to size (PPS). 2-3 PSUs per district may be selected extra (reserve) in order to cope up with situations arising out of natural calamities (land-slides/ heavy rain/snowfall/ flood etc.).
 - **Urban PSUs (wards):** 5 urban wards per distict from the existing urban local body (ULB) may be selcted randomly.
4. **Selection of households:** A total of 250 households may be surveyed in each of the selected district. Of these 250 households, 200 households are to be covered from rural PSUs (village) and 50 households from urban PSUs (wards). Each selected village/ ward should be divided into 5 clusters (east, west, north, south and central) and from each cluster 2 households are to be selected. Thus, total 1000 households may be covered. From these households, mothers with at least one pre-school children should be interviewed for their knowledge and practices on breast feeding, child-rearing and socio-cultural aspects with referenece to food consumption.

Particulars	Units	Total Coverage
Divisions	2	2
Districts	2 (per division)	4
Rural PSUs (Villages)	20 (per district)	80
Urban PSUs (Wards)	5(per district)	20
Households	10	1000
Anthropometric Measurements may be done in all households		

5. Methodology for qualitative data collection

Qualitative data should be collected through in-depth interviews of various stakeholders like LHV/ANM, ASHA, AWW.

5.4 Maternal Mortality Ratio (MMR) (per 100000 live birth) as well as causes of mortality

India accounts for more than one fifth of global maternal and child deaths and one fifth of births worldwide. Each year large numbers of women die of causes related to pregnancy and

childbirth. Also, India has the highest number of neonatal deaths every year, which is nearly one third of the neonatal deaths globally. Most of these deaths could be averted with universal skilled attendance and access to emergency care. Eventhough India has made progress in improving the overall health status of its population it is far from satisfactory. The slow pace of decline of infant and child mortality on one hand and maternal mortality on the other hand is a cause of concern.

One of the major millenium development goals (MDG) is to reduce the maternal mortality by three fourths and the mortality rate among children under-five by two thirds.

Major causes associated with maternal deaths are complications in delivery in all its stages: pre-intra-and-post. Pre-delivery complications are related to neglect during pregnancy while intra-delivery complications are due to lack of appropriate care and inappropriate facilities during delivery. Post-delivery complications are outcome of neglect after delivery.

For safe motherhood and infant survival, it is important to have good and appropriate infrastructure. Community based organisations (CBOs) amd non government organisations (NGOs) and government functionaries can play a decisive role to bring required changes in health behavioirs. The main objective of the suggested study is to investigate the causes of maternal mortality and to investigate the causes of maternal mortality. Following methodolgy may be adopted.

5.4.1 Methodology for validation is proposed for sub-indicator Maternal Mortality Ratio

1. **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand should be covered
2. **Sampling Plan/ Sample Selection procedure:** The sample selection should be done by purposive method of sampling.

Division	Maternal Mortality Ratio (MMR)
Kumaun	182
Garhwal	158
Uttarakhand	165

Source- Annual Health Survey Report 2012-13

3. **Selection of CHCs:** From each division, 4 CHCs should be selected based on two highest and two lowest number of maternal deaths rate.
4. **Selection of PHCs:** From each selected CHC, 2 PHCs should be selected based on one highest and one lowest number of maternal deaths rate.

Complete enumeration of PHC should be done through verbal autopsy to find out the causes of maternal deaths.

5.5 Child Mortality Rate and Neo Natal deaths (per 1000 live births) and their reasons

❖ Child Mortality Rate (per 1000 live birth) and reasons

Death of children below 5 years and infants is termed as child mortality. Child mortality rate is calculated as number of deaths of 1000 live births. Sample Registration System which through large scale demographic survey provides reliable annual estimates of birth rate, death rate and other fertility and morality indicators at the national and lower levels. Based on latest census frame SRS sample is replaced every ten years. Ten million infants and

children die worldwide each year before their fifth birthday, and most of these deaths occur in developing nations. Infant and under-five mortality rates are key indicators for assessing the health status of communities, districts, and nations. and, of districts. In view of the importance of these indicators, the objective of this study is to assess the causes of child mortality. Methodology suggested here can used to meet this objective.

❖ **Neo-natal deaths (per 1000 live birth) and reasons**

In recent years a remarkable reduction in child mortality under 5 years of age has been observed globally. These reductions are due to lives saved after the first 4 weeks of life. Reduction in neo-natal deaths, however, is very low. To meet the Sustainable Development Goal (SDG) 3 of fifty percent reduction in child mortality by 2030, reduction in neo-natal deaths should be major public health priority. As per trends, indicated in the Global Burden of Disease Study (2013), unless further progress is made in reducing neonatal mortality, the proportional contribution of neonatal deaths to the under-5 deaths would increase.

Approximately 25 percent neo-natal deaths at international level occur in India which is currently off track to meet the MDG 4 goal. As per estimates nearly 40 percent of these neonatal deaths occur on the first day of life and nearly three fifths during the first 3 days. Further, that 40 percent of all under-five deaths are in neonates. For densely populated country like India, it is important to have relevant data at sub-national levels which includes improved estimates and causes of infant, neonatal and under-5 child mortality. This would help direct child survival resources appropriately. Chances of child survival born to poor parents are comparatively less than child born to rich parents. Important linkages exist between access to maternal and child health care infrastructure and neo-natal deaths. Aim of MDG 5 is to improve maternal health for which data at the sub-national levels are also needed as the national level data often mask inequities within the country.

It may be interesting to investigate the causes of neo-natal deaths as per the suggested methodology given below.

5.5.1 The methodology would be similar for Child Mortality Rate and Neo-Natal Mortality Rate:

1. **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand should be covered.
2. **Sampling Plan/ Sample Selection procedure:** The sample selection should be done by purposive method of sampling.
3. **Selection of districts:** Two districts from each division should be selected based on one highest and one lowest number of deaths rate respectively as per record of Annual Health Survey Report 2012-13.

<i>Table 5.4 Neo-Natal Mortality Rate and Child Mortality Rate</i>			
Sl.No.	District	Neo-Natal Mortality Rate	Child Mortality Rate
Kumaun Division			
1.	Almora	15	24
2.	Bageshwar	20	38
3.	Champawat	24	42
4.	Pithoragarh	14	27
5.	Nainital	20	36
6.	U.S. Nagar	27	44
Garhwal Division			

7.	Chamoli	17	29
8.	Dehradun	25	40
9.	Haridwar	45	77
10.	Pauri Garhwal	25	45
11.	Rudraprayag	11	26
12.	Tehri Garhwal	38	65
13.	Uttarkashi	26	51

<i>Table 5.5: Selected Districts</i>		
Division	Neo-Natal Mortality Rate	Child Mortality Rate
Kumaun	Pithoragarh and U S Nagar	Almora and U S Nagar
Garhwal	Haridwar and Rudraprayag	Haridwar and Rudraprayag

4. **Selection of CHCs:** From each selected district, 2 CHCs should be selected on the basis of one highest number and one lowest number of deaths rate.

5. **Selection of PHCs:** From each selected CHC, 2 PHCs should be selected based on one highest number and one lowest number of deaths rate.
Complete enumeration of PHCs should be done through verbal autopsy to find out the causes of deaths.

5.6 Status and Coverage of Institutional Birth

Over the past two decades, India has witnessed progress in increasing the number of institutional deliveries which means giving birth to a child in a medical institution under the overall supervision of trained and competent health personnel. Institutional births have increased substantially with more than 80 percent of the women delivering in institutions in 19 States and UTs (NFHS-5).

Institutional delivery is more than 90 percent in 14 out of the total 22 States and UTs.

<i>Table 5.6: Levels of Institutional Birth data validation</i>		
Level No.	Level head	Descriptions
Level 1	State level	State level data validate with District level data
Level 2	District level	District level validate with Block/CHC level data
Level 3	Block /CHC level	Block/CHC level validate with PHC level data
Level 4	PHC level	PHC level data validate with Sub-Centre level data
Level 5	SHC level	Sub-Centre level data validate with Village level data
Level 6	Village level	Village level data validate at Household level

5.6.1 Methodology for validation proposed for sub-indicator Status and Coverage of Institutional Birth

1. **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand should be covered.
2. **Sampling Plan/ Sample Selection procedure:** The sample selection should be done by purposive method of sampling.
3. **Selection of districts:** Two districts from each division should be selected to validate status and coverage of Institutional births based on one highest proportion of Institutional

births and other would-be lowest proportion of Institutional births as reported in the National Family Health Survey - 5.

Table 5.7 Institutional births (%)		
Sl.No.	District	Institutional births (%)
Kumaun Division		
1.	Almora	80.1
2.	Bageshwar	82.0
3.	Champawat	79.8
4.	Pithoragarh	84.9
5.	Nainital	81.2
6.	U.S. Nagar	85.9
Garhwal Division		
7.	Chamoli	73.9
8.	Dehradun	91.7
9.	Haridwar	79.8
10.	Pauri Garhwal	76.0
11.	Rudraprayag	86.6
12.	Tehri Garhwal	82.2
13.	Uttarkashi	85.9

Table 5.8 Selected Districts	
Kumaun Division	Champawat and US Nagar
Garhwal Division	Chamoli and Dehradun

4. **Selection of Blocks/ CHCs:** From each selected district, 2 blocks /CHCs should be selected randomly.
5. **Selection of PHCs:** From each selected block/CHC, 2 PHCs should be selected randomly.
6. **Selection of SHCs:** From each selected PHC, 2 SHCs should be selected randomly.
7. **Selection of villages:** One village per SHC should be selected randomly.

Complete enumeration should be done for the last one year of delivery in order to identify whether the births are institutional or non-institutional.

5.7 Status of Immunization of Children & Pregnant Women

Vaccines are used to provide immunity by stimulating the production of antibodies. Process of immunization is designed to develop resistance towards infectious diseases in human beings.

To protect children from life threatening conditions, which are preventable, immunization programme is one of the key interventions, Due to this intervention programme, morbidity, and mortality due to vaccine preventable diseases has been drastically reduced. This programme was modified as Universal Immunization Programme (UIP) in 1985 and implemented in phased manner. Twelve vaccines are provided to infants, children, and pregnant women. Overall vaccination, however, falls short of expected targets in different geographical regions. For example, according to NFHS-5 data, Pithoragarh had the highest and Dehradun & Garhwal had the lowest in all basic vaccination coverage and there is a 4.2 percent gap between the Male and Female population in Uttarakhand.

❖ *Service Providers*

- Routine Immunization
- ANM at sub centre and APHC/ PHC/CHC/ District Hospital.
- 1st Wednesday of every month at sub centre and in District Hospitals every Wednesday.
- Outreach sessions to be held on every Saturday on village health nutrition day (VHND)
- Sessions sites are either Anganwadi centre / Panchayat Bhawan/ Schools.

<i>Table 5.9: Immunization Schedule</i>				
Vaccine	When to give	Dose	Route	Site
For Infants				
BCG	At birth or as early as possible till one year of age	0.1ml (0.05ml until 1 month of age)	Intra -dermal	Left Upper Arm
Hepatitis B Birth dose	At birth or as early as possible within 24 hours	0.5 ml	Intramuscular	Anterolateral side of mid-thigh-LEFT
OPV Birth dose	At birth or as early as possible within the first 15 days	2 drops	Oral	-
OPV 1,2 & 3	At 6 weeks, 10 weeks & 14 weeks	0.5 ml	Oral	-
IPV (inactivated Polio Vaccine)	14 weeks	0.5 ml	Intramuscular	Anterolateral side of mid-thigh-RIGHT
Pentavalent 1,2 & 3	At 6 weeks, 10 weeks & 14 weeks	0.5 ml	Intramuscular	Anterolateral side of mid-thigh-LEFT
Rota Virus Vaccine	At 6 weeks, 10 weeks & 14 weeks	5 drops	Oral	-
Measles 1st Dose	9 completed months-12 months. (Give up to 5 years if not received at 9-12 months age)	0.5 ml	Subcutaneous	Right Upper Arm
Vitamin A, 1st Dose	At 9 months with measles	1 ml (1 lakh IU)	Oral	-
For children				
DPT 1st booster	16-24 months	0.5 ml	Intramuscular	Anterolateral side of mid-thigh-LEFT
OPV Booster	16-24 months	2 drops	Oral	
Measles 2nd dose	16-24 months	0.5 ml	Subcutaneous	Right Upper Arm
Vitamin A (2nd to 9th dose)	16 months with DPT/OPV booster, then, one dose	2 ml (2 lakh IU)	Oral	-

	every 6 month up to the age of 5 years)			
DPT 2nd Booster	5-6 years	0.5 ml.	Intramuscular	Left Upper Arm
TT	10 years & 16 years	0.5 ml	Intramuscular	Upper Arm

**Source- National Health Mission – Universal Immunization Program- National Immunization Schedule*

❖ **Objective of this exercise**

The overall objective of this proposed exercise is to assess the variation in Routine Immunization Coverage reported at different levels in districts of Uttarakhand.

The specific objectives of this exercise should be:

- To collect routine immunization coverage data as reported during Immunization at different levels viz., session site/ village, PHC/UPHC, CHC and district.
- To validate the routine immunization coverage and identify errors which take place in reporting at these levels during the roll up process.

5.7.1 Reporting structure during Routine Immunization Programme (RIP)

- As a first step, at the proposed immunization site ASHA/AWW/ANMs prepare a list of all children living in the area in format-1 of routine immunization. On the day of immunization, this format is used by the service provider and name of the child immunized is ticked.
- Next, ASHA/AWW/ANMs compile format-1 and use the data to fill up format-2 which is submitted to respective PHC or Urban Health Centre (UHC) in case of urban area.
- At third stage all PHCs/UHCs compile format 2 into format 3 and send this format to respective CHC/Block PHC/Civil/District Hospital.
- At fourth stage all CHCs/Block PHCs/Civil/District Hospitals compile format 3 into format 4 and submit the information to the DIO of their district.
- At stage five DIO at district level compiles all the block reports received from the CHCs/Block PHCs in Format 5 and submit it to the state.
- Finally, State health officials compile reports received from all the districts.

Table 5.10: Levels of Immunization data validation		
Level No.	Level head	Descriptions
Level 1	State level	State level data validate with District level data
Level 2	District level	District level validate with Block/CHC level data
Level 3	Block /CHC level	Block/CHC level validate with PHC level data
Level 4	PHC level	PHC level data validate with Sub-Centre level data
Level 5	SHC level	Sub-Centre level data validate with Village level data
Level 6	Village/Session site level	Village/Session site level data validate at Household level

5.7.2 Methodology for validation proposed for sub-indicator Status of Immunization of Children & Pregnant Women

1. **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand should be covered.
2. **Sampling Plan/ Sample Selection procedure:** The sample selection should be done by purposive method of sampling.
3. **Selection of districts:** Two districts from each division should be selected to validate coverage of immunization service based on their extent coverage of immunization (one high, and one poor coverage of immunization) in the previous year of immunization coverage.

Table 5.11: Percentage of Children age 12-23 months fully vaccinated (NFHS-5)

District	Percentage of Children age 12-23 months fully vaccinated based on information from vaccination card (NFHS-5)
Kumaun Division	
Almora	96.3
Bageshwar	91.0
Champawat	91.6
Pithoragarh	97.0
Nainital	73.5
U.S. Nagar	92.2
Garhwal Division	
Chamoli	91.1
Dehradun	83.0
Haridwar	93.7
Pauri Garhwal	80.4
Rudraprayag	94.0
Tehri Garhwal	77.6
Uttarkashi	91.5
Uttarakhand	88.6

Table 5.12 Selected Districts

Kumaun Division	Pithoragarh and Nainital
Garhwal Division	Rudraprayag and Tehri Garhwal

4. **Selection of Blocks/ CHCs:** From each district, 2 blocks /CHCs should be selected to validate coverage of immunization service based on their extent coverage of immunization (one high, and one poor coverage of immunization) in the previous year of immunization coverage.
5. **Selection of PHCs:** From each blocks/CHC, 2 PHCs should be selected to validate coverage of immunization service based on their extent coverage of immunization (one high, and one poor coverage of immunization) in the previous year of immunization coverage.

6. **Selection of SHCs:** Similar to the above, selection of SHC should also be done to validate coverage of immunization service on the basis of their extent coverage of immunization (one high, and one poor coverage of immunization) in the previous year of immunization coverage.
7. **Selection of villages/ session sites:** One village/ session site per SHC should be selected randomly.
8. **Selection of households/children:** 10 children from each village/ session site will be selected through systematic random sampling by taking a random start. The care-givers of these children will be asked about the immunization status of the selected child.
9. **Method of selecting 10 children from the tally sheets/ Format 1:**
 - ✓ Total number of children from the tally sheet should be divided by 10 to get sampling interval
 - ✓ A random number from the obtained interval be selected to select the first child.
 - ✓ Sampling interval should be added to the first selected number to select the subsequent child till 10 children are selected.

Note: 3 extra children per village/ session site should be selected (following the similar selection procedure) to cover the non-response/ unavailability etc.

Example: If there are 63 children, sampling interval is $63 / 10 = 6.3$. Assume, random number selected is 2. First child is 2, second child selected is $2 + 6 = 8$, and third child selected is $8 + 6 = 14$ and so on.

For selecting the extra 3 children same sampling interval should be taken and the procedure should be repeated excluding the selected children.

5.8 Status of Integration of AYUSH Health Personnel's with health delivery systems in Uttarakhand

Realizing the importance of the traditional and ancient system of medicines World Health Organizations (WHO) initiated the scheme for the development of every traditional system of medicine.

Based on the WHO initiatives, Government of India (GoI) formed the Department of Indian Systems of Medicine and Homoeopathy (ISM&H) in March 1995 under the Ministry of Health & Family Welfare.

Govt of India renamed the ISM&H Department as Department of AYUSH in March 2003 and created Ministry of AYUSH in November 2014 to promote education and research in Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy systems and other alternative medicine systems.

After the launch of NRHM, an initiative has been taken by the Department of Health & Family Welfare and Ministry of AYUSH for strengthening of health care facilities at all levels by integrating AYUSH systems in national health care delivery systems under NRHM.

Physical and functional integration of AYUSH systems in NRHM is most important strategy of Mainstreaming under NRHM. Integration is facilitated by appointing AYUSH doctors & supporting staff and creating infrastructure according to local needs. AYUSH doctors who are being appointed are used to facilitate management of programmes, monitoring and effective implementation of various interventions under NRHM.

The erstwhile Department of AYUSH under the Ministry of Health and Family Welfare has launched National AYUSH Mission (NAM) during the 12th Plan for the States /Union Territories (UTs) with the objectives of providing cost effective AYUSH services, upgrading the AYUSH hospitals & dispensaries, co-location of AYUSH facilities at every health centres and hospitals, strengthening institutional capacity and enforcement mechanism, strengthening the research activities, adopting good practices for cultivation of medicinal plants and supply of quality raw materials, development of infrastructure for entrepreneurs and effective marketing and promotion.

In 2018 Govt. of India has launched the Ayushman Bharat Yojana which aims to set up 1.5 lakhs wellness centres by 2022 that will leverage on comprehensive primary health care for preventive, promotive and curative care.

The State of Uttarakhand is blessed with the rich bio-diversity (including rich medicinal and aromatic plants) and its forest area accounts to around 65 percent of the total area. The State is home to numerous important tourist attractions like The Ganges, religious sites (Char Dham, Haridwar, Rishikesh, Panch Prayag etc.), National Parks & Wildlife Sanctuaries, hill stations and mountain peaks, lakes, trekking routes etc.

5.8.1 Methodology for validation proposed for sub-indicator Status of Integration of AYUSH Health Personnel's

Multistage stratified random cum purposive sampling technique should be adopted in selection of division, districts, Hospitals, Community Health Centres (CHCs), Primary Health Centres (PHCs) and Patient.

There are 13 districts in Uttarakhand which are grouped into two divisions— Kumaun and Garhwal. The Kumaun division includes six and Garhwal division includes seven districts

In the first stage of sampling, both Kumaun and Garhwal division will be selected for the study.

1. Selection of Districts:

Secondly, the selection of district on the basis of total number of 24x7x365 health facilities available, district having high, and low number of 24x7x365 health facilities in the both divisions will be selected for the study.as given in Table-5.13. Thus, Almora district in high number of 24x7x365 health facilities and Bageshwar in low number of 24x7x365 health facilities in Kumaun division and Pauri Garhwal district in high number of 24x7x365 health facilities and Rudraprayag in low number of 24x7x365 health facilities in Garhwal division should be selected at this stage.

Thus, study should be carried out in 4 districts of Uttarakhand State namely-Almora, Bageshwar, Pauri Garhwal and Rudraprayag

<i>Table.5.13: Division wise district with no. of 24x7x365 health facilities</i>					
S.No.	District	District / Base / Female / Male / Combined Hospitals	Community Health Centre's (CHCs)	Primary Health Centre's (PHCs)	Total Facilities
Kumaun Division					
1.	Almora	4	4	16	24
2.	Bageshwar	1	2	2	5
3.	Champawat	1	2	6	9
4.	Pithoragarh	2	4	6	12

5.	Nainital	7	4	6	17
6.	U.S. Nagar	2	6	2	10
Garhwal Division					
7.	Chamoli	1	5	5	11
8.	Dehradun	5	7	2	14
9.	Haridwar	4	4	2	10
10.	Pauri Garhwal	5	5	7	17
11.	Rudraprayag	1	2	2	5
12.	Tehri Garhwal	2	3	8	13
13.	Uttarkashi	1	3	3	7
Uttarakhand		36	51	67	154

Source: <http://nhm.gov.in> › uttrakhand › 24x7_uttarakhand

2. **Selection of District Hospital:** From each selected district one district level government hospital (with 24 x 7 facilities) should be selected for detailed coverage of Doctors and Paramedical staffs of sanctioned and in-position post, and availability of AYUSH medicine etc.
3. **Selection of Community Health Centres (CHCs):** From each selected district 2 Community Health Centres (CHCs) (with 24 x 7 facilities) should be selected for detailed coverage of Doctors and Paramedical staffs of sanctioned and in-position post, and availability of AYUSH medicine etc.
4. **Selection of Primary Health Centres (PHCs):** From each selected district 2 Primary Health Centres (PHCs) (with 24 x 7 facilities) should be selected for detailed coverage of Doctors and Paramedical staffs of sanctioned and in-position post, and availability of AYUSH medicine etc.
5. **Selection of Patient from District Hospital:** From each selected district level government hospital 50 patient should be selected for exit interview. Thus, a total of 200 patient interview should be done.
6. **Selection of Patient from CHC:** From each selected Community Health Centre (CHC) 20 patient be selected for exit interview. Thus, a total of 160 patient interview should be done.
7. **Selection of Patient from PHC:** From each selected Primary Health Centre (PHC) 20 patient should be selected for exit interview. Thus, a total of 80 patient interview should be done.

Table.5.14: District wise total sample coverage

Sl.no.	Name of Selected districts	Facilities (with 24 x 7 facilities)			Patient		
		District Hospital	No. of CHCs	No. of PHCs	From District Hospital	From CHCs	From PHCs
1.	Almora	1	2	2	50	40	20
2.	Bageshwar	1	2	2	50	40	20
3.	Pauri Garhwal	1	2	2	50	40	20
4.	Rudraprayag	1	2	2	50	40	20
Total		4	8	8	200	160	80

5.9 Status and Progress of Rastriya Bal Suraksha Karyakram

Rashtriya Bal Swasthya Karyakram (RBSK) is a recent initiative which aims at early identification and early intervention for children from birth to 18 years to cover 4 'D's viz. Defects at birth, Deficiencies, Diseases, Development delays including disability.

It may be noted that the 0 - 6 years age group has to be specifically managed at District Early Intervention Centre (DEIC) level while for 6 -18 years age group, management of conditions is to be managed through existing public health facilities. DEIC acts as referral linkages for both the age groups.

Through Medical Officers, Staff nurses, and ANMs first level of screening is to be done at all delivery points.

After 48 hours till 6 weeks the screening of new-borns be done by ASHA at home as a part of HBNC package. Outreach screening is to be done by dedicated mobile block level teams for 6 weeks to 6 years at Anganwadi centres and 6 - 18 years children at school. Once the child is screened and referred from any of these points of identification, it should be ensured that the necessary treatment/intervention is delivered at zero cost to the family.

5.9.1 Target age group

The services target to cover children of 0 -6 years of age in rural areas and urban slums in addition to children enrolled in classes first to twelfth in Government and Government aide Schools. It is expected that these services would cover 27 crores children in a phased manner. The broad category of age group and estimated beneficiary is as shown below in the table. The children have been grouped in to three categories owing to the fact that different sets of tools would be used and also different set of conditions could be prioritized.

Table 5.15: Target group under Child Health Screening and Intervention Service Categories

Categories	Age Group	Estimated Coverage
Babies born at public health facilities and home	Birth to 6 weeks	2 crores
Preschool children in rural areas and urban slum	6weeks to 6 years	8 crores
School children enrolled in class 1st and 12th in government and government aided schools	6yrs to 18 yrs	17 crores

Health conditions to be screened

Table 5.16: Selected Health Conditions for Child Health Screening and Early Intervention Services

A. Defects at Birth		B. Diseases of Childhood	
1.	Neural tube defect	10.	Skin conditions (Scabies, fungal infection and Eczema)
2.	Down's Syndrome	11.	Otitis Media
3.	Cleft Lip & Palate / Cleft palate alone	12.	Rheumatic heart disease
4.	Talipes (club foot)	13.	Reactive airway disease
5.	Developmental dysplasia of the hip	14.	Dental conditions
6.	Congenital cataract	15.	Convulsive disorders
7.	Congenital deafness		

8.	Congenital heart diseases		
9.	Retinopathy of Prematurity		
C. Deficiencies		D. Developmental delays and Disabilities	
16.	Anemia especially Severe anemia	21.	Vision Impairment
17.	Vitamin A deficiency (Bitot spot)	22.	Hearing Impairment
18.	Vitamin D Deficiency, (Rickets)	23.	Neuro-motor Impairment
19.	Severe Acute Malnutrition	24.	Motor delay
20.	Goiter	25.	Cognitive delay
		26.	Language delay
		27.	Behavior disorder (Autism)
		28.	Learning disorder
		29.	Attention deficit hyperactivity disorder
		30.	Congenital Hypothyroidism, Sickle cell anemia, Beta thalassemia (Optional)

**Source: - National Health Mission - Rashtriya Bal Swasthya Karyakram (RBSK)*

5.9.2 Mechanisms for screening at Community & Facility level

In RBSK, Child screening is done at two levels, community level and facility level. While facility based new born screening at public health facilities like PHCs / CHCs/ DH, is done by existing health manpower like Medical Officers, Staff Nurses & ANMs, the community level screening is conducted by the Mobile health teams at Anganwadi Centres and Government and Government aided Schools.

➤ **Screening at Anganwadi Centre:**

All pre-school children below 6 years of age would be or should be or are screened by Mobile Block Health teams for deficiencies, diseases, developmental delays including disability at the Anganwadi centre at least twice a year. Tool for screening for 0-6 years is supported by pictorial, job aids specifically for developmental delays. For developmental delays children would be screened using age specific tools specific and those suspected would be referred to DEIC for further management.

➤ **Screening at Schools - Government and Government aided:**

School children age 6 to 18 years would be screened by Mobile Health teams for deficiencies, diseases, developmental delays including disability, adolescent health at the local schools at least once a year. The tool used is questionnaire (preferably translated into local or regional language) and clinical examination.

➤ **Composition of mobile health team:**

The mobile health team will consist of four members- two Doctors (AYUSH) one male and one female, at least with a bachelor degree from an approved institution, one ANM/Staff Nurse and one Pharmacist with proficiency in computer for data management.

S. No	Member	Number
1.	Medical officers (AYUSH) -1male and 1 female at least with a bachelor degree from an approved institution	2
2.	ANM/Staff Nurse	1
3.	Pharmacist with proficiency in computer for data management	1

Source: National Health Mission (NHM)

5.9.3 Methodology for validation proposed for sub-indicator Status and Progress of Rastriya Bal Suraksha Karyakram

Multistage stratified random cum purposive sampling technique should be adopted in selection of districts, blocks and Anganwadi centres.

There are 13 districts in Uttarakhand which are grouped into two divisions— Kumaun and Garhwal. The Kumaun division includes six and Garhwal division includes seven districts

In the first stage of sampling, both Kumaun and Garhwal division should be selected for the study.

1. Selection of Districts:

Secondly, the district having high percentage of children screened for 4D's under RBSK, and the other of low percentage children screened selected for the study as given in Table-1. Thus, U.S. Nagar district in high percentage of children screened for 4D's under RBSK and Champawat in low percentage of children screened for 4D's under RBSK in Kumaun division and Tehri Garhwal district in high percentage of children screened for 4D's under RBSK, and Uttarkashi in low percentage of children screened for 4D's under RBSK in Garhwal division should be selected.

S.No.	District	Percentage of children screened for 4D's under RBSK
Kumaun Division		
1.	Almora	62.00
2.	Bageshwar	76.00
3.	Champawat	58.00
4.	Pithoragarh	65.00
5.	Nainital	85.00
6.	U.S.Nagar	88.00
Garhwal Division		
7.	Chamoli	76.00
8.	Dehradun	85.00
9.	Haridwar	71.00
10.	Pauri Garhwal	76.00
11.	Rudraprayag	74.00
12.	Tehri Garhwal	98.00
13.	Uttarkashi	66.00
Uttarakhand		78.00

Source: SDG Index Uttarakhand 2019-20

2. **Selection of blocks:** From each district Community Development Blocks (CDBs) should be divided into two groups of high and low performance, based on the information on key indicators of development. The indicators used should be school enrolment rates, percentage of villages electrified, percentage of villages having safe drinking water facility and percentage of villages having health centres. One block from each of the two groups should be selected on random basis in the district. Accordingly, 8 blocks should be selected from the four selected districts.
3. **Selection of Schools (Government and Government aided):**
From each selected block, a sample of 10 schools (for children age 6 to 18 years) should be selected by probability proportional to size (PPS), the size being the enrolment with special focus on the girl student.
4. **Selection of Anganwadi Centres:**
From each selected block, a sample of 5 Anganwadi Centres (for children below 6 years of age) should be selected by probability proportional to size (PPS), the size being the enrolment of children below 6 years of age in Anganwadi Centres.
5. **Selection of children from Schools:**
From each selected school a sample of 30 student's/children should be selected on random basis for validation/detail information about RBSK.
6. **Selection of children from Anganwadi Centers:**
From each selected Anganwadi Centre sample of 15 children should be selected on random basis for validation/detail information about RBSK.
Hence, total sample consists of 750 children per district and 3000 children interviewed/validate in the state. Details of total sample as per Tab. No.15.19.

<i>Table 5.19: Total Sample size</i>		
Category	Sample size per district	Total Sample size
Division (Both Kumaun & Garhwal)	-	2
District (2 from each division)	-	4
Blocks (2 from each district)	2	8
Schools (10 from each Block)	20	80
Anganwadi Centre's (5 from each Block)	10	40
Student/Children from School (30 per school)	750	3000
Children from Anganwadi Centre (15 per Anganwadi Centre)		

5.10 Status of Birth & Death registration

Birth and Deaths are the two most fundamental vital events that define life of an individual. Legally, the existence of an individual is ascertained based on these statistics.

Process of Civil Registration is a continuous, permanent, and compulsory recording of the occurrence and characteristics of vital events, like births, deaths and still births. For planning, monitoring, and evaluation of various programmes these vital statistics are invaluable.

5.10.1 Methodology for validation proposed for sub-indicator Status of Birth & Death registration

- **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand should be covered.
- **Sampling Design:** WHO 30 Cluster Sampling Design should be adopted for the study. A sample of 30-30 villages should be selected using PPS (Probability Proportional to Size) systematic sampling out of the total villages from both Garhwal and Kumaun division of Uttarakhand respectively. Ten households should be selected from each village using the standard EPI (Expanded Programme on Immunization) proximity sampling method. The methodology involves selection of sample of 600 households.

Enquiry will be made for the registration of their death and birth.

5.11 Communicable and Non-communicable diseases

With almost 25 percent of the world's population living in India, the health status and the drivers of health loss are likely to vary between different parts of the country and the states. Accordingly, effective efforts to improve population health in each state require systematic knowledge of the local health status and trends of disease. Health status can be judged by investigating the spread of communicable and Non-communicable diseases in the society. This section is devoted to status of communicable and Non-communicable diseases in Uttarakhand.

5.11.1 Communicable Diseases

Communicable diseases are caused by viruses or bacteria that people spread to one another through contact with contaminated surfaces, bodily fluids, blood products, insect bites, or through the air and water. Some of the examples of the communicable disease are HIV infections, hepatitis A, B and C, measles, salmonella, measles, and blood-borne illnesses. Majority of common forms of spread include fecal-oral, food, sexual intercourse, insect bites, contact with contaminated fomites, droplets, or skin contact.

Information regarding status of spread of communicable diseases is important in the planning and evaluation of disease prevention and control programs, in the assurance of appropriate medical therapy, and in the detection of common-source outbreaks.

5.11.2 Non-communicable Diseases (NCDs)

These diseases are medical conditions or diseases that are not caused by infectious agents. These constitute chronic diseases of long duration. The progression of these diseases is generally slow. They are the result of a combination of genetic, physiological, environmental and behavioural factors.

In 21st century NCDs are one of the major challenges for public health. They besides harming individuals inflict harm on socio-economic development of the nation.

NCDs kill about 41 million people (71% of global deaths) worldwide each year. This includes 14 million people who die too young between the ages of 30 and 70. The majority of premature NCD deaths are preventable. As per the World Health Organization (WHO) projections, the total annual number of deaths from NCDs will increase to 55 million by 2030, if immediate and appropriate interventions are not done for prevention and control of NCDs.

According to a report “India: Health of the Nation’s States” by Ministry of Health and Family Welfare (MOHFW), Government of India (GOI), there is increase in the contribution of NCDs from 30 percent of the total disease burden- ‘disability-adjusted life years’ (DALYs) in 1990 to 55 percent in 2016 and also an increase in proportion of deaths due to NCDs (among all deaths) from 37 percent in 1990 to 61 percent in 2016. In view of the grave situation, it is important to study the scenario of communicable and Non-communicable diseases.

5.11.3. Methodology for validation proposed for sub-indicator (Communicable and Non-communicable diseases)

Multistage stratified random as well as purposive sampling technique should be adopted in selection of districts, Hospitals, Community Health Centres (CHCs) and Primary Health Centres (PHCs).

There are 13 districts in Uttarakhand which are grouped into two divisions— Kumaun and Garhwal. The Kumaun division includes six and Garhwal division includes seven districts.

In the first stage of sampling, both Kumaun and Garhwal division may be considered for the study.

1. Selection of Districts:

Secondly, the district having high, medium, and low number of OPD registrations in both divisions may be selected for the study as given in Table-5.20. Thus, U.S. Nagar district in high number of OPD registrations, Almora in medium number of OPD registrations and Champawat in low number of OPD registrations in Kumaun division and Dehradun district in high number of OPD registrations, Pauri Garhwal in medium number of OPD registrations and Rudraprayag in low number of OPD registrations in Garhwal division should be selected at this stage.

Thus, study should be carried out in 6 districts of Uttarakhand State namely-Almora, Champawat, Udham Singh Nagar, Dehradun, Pauri Garhwal and Rudraprayag

<i>Table.5.20: Division wise district with no. of OPD registration</i>		
S.No.	District	District wise No. of OPD Registrations in 2019-20
Kumaun Division		
1.	Almora	452786
2.	Bageshwar	337226
3.	Champawat	157467
4.	Pithoragarh	367877
5.	Nainital	792055
6.	U.S.Nagar	836300
Garhwal Division		
7.	Chamoli	169870
8.	Dehradun	1328199
9.	Haridwar	824848
10.	Pauri Garhwal	652948

11.	Rudraprayag	124867
12.	Tehri Garhwal	389162
13.	Uttarkashi	277569
Uttarakhand		6,199,685

Source: Performance of Key HMIS Indicators for Uttarakhand - 2019-20

- 2. Selection of Hospitals:** From each selected district, all district level government hospitals (with 24 x 7 facilities) should be selected for detailed coverage of Communicable & Non-communicable disease type, status, and burden.
- 3. Selection of Community Health Centres (CHCs):** From each selected district, all Community Health Centres (CHCs) (with 24 x 7 facilities) should be selected for detailed coverage of Communicable & Non-communicable disease status and burden.
- 4. Selection of Primary Health Centres (PHCs):** From each selected district, all Primary Health Centres (PHCs) (with 24 x 7 facilities) should be selected for detailed coverage of Communicable & Non-communicable disease status and burden.

Table.5.21: Total sample coverage (District wise)

Sl.no.	Name of Selected districts	District / Base / Female / Male / Combined Hospitals	No. of CHCs (with 24 x 7 facilities)	No. of PHCs (with 24 x 7 facilities)	Total Health Facility centres Cover
1.	Almora	4	4	16	24
2.	Champawat	1	2	6	9
3.	U.S. Nagar	2	6	2	10
4.	Dehradun	5	7	2	14
5.	Pauri Garhwal	5	5	7	17
6.	Rudraprayag	1	2	2	5
Total		18	26		79

Source: List of all 24X7X365 facilities in Uttarakhand

5.12 Status of Modern Family Planning Methods User (Currently married women)

Family planning (FP) involves the use of contraceptive methods to prevent unintended pregnancy, limit the number of children, and space childbirth.

Modern methods of contraception include female sterilization, male sterilization, intrauterine contraceptive device (IUD), implants, injectables, pill, male condoms, female condoms, emergency contraception, and lactational amenorrhea method (LAM), while traditional methods include rhythm (calendar), withdrawal, and folk methods. The over-all objective is to validate the current status of availability, access and quality of reproductive health (RH) and family planning (FP) services and women's reproductive intentions over the next 24 months.

5.12.1 Methodology for validation proposed for sub-indicator Status of Modern Family Planning Methods User

Study Area

Six districts should be selected based on health indicators outcome. For selection of districts, NFHS-5 data available in the public domain and 8 key appropriate indicators there-in are to be considered to select districts in the states, details of which are stated in the table given below:

1. Child Marriage (Women aged 20-24 years married before age 18 years)	2. Teenage Pregnancy (Women aged 15-19 years who were already mothers or pregnant at the time of the survey)
3. All women aged 15-49 years who are anaemic	4. Total unmet need
5. Unmet need for spacing	6. Health worker ever talked to female non-users about FP
7. Mothers who had at least 4 antenatal care visits	8. Institutional births in public facility

Based on the indicators so stated in the table given above, **3 Top** and **3 Bottom Districts** in terms of performance in Uttarakhand.

District	Child Marriage	Teenage Pregnancy	All women aged 15-49 years who are anaemic	Total unmet need	Unmet need for spacing	Health worker ever talked to female non-users about FP	Mothers who had at least 4 antenatal care visits	Institutional births in public facility
Kumaun Division								
Almor a	1.5	1.7	33.4	6.4	2.6	13.4	44.3	69.4
Bagesh war	12.9	1.7	27.8	8.4	2.9	17.3	67.9	75.1
Champ awat	11.7	1.9	32.5	10.4	3.5	28.1	62.0	51.8
Pithora garh	16.2	3.7	25.5	11.3	4.5	28.3	58.7	80.0
Nainita l	11.3	2.0	34.5	6.5	2	15.1	59.7	56.4
U.S. Nagar	14.6	5.2	51.0	7.2	2.1	22.8	75.9	51.0
Garhwal Division								
Chamo li	3.4	3.0	41.8	9.3	3.6	21.8	52.2	67.3
Dehrad un	6.6	0.4	47.9	6.5	2.8	27.7	75.3	49.4
Harid war	9.9	2.3	43.8	11.8	4.1	11.4	48.5	37.9

Pauri Garhwal	8.6	1.3	40.3	9.9	3.2	9.4	39.6	59.4
Rudraprayag	8.6	1.8	40.6	12.2	4.5	26.7	76.5	81.0
Tehri Garhwal	6.3	1.7	42.2	13.8	5.6	20.4	48.9	59.3
Uttarkashi	5.7	4.8	60.9	7.7	3.9	34.2	66.8	77.0

Table 5.24: Average of all 8 NFHS Indicator (%)

District	Average of all 8 NFHS Indicator (%)
Almora	21.59
Bageshwar	26.75
Chamoli	25.30
Champawat	25.28
Dehradun	27.10
Haridwar	21.21
Nainital	31.25
Pauri Garhwal	21.46
Pithoragarh	28.52
Rudraprayag	31.50
Tehri Garhwal	24.78
US Nagar	28.72
Uttarkashi	32.62

Table 5.25: Proposed Districts

State	Top 3 Districts			Bottom3 Districts		
Uttarakhand	Nainital	Rudraprayag	Uttarkashi	Almora	Pauri Garhwal	Haridwar

- 1. Selection of PHCs:** From each district, 2 PHCs should be selected (one in the vicinity of district headquarter, and another one from distant location).
- 2. Selection of Sub-centres:** From each PHC, 5 sub-centres should be selected randomly.
- 3. Selection of Respondents:** From each Sub-centre, 10 currently married women will be selected randomly.

➤ **Quantative data and Qualitative Data**

Quantative data will be collected from 100 selected currently married women through questionnaire and Qualitative data will be collected through in-depth interviews of currently married women and various stakeholders like ANM, ASHA, AWW.

6 Water Supply

6.1 Preamble

Water is a prime natural resource, a basic human need, and a precious natural asset. Water ranks high among the top priorities of any human settlement. Actual availability and easy access to clean and safe water and sanitation are among the most important determinants of health of human beings. Uttarakhand, with the presence of mighty glaciers and perennial rivers, is a water rich state. Also, due to its topography, the state receives decent rainfall. The situation however worsens during peak summers due to uneven hilly terrain and availability of water becomes scarce for rural masses settled in remote areas.

The state of Uttarakhand considered as reservoir of water for Indian subcontinent faces drought of various magnitudes. According to an estimate by United Nations Development Program about 2.6 lakh springs provide 90 percent of the drinking water sources in Uttarakhand. During the peak summer season as approximately 50 percent of the mountain springs in the Indian Himalayan region, which includes Uttarakhand, are drying up. As highlighted in the state action plan for climate change about 20 percent of the 15,165 villages have varied range of problems related to drinking water provision and more than 180 villages do not have a designated source. The districts like Almora, Pauri, Tehri, Pithoragarh and Chamoli are facing drinking water crisis.

To assess the problem of water supply it is proposed to carry out the study under 4 heads i.e.,

1. Status of households with access to safe and potable drinking water
2. Status of households having access to toilet facility
3. Progress of Jal Jeevan Mission (JJM)
4. Urban Households covered with sewage system and Progress of water sewage treatment

In the following sections we discuss proposed methodology for proper data collection and its validation thereof.

6.2 Status of households with access to safe and potable drinking water

As stated earlier in this chapter safe drinking water availability is of paramount importance for human beings. Absence of safe drinking water leads to many water borne diseases like typhoid and diarrhoea etc.

6.2.1 Methodology for validation proposed for sub-indicator Status of households with access to safe and potable drinking water

The proposed assignment is to be undertaken in both the division (Kumaun & Garhwal) of Uttarakhand State. The basis of selection of districts will be NFHS data on prevalence of diarrhoea available in the public domain as it is a direct consequence of consumption of unsafe drinking water.

The details are given as under,

Division	District							
Kumaun	Almora	Bageshwar	Champawat	Pithoragarh	Nainital	U Nagar	S	
Diarrhea Prevalence (%)	6.2	4.0	4.2	4.9	5.0	3.4		
Garhwal	Chamoli	Dehradun	Haridwar	Pauri	Rudraprayag	Tehri	Uttarkashi	

Diarrhea Prevalence (%)	5.7	1.7	6.4	6.1	3.2	3.0	4.8
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In the selection process, 2 districts of highest prevalence and two of lowest prevalence of diarrhoea from each division should be selected as reported below.

Division	Top 2 Districts		Bottom 2 Districts	
Kumaun	Almora	Nainital	Bageshwar	U S Nagar
Garhwal	Haridwar	Pauri Garhwal	Dehradun	Tehri Garhwal

1. **Selection of blocks:** From each selected district, select 2 blocks using PPS (Probability Proportional to Size) sampling technique.
2. **Selection of PSUs (Rural and Urban):**
 - **Rural PSU:** Select 10 villages from each selected community development. Thus, total 160 villages are to be covered.
 - **Urban PSU:** Select 5 urban wards using PPS (Probability Proportional to Size) sampling technique within the existing urban local body (ULB).
3. **Selection of households:** First, 5 households are to be selected randomly and after that sample from households be collected two times pre and post monsoon.

Water sources as per record in districts are: -
 Deep Tube-well; Khadins / Nadins/ Tankas/ Ponds / Wells/ Oorans; Infiltration well;
 River; Rivulet / Naula / Gadhera; Spring; Treated Surface Water; Streams; Shallow Tube-well

➤ **Criterion for selection of water samples**

Water samples should be collected from households under study. While collecting water samples, the source of water should be recorded. This would help in carrying out the analysis as per source of water. For example, water collected from tube wells may be used for bacterial analysis. The samples should be analysed immediately for the parameters like Coliform, BOD, COD and nutrients. Other parameters like pH and conductivity analysed within a week's time.

➤ **Quantity of Sample to be Collected**

Samples for chemical & bacteriological analysis should be collected separately according to the method of sampling and preservation. The interval between collection and analysis of the sample should be shortest possible.

Quantity of sample for General Analysis - 2 litres (non-acidified), Bacteriological Analysis- 250 ml in sterilized bottles and for Metals Analysis - 1000 ml acidified sample for metal analysis

6.3 Status of households having access to toilet facility

Open defecation is a major global health problem. To accelerate the efforts to achieve universal sanitation coverage and to put the focus on sanitation, the Prime Minister of India had launched the Swachh Bharat Mission on 2nd October 2014. Under Swachh Bharat Mission, the Rural Uttarakhand achieved 100 percent toilet coverage in more than 7,500 villages by constructing 5,84,000 individual toilets in the 13 districts and highlighting Open defecation free situation.

6.3.1 Methodology for validation is proposed for sub-indicator Status of households having access to toilet facility

To assess the status of households having access to toilet facility, information from households under study should be collected using following procedure.

- 1. Selection of districts:** After categorizing all the 13 districts of Uttarakhand as per their locations, 2 districts from upper hills and 2 districts from mid hills and 1 from plains are to be selected randomly.
- 2. Selection of blocks:** From each selected district, 2 blocks to be selected in which one block should be in the close vicinity of district headquarters and another one from distant location
- 3. Selection of PSUs (Rural and Urban):**
 - **Rural PSU:** A total of 50 villages to be selected randomly (5 villages per block)
 - **Urban PSU:** 25 percent of urban wards should be selected from each one of the 5 selected districts.
- 4. Selection of households:** 25 households from each selected village and 50 households from each selected urban ward are to be selected randomly.

6.4 Progress of Jal Jeevan Mission

Jal Jeevan Mission, a central government initiative under the Ministry of Jal Shakti, aims to ensure access of piped water for every household in India. The mission's goal is to provide to all households in rural India safe and adequate water through individual household tap connections by 2024. Under Drinking Water Supply Schemes approved Under Jal Jeevan Mission in Uttarakhand. All eight water supply schemes sanctioned are multi-village schemes providing direct tap water connections to more than 9,000 rural households.

These eight water supply schemes will benefit 140 villages in Almora, Bageshwar, Dehradun, Nainital and Uttarkashi districts. Masi, Mangurkhal and Jhimar multi-village tap water supply schemes in Almora district will benefit about 20 thousand people living in 68 villages. Shama and Baidamajhera multi-village tap water supply schemes in Bageshwar district will benefit about 18 thousand people living in 38 villages. Basgaon Loshgyani multi-village tap water supply schemes will provide tap water to more than 3 thousand people living in 9 villages of Nainital district. Similarly, Kandari multi-village scheme in Uttarkashi and Motidhar Paniyala scheme in Dehradun will benefit more than 7 thousand people living in 25 villages of these two districts.

6.4.1 Methodology for validation proposed for sub-indicator Progress of Jal Jeevan Mission

To assess the progress of Jal Jeevan Mission, information regarding supply of piped water be gathered and analysed using the following selection scheme.

1. **Selection of districts:** After categorizing all the 13 districts of Uttarakhand, according to their locations, 2 districts from upper hills and 2 districts from mid hills and 1 from plains will be selected randomly.
2. **Selection of blocks:** From each selected district, 2 blocks will be selected in which one block will be in the close vicinity of district headquarters and another one from distant location.
3. **Selection of PSUs (Rural and Urban):**
 - **Rural PSU:** A total of 50 villages will be selected randomly (5 villages per block)
 - **Urban PSU:** 25 percent of urban wards should be selected from each one of the 5 selected districts.
4. **Selection of households:** 25 households from each selected village and 50 households from each selected urban ward will be selected randomly to validate the status of tap connections in households under the Jal Jeevan Mission.

6.5 Urban Households covered with sewage system and Progress of water sewage treatment

Uttarakhand is the source of major rivers in the country such as Ganga and Yamuna. These rivers feed most of the population of northern India and are a lifeline for almost half of the country's population. However, as the data shows, the rivers are grossly polluted by untreated sewage, as hundreds of millions of litres of wastewater is flowing into these rivers."

Sewerage system and Drainage in urban areas are of utmost priority in Indian setting because of rapid urbanization, industrialization, and population growth, along with increase in slum population and migration. As per the census 2011, at country level, there is no drainage facility in 48.9% households, while 33% households have only open drainage system. Treatment of wastewater is one of the important steps to prevent contamination of urban underground water

- Sewage generated in the state of Uttarakhand is 495 million litres each day.
- Uttarakhand's 24 sewage treatment plants (STPs) are treating 153 million litres of sewage each day which is only a third of the sewage that the urban areas of the hill state generate each day.
- Sewage generated in Dehradun city is 170.55 million litres each day and out of which 115.13 million litres of sewage is treated each day.

6.5.1 Methodology for validation is proposed for sub-indicator Urban Households covered with sewage system and Progress of water sewage treatment

1. **Selection of districts:** All 13 districts of Uttarakhand may be categorized according to geographical locations (Upper Hill, Mid Hill and Plains).
 Upper hills — Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar
 Middle hills — Tehri-Garhwal, Pauri-Garhwal, Almora, Champawat and Nainital
 Plains - Dehradun, Haridwar, Udham Singh Nagar

Selection of districts by using Probability Proportional to Size (PPS) sampling

$N =$ Total number of districts = 13

$n =$ Total number of districts to be selected = 5

$T =$ Total urban households according to 2011 census = 631889

k (sampling interval) = $T/n = 126377.8 = 126378$

Selection process of districts should be initiated only after arranging the households in ascending order.

✓ *Steps for the selection of districts:*

- Random number between 1 to 126378= 13555 (r)
- The first selected district is the one whose cumulative total is either equal to r or just above it.
- Add k to r which gives k+r, next sample district
- The process is repeated till a sample of size 5 districts is accomplished

Table 6.3: Number of urban households (municipal corporation) according to 2011 census

Districts	Number of urban households (municipal corporation) according to 2011 census	Cumulative Frequency	Assigned Random numbers	
Bageshwar	2054	2054	1-2054	
Rudraprayag	2660	4714	2055-4714	
Uttarkashi	5688	10402	4715-10402	
Champawat	8212	18614	10403-18614	Selected
Chamoli	14646	33260	18615 -33260	
Almora	15368	48628	33261-48628	
Tehri Garhwal	17023	65651	48629-65651	
Pithoragarh	17759	83410	65652-83410	
Pauri Garhwal	25598	109008	83411-109008	
Nainital	76429	185437	109009-185437	Selected
US Nagar	109936	295373	185438-295373	Selected
Haridwar	133627	429000	295372-429000	Selected
Dehradun	202889	631889	429001-631889	Selected

Table 6.4: Selected District

Random Number	13555	139933	266311	392689	519067
Districts	Champawat	Nainital	US Nagar	Haridwar	Dehradun
SSWOR	1	2	3	4	5

Table 6.5: Coverage of sample households at the rate of .5% of the total urban households from the selected five districts

Selected districts	Number of urban households (municipal corporation) according to 2011 census	Households to be selected for survey (.5% of the total households)
Champawat	8212	41
Nainital	76429	382
US Nagar	109936	550
Haridwar	133627	668
Dehradun	202889	1014
Total		2655

Thus, a total number of households to be selected from urban city of selected district for survey is 2655.

7 Rural and Urban development

7.1 Preamble

The development process of any region or country depends on its land and other natural resources, population, technological developments, and organizational skills of its people. Industrial and agricultural progress plays a dominant role in development. Although, increased production levels, infrastructural growth and the expansion of the service sector improve quality of life, they pose serious problems of depreciation and depletion of resources and environmental degradation. However, development is a desirable objective in every society and as such its growth must be planned and monitored in such a manner that it could be sustained with minimal damage to the environment and the eco-system.

To validate the situation of Rural and Urban Development it is proposed to carry out the study under 7 sub- indicators:

1. Population living below the poverty line and status of households lifted from poverty and challenges and households provided livelihood under different scheme
2. Status of P.M. Awas Yojna
3. Percentage of Urban household living in slums
4. Employment Status and challenges of Youth in Uttarakhand
5. Self Help Development Groups (SHGs) formed and working
6. Village link under PMGSY
7. Employment status under MGNREGA

7.2 Population living below the poverty line and status of households lifted from poverty and challenges and households provided livelihood under different scheme

- **Selection of districts:** 1 district each from Upper and middle hills with highest BPL households. From foothills both 'aspirational districts' - Haridwar and Udham Singh Nagar.
- **Selection of blocks:** From each district, 2 blocks should be selected randomly (Total 8 blocks)
- **Selection of Gram Panchayats:** From each selected block, 5 Gram Panchayats selected randomly. (40 GPs)
- **Selection of households:** 20 BPL households from each selected Gram Panchayats should be selected randomly. (800 BPL households)
- To find out whether these households remained under BPL or some of them shifted to APL.
- The extent of benefit provided under different government schemes for their livelihood.

7.3 Status of P.M. Awas Yojna

Pradhan Mantri Awas Yojana is a scheme of the Government of India, through which poor people living in cities and rural areas will be provided houses according to their purchasing power. It has two components: Pradhan Mantri Awas Yojana Urban (PMAY-U) for the urban poor and Pradhan Mantri Awas Yojana Gramin (PMAY-G/PMAR-R) the rural poor The government has identified 305 cities and towns in 9 states in which these houses will be built.

Pradhan Mantri Awas Yojana Rural Scheme is a rural scheme run by the Central Government; this scheme was launched on June 25, 2015. The objective of this scheme is to provide houses to all by 2022. For this, the government will get 20 lakh houses constructed, out of which 18 lakh houses will be built in the slum areas and the remaining 2 lakh in the poor areas of the cities.

The expenditure incurred in this scheme will be done jointly by the Central Government and the State Government. The ratio of this amount to be shared will be 60:40 in the plains and 90:10 in the three north-east and Himalayan states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand.

- ✓ PMAY-U is introduced in 2016 aimed to provide ‘Housing for All by 2022’ by establishing 1.12 crore houses for urban poor across the country over the next seven years (between 2015 and 2022).
- ✓ PMAY-G is launched in November 2016 was designed to support ‘Housing for All by 2022 by building 2.95 crore houses for rural poor across the country by 2022.

7.3.1 Methodology for validation proposed for sub-indicator Status of P.M. Awas Yojna

1. **Research Approach:** Mixed method approach using both quantitative and qualitative data collection will be used.
2. **Selection of districts:** All 13 districts of Uttarakhand was categorized according to geographical locations (Upper Hill, Mid Hill and Plains).

Upper hills - Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar

Middle hills - Tehri-Garhwal, Pauri-Garhwal, Almora, Champawat and Nainital

Plains - Dehradun, Haridwar, Udham Singh Nagar

One district from upper hills, one district from mid hills and one district from plains should be selected based on the report of total household with highest number of completed houses under PM Awas Yojana.

Table 7.1: Total Houses completed (2014-2023)				
S.No.	District Name	Block	Urban	Total
Upper Hill				
1.	Chamoli	1689	828	2517
2.	Bageshwar	691	94	785
3.	Pithoragarh	1585	304	1889
4.	Rudraprayag	663	602	1265
5.	Uttarkashi	1149	117	1266
Mid Hill				
6.	Almora	375	368	743
7.	Champawat	1559	404	1963
8.	Nainital	904	3321	4225
9.	Pauri Garhwal	925	736	1661
10.	Tehri Garhwal	780	127	907
Plains				
11.	Dehradun	3140	4970	8110
12.	Haridwar	2973	5263	8236
13.	Udham Singh Nagar	4215	5318	9533

	Total	20648	22452	
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Selected District: Upper hill- Chamoli; Mid hill – Nainital; Plain - Udham Singh Nagar

- 3. Selection of blocks:** From each selected district, 2 blocks should be selected in which one block with the highest number of completed households and another one with the smallest number of completed households.
- 4. Urban PSU:**
From each district, 2 urban wards should be selected on the same basis (one urban ward/city with the highest number of completed households and another one with the smallest number of completed households).
- 5. Selection of villages:** From each selected block, 2 percent of villages should be selected.
Complete enumeration should be done in all selected villages and urban wards in order to validate the status of PM Awas Yojna.
- 6. Qualitative Data Collection:** Informal interviews and discussions with villagers, beneficiaries / non-beneficiaries.

7.4 Population and Socio-Economic Condition of urban household living in slums of Uttarakhand

Slum is a commonly used term for thickly populated urban areas with dilapidated and substandard housing and squalor. Britannica Concise Encyclopaedia defines slum as densely populated area of substandard housing, usually in a city, characterized by unsanitary conditions and social disorganization. The Census (2001) of India has defined Slum as “a compact area of at least 300 populations or about 60- 70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities. 2613 towns reported slum population out of 4041 statutory towns. In 2001, 42.6 million populations were lived in slums in India which increased to 65.5 million by 2011. This constituted 17.4% of the urban population of the states/uts in 2011.

7.4.1 Methodology for validation proposed for sub-indicator Population and Socio-Economic Condition of urban household living in slums of Uttarakhand

Information regarding status and Socio-Economic Condition of Urban household living in slums of Uttarakhand may be gathered, using the following sampling methodology.

- 1. Research approach:** The proposed validation methodology should be based on secondary as well as primary data.
 - **Secondary Data:** The secondary data should be collected from published literature, reports, write-ups, and seminar and conference papers, census reports including the basic statistics available with Nagar Nigams, Nagar Palika Parishad and Nagar Panchayats of the Uttarakhand.
 - **Primary Data:** The primary data and information should be collected from the selected respondents regarding their containing socio-economic status, age group of family members, literacy standards of members, occupation, income and income sources, household expenditure, health problems, possession of assets, including crucial data and information related to problems, constraints and inadequacies faced by urban slum and non-slum dwellers.

2. Selection of Urban Local Body (ULB):

There are 13 district, 95 community development blocks and three types of 92 urban local bodies - Nagar Nigam (NN-8), Nagar Palika Parishad (NNP-41) and Nagar Panchayats (NP-43). From each of the urban local bodies 25% should be selected by pps method of selection using number of wards as size i.e.2 from Nagar Nigam, 10 from Nagar Palika Parishad and 11 from Nagar Panchayat. Thus, a total of 23 urban local bodies should be selected for detailed study.

Table 7.2: Urban Local Body (ULB) wise number of wards

Nagar Nigam			Nagar Palika Parishad			Nagar Panchayats		
S.No.	Name	No. of Wards	S.No.	Name	No. of Wards	S.No.	Name	No. of Wards
1.	Dehradun	100	1.	Vikashnagar	09	1.	Selakui	09
2.	Rishikesh	40	2.	Musoori	13	2.	Jhabreda	08
3.	Haridwar	80	3.	Harbartpur	07	3.	Landaaura	10
4.	Kotdwar	40	4.	Doiwala	20	4.	Bhagwanpur	09
5.	Haldwani	80	5.	Manglore	15	5.	Pirankaliyar	09
6.	Kashipur	40	6.	Laksar	09	6.	Purola	07
7.	Roorki	40	7.	Shivalik Nagar	13	7.	Naugaon	07
8.	Rudrapur	60	8.	Uttarkashi	09	8.	Nandprayag	04
			9.	Barkot	07	9.	Pokhri	07
			10.	Chinyalisaur	07	10.	Gairsain	07
			11.	Chamoli,Gpoe shwar	09	11.	Tharali	01
			12.	Joshimath	09	12.	Pipalkoti	01
			13.	Gauchar	07	13.	Kirtinagar	04
			14.	Karnprayag	07	14.	Ghansali	07
			15.	Tihri	13	15.	Gaja	04
			16.	Srinagar	09	16.	Lambgaon	01
			17.	Narendranagar	04	17.	Chamiyala	07
			18.	Chamba	07	18.	Agustmuni	04
			19.	Devprayag	03	19.	Ukhimath	04
			20.	Muni Ki Reti	07	20.	Tilwara	01
			21.	Rudraprayag	09	21.	Swargashram	04
			22.	Pauri	11	22.	Satpuli	01
			23.	Dugadda	04	23.	Gangolihaat	08
			24.	Pithoragarh	15	24.	Berinag	01
			25.	Didihat	04	25.	Lohaghat	10
			26.	Dharchula	07	26.	Banbasa	01
			27.	Tanakpur	09	27.	Dwarahat	05
			28.	Champawat	09	28.	Bhikiyasain	01
			29.	Almora	11	29.	Kapkot	08
			30.	Ranikhet	07	30.	Kaladungi	08
			31.	Bageshwar	07	31.	Lalkuan	08
			32.	Nainital	13	32.	Bhimtal	08

			33.	Ramnagar	15	33.	Mahuwadabra	11
			34.	Bhowali	07	34.	Sultanpur Patti	08
			35.	Gadarpur	09	35.	Kelakheda	11
			36.	Bajpur	11	36.	Dineshpur	08
			37.	Jashpur	13	37.	Shaktigarh	05
			38.	Kichha	13	38.	Nanakmatta	07
			39.	Sitarganj	11	39.	Gularbhoj	07
			40.	Khatima	09	40.	Bhatrojkhana	01
			41.	Mahuwa khedaganj	07	41.	Gangotri	05
						42.	Badrinath	02
						43.	Kedarnath	01

3. Selection of Urban Wards:

- **Division of wards:** All the wards of each selected Urban Local Body/towns/cities should be grouped in five geographical zones (East, West, North, South and Central).
- **Selection of ward under the zone:** One ward should be selected from each zone using simple random sampling (SRS) method. Thus, a total of 115 wards should be selected for the validation study from the state.

4. Selection of Households within Wards:

- From each selected ward 20 households should be selected using Deep Stratification. The stratification variables which contribute to variability in the population - socio-economic characteristics like income/poverty (posh and slum areas), caste (SC/ST), drinking water supply, sanitation etc. should be used.
- Systematic sampling should be used as an alternative starting by way of selecting ward at a specified interval. The interval should be derived based on sample size and total number of households in the ward

7.5 Employment Status and challenges of Youth in Uttarakhand

India has the largest youth population in the world and there exists a vast potential for societal and economic progress of the country by providing adequate educational employment opportunities to the youth. But, according to a recent report by Institute of human development (IHD), Uttarakhand has not been able to generate adequate jobs to absorb the 15+ population in labour force, as in their study 47 percent adults (15+) were found to be unemployed. The youth (15-29 years) unemployment rate in Uttarakhand increased from 6 percent in 2004-05 to 10.2 percent in 2011-12. This is more than twice the adult unemployment rate of 4.2 percent of the state, pointing towards the proportion of unemployed youth in the state that needs to be addressed. Trends in labour force and work force participation rates for Uttarakhand also showed a decline (LFPR being 67.3 percent in 2004-05 to 53.8 percent in 2011-12 and 47.3 percent in 2017 while WPR being 65.9 percent in 2004-05 to 52.2 percent in 2011-12 and 45.3 percent in 2017) Such reduction in the LFPR and the WPR for Uttarakhand can be attributed mainly to increasing participation in higher education, withdrawals from the labour-force due

to income effects and the absence of suitable job opportunities, particularly for women, in recent years.¹

This makes it important to study the expectations and aspirations of youth to understand the misalignments between the career and educational ambitions and provide solutions for them to be successful. Uttarakhand needs to find innovative strategies for enhancing the capabilities of its workforce for jobs that best meet their expectations to address both youth employment and migration; that is basically the result of lack of employment opportunities in the region. Even relatively higher literacy rates and higher educational attainments have not helped in restricting out-migration. This clearly calls for a study on youth employment status, challenges and opportunities with the following objectives;

1. To study employment profile of youth according to education and skills
2. To assess the satisfaction level in the current employment
3. To study the perception of youth on adequacy of formal education for preparedness to enter workforce
4. To study the Challenges/barriers to education and employment

7.5.1 Methodology for validation proposed for sub-indicator Employment Status and challenges of Youth in Uttarakhand

- ❖ ***Geographical coverage:*** Both Garhwal and Kumaun division of Uttarakhand
- ❖ ***Research approach:*** Mixed method approach-using both quantitative and qualitative survey
- ❖ ***Research process for quantitative survey:***

1. Sampling design: Multi-stage stratified random sampling

2. Selection of districts: Out of the 13 districts of the State, 3 are plain districts and the remaining 10 are hill districts. Geographically the state can broadly be divided into three zones;

- Upper hills — Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar
- Middle hills — Tehri-Garhwal, Garhwal, Almora, Champawat and Nainital
- Foothills- Dehradun, Haridwar, Udham Singh Nagar

2 districts each from Upper and middle hills should be taken for study, one with highest and second with lowest youth population. From foothills both ‘aspirational districts’ - Haridwar and Udham Singh Nagar should be taken.

3. Selection of blocks: From each district, 2 blocks should be selected randomly

4. Selection of PSUs (Rural and Urban):

- ***Rural PSU:*** 10 villages per block should be selected randomly. Thus, a total 120 villages will be covered.
- ***Urban PSU:*** 2 wards per district from existing ULBs should be selected randomly. Thus, a total 12 wards will be covered.

5. Selection of youth: According to Census 2011, youth population in Uttarakhand is 20, 94,178 which is 20.8 percent of total population. It is proposed to select total

2400 youth (1200 males and 1200 females) for the study, which is over 0.1 percent of total youth population.

According to the IHD report, youth unemployment is higher in the plains (14.9 percent) than hills (11.1 percent) and more in urban than rural areas. Also, the unemployment is highest for females in plains and males in hills. Thus, it would be justified to do the sampling more from foothills than middle and upper hills. Moreover, foothill districts are ‘aspirational districts’ of NITI Aayog. Hence, it is suggested to cover 10 youth from each PSU of upper and middle hills and 30 youth from each PSU of foothills.

Table 7.3: Sample size and coverage

Sample particulars / Geographical zones		Sample size per unit	Total sample size
District		2 from each geographical zone	6
Blocks		2 per district	12
Village		10 per block	120
Urban wards		2 per district	12
Youth (both males and females)	Upper hills	10 per PSU	440
	Middle hills	10 per PSU	440
	Foot hills	30 per PSU	1320

❖ **Research process of qualitative survey:**

Focus group discussions (FGDs) with community in both rural and urban areas should be done to know about the existing livelihood opportunities and the scope for newer ones, the problems/ hurdles that might be faced in creating new avenues, their desired trades for engagement of youth and their perception on migration (whether its good or not, ways to mitigate it etc.). Total 12 FGDs should be done (1 rural and 1 urban per district) to assess the district specific needs.

7.6 Self Help Development Groups (SHGs) formed and working

The Self-Help Group (SHG) is a group of rural poor who volunteer to organize themselves in a group for eradication of poverty of the group members. This is done through an agreement among the members that they will save a part of their earnings regularly and convert their savings into a common pool of fund or funds that they may receive as a group from DRDA through a common management.

Role of SHGs for promoting rural entrepreneurship using local resources, local skills and local knowledge involving women workforce has long been emphasized. The groups play an important role in developing rural women. Micro-finance through SHGs can motivate women to get self-employment and help them in development of entrepreneurial skills. Planning Commission as well as Indian Government have rightly recognized the potential of women for livelihood improvement and economic development. India's Self Help Group movement has emerged as the world's largest network of community-based organizations. The SHG bank linkage program (SBLP), which is the India's own innovation has proved to be one of the most effective poverty alleviation and women empowerment programs. Empowerment of women through Self Help Groups would lead to benefits not only to the individual women but to the family and community through collective action for the development.

7.6.1 Methodology for validation proposed for sub-indicator Self Help Development Groups (SHGs)

- ❖ **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand
- ❖ **Research approach:** Mixed method approach-using both quantitative and qualitative survey

- ❖ **Research process for quantitative data collection:**

1. **Sampling design:** Multi-stage stratified random sampling
2. **Selection of districts:** All 13 districts of Uttarakhand was categorized according to geographical locations (Upper Hill, Mid Hill and Plains).

Upper hills - Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar

Middle hills - Tehri-Garhwal, Pauri-Garhwal, Almora, Champawat and Nainital

Plains - Dehradun, Haridwar, Udham Singh Nagar

2 districts from upper hills ,2 districts from mid hills and 2 districts from plains should be selected one with highest and second with lowest number of SHGs.

3. **Selection of blocks:** From each district, 2 blocks should be selected randomly.
4. **Urban PSU:** From each district, 2 urban wards should be selected randomly.
5. **Selection of SHGs:** From each selected PSU both rural/urban, 5 SHGs should be selected randomly.

- ❖ **Research process of qualitative data collection:**

From the selected villages, the information should be collected from all the beneficiaries who were covered under SHG in the selected villages. In addition to it, from each selected village, 5 respondents who had applied, but not selected, were also interviewed. Besides, detailed interviews were held with the officials at state, district, and block level.

- ❑ Data will be collected from the officials at various levels, beneficiaries, and non-beneficiaries of the scheme through structured questionnaires. In addition to this in-depth interviews and Focus Group Discussions (FGDs) will also be held with the Women Self Help Groups (WSHG) and other Self-Help Groups (SHGs) to ascertain their status.

7.7 Village link under PMGSY

- **PMGSY: Programme Goals**

Rural Road connectivity is a key component of rural development by promoting access to economic and social services and thereby generating increased agricultural income and productive employment opportunities. It is also a key ingredient in ensuring poverty reduction.

It was against this background of poor connectivity that the Prime Minister announced in 2000, a massive rural roads programme. The Prime Minister's Rural Road Programme (Pradhan Mantri Gram Sadak Yojana, PMGSY) set a target of:

- (I)-Achieving all-weather road access to every village/habitation with a population greater than 1000 by 2003

(ii)-Providing all-weather road access to all villages/habitations of population greater than 500 people [250 in case of hill States (North-Eastern states, Sikkim, Himachal Pradesh, Jammu & Kashmir, and Uttarakhand), the desert areas and tribal areas] by the end of the Tenth Five Year Plan, i.e., 2007

➤ ***Noteworthy Features of the PMGSY***

The Ministry of Rural Development (MoRD) has been entrusted with the task of organizing the programme. Some of the noteworthy features of the programme are:

- (i) Full central funding, with 50 percent of the cess on High-Speed Diesel being earmarked for this programme.
- (ii) Preparation of Master Plans and Core Network for Rural Roads for all the Districts and Blocks, identifying the unconnected habitations and proposing the most cost-effective routes for the purpose.
- (iii) Design and Specifications as contained in the Rural Roads Manual (RRM, IRC SP: 20), published by the Indian Roads Congress (IRC).
- (iv) Appointment of a dedicated State Level Agency in all States with overall responsibility for rural road planning, programme execution and management.
- (v) Appointment of programme implementing agencies, by all States, typically Public Works Departments (PWDs) or Rural Engineering Organizations (REOs).
- (vi) Independent State Technical Agencies (STA) commissioned by MoRD to vet designs and estimates.
- (vii) Use of competitive tendering by the implementing agencies of all works on the basis of a Standard Bidding Document (SBD).
- (viii) Execution of the works within a period of 9-12 months.
- (ix) A Defects Liability and maintenance period of 5 years specified in the Contracts for the roads constructed under the programme, with funds for maintenance being provided by the States.
- (x) A Central on-line web-based financial and project monitoring system.
- (xi) A 3-Tier Quality Management System.
- (xii) Operational management at Central level by the National Rural Roads Development Agency (NRRDA).

7.7.1 Methodology for validation proposed for sub-indicator Village link under PMGSY

- ❖ ***Geographical coverage:*** Both Garhwal and Kumaun division of Uttarakhand
- ❖ ***Research approach:*** Mixed method approach-using both quantitative and qualitative survey
- ❖ ***Research process for quantitative data collection:***

1. Sampling design: Multi-stage stratified random sampling

Selection of districts: All 13 districts of Uttarakhand was categorized according to geographical locations (Upper Hill, Mid Hill and Plains).

Upper hills - Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar

Middle hills - Tehri-Garhwal, Pauri-Garhwal, Almora, Champawat and Nainital

Plains - Dehradun, Haridwar, Udham Singh Nagar

2 districts each from upper and middle hills, should be taken for study, one with highest and second with lowest number of habitations with greater than 250 population. From foothills both 'aspirational districts' i.e., Haridwar and Udham Singh Nagar will be taken.

2. **Selection of blocks:** From each district, 2 blocks should be selected randomly.
3. **Selection of habitation (with greater than 250 population):** 5 habitation per block should be selected randomly. Thus, total 60 habitations/village should be covered.

❖ **Research process of qualitative data collection:**

In addition to quantitative data collection, qualitative data through in-depth interviews will also be collected from stakeholders like District Implementing Agencies, members of Panchayati Raj Institutions (PRIs), Women Self Help Group (SHG) members, Farmers, Shop Keepers and other opinion leaders of the habitations.

7.8 Employment status under MGNREGA

Agriculture and allied activities are still the mainstay of the overwhelming majority of the people in the country. More than 60 percent of total workforce derives their livelihood from agriculture. High dependence on agriculture has caused decrease in per capita household income from farm sector and use of labour-saving technologies in agricultural production have resulted in less employment in the rural areas, leading to poverty among rural masses.

In such a situation an effective way to reduce rural poverty could be to accelerate the shift of workers from relatively lower productive agriculture to more productive employment in the non-farm sector. In such a context of persistent poverty and unemployment scenario Mahatma Gandhi National Rural Employment Guarantee scheme (MGNREGA) was initiated to serve the people belonging to lower strata (mainly wage earners) in the society.

In Uttarakhand, 74 percent population lives in rural areas, out of which about 41 percent population belongs to BPL, having low educational, health and nutritional status. Work participation rate is merely 37 percent and 63 percent are non-workers in the state. There is a strong argument of shifting of labour force from the agricultural jobs to non-agricultural works, which is adversely affecting the agricultural operations.

Fewer options have been witnessed in the hands of the villagers in terms of earning their livelihood other than agriculture which led to most people being driven to landowner farmers to work under them for meagre wages. MGNREGA was expected to change this scenario by providing more employment opportunities to rural poor and acting as wage regulator in labour market. But when it comes to providing 100 days of wage employment to every household, the programme is far behind from achieving the target.

Besides this, NSSO in its 68th round survey on monthly per capita expenditure on food found that an average rural Indian spends Rs.756 per month on food, which is far less than the national average of Rs.1024. This meagre expense on food corroborated by the malnutrition figure of National Family Health Survey shows that 70 percent of India's children aged 6–59 months are anaemic. The monthly average for all consumer expenditure per capita is Rs.1430 per month in rural India and Rs.2630 in urban India.

The comprehensive assessment of the performance of the scheme reveals serious lapses arising mainly due to lack of public awareness, mismanagement, mass corruption and institutional incapacity. Loads of paper work, regular entry of data, delay in fund release etc. are some of the problems faced by stakeholders as reported by earlier studies.

7.8.1 Methodology for validation proposed for sub indicator Employment status under MGNREGA

Information regarding validation of “Employment status under MGNREGA in Uttarakhand” may be gathered using the following sampling methodology

- ❖ **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand.
- ❖ **Research approach:** Mixed method approach-using both quantitative and qualitative survey.
- ❖ **Sampling design:** Multi - stage stratified random sampling.

A) Research process for quantitative Data collection:

Geographically the state is divided into three zones

1. **Upper hills** - Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar
2. **Middle hills** - Tehri-Garhwal, Garhwal, Almora, Champawat and Nainital
3. **Foothills**- Dehradun, Haridwar, Udham Singh Nagar

All three zones should be covered for the study.

1. Selection of districts:

The criteria of selection of district should be based on their performance in terms of percentage of households provided employment out of total job card holders under MGNAREGA. Two districts (one with high performance and another with low performance) should be selected from each zone.

Thus, study should be carried out in 6 districts of Uttarakhand State namely- Bageshwar, Uttarkashi, Almora, Tehri Garhwal, Dehradun, and Udham Singh Nagar.

Table 7.4: Performance of District under MGNREGA		
Sl.No.	District	Percentage of HH provided Employment out of total job card holders
Upper hill zone		
1.	Bageshwar	53.9
2.	Chamoli	79.95
3.	Pithoragarh	66.39
4.	Rudraprayag	62.79
5.	Uttarkashi	80.43
Middle hill zone		
6.	Almora	56.99
7.	Champawat	67.90
8.	Nainital	61.18
9.	Pauri Garhwal	63.50
10.	Tehri Garhwal	69.86
Foot hill zone		
11.	Dehradun	63.91
12.	Haridwar	51.84
13.	U.S.Nagar	49.94
Total of Uttarakhand		64.99

Source: SDG INDEX Uttarakhand 2019-20

2. Selection of blocks:

From each selected district, two blocks should be selected on the same criteria. Thus, a total of 12 community development blocks should be covered.

3. Selection of gram panchayats (GPs):

From each selected block, four-gram panchayats should be selected on the basis of performance in respect of two parameters 1) number of households with at least one member with MGNAREGA job card and 2) number of house hold getting jobs under MGNAREGA in last financial year. The panchayats will be ranked on the basis of their aggregate score on employment. Two good performing gram panchayats and two poor performing gram panchayats should be selected. Thus, a total of 48-gram panchayats will be covered.

4. Selection of Beneficiaries:

Twenty beneficiaries from each Gram Panchayat should be selected randomly for interview from the list of beneficiaries having working job cards for last three years. Thus, a total sample of 960 beneficiaries may be covered for the validation of employment status under MGNAREGA.

8 Social Welfare

8.1 Preamble

National Social Assistance Programme (NSAP)

National Social Assistance Programme (NSAP) provides social assistance benefits to poor households in India such as old age person, widow, and disabled person. Main objective of NSAP is to ensure social protection to its beneficiaries in India.

To validate the status of Social Welfare it is proposed to carry out the study under 4 sub-indicators:

1. Beneficiaries under disability pension scheme
2. Beneficiaries under widows' pension scheme
3. Beneficiaries under old age pension scheme
4. Status of De-addiction Centre

8.2 Disability Pension Schemes

In the state of Uttarakhand under Uttarakhand Viklang Pension Scheme a sum of 1200 rupees per handicapped per month is provided in 2 equal instalments.

8.3 Widow pension scheme

The State Government of Uttarakhand has introduced Widow Pension Scheme for the welfare of widows. This scheme provides monthly pension to the eligible widows of the State. Benefits and eligibility criterion of the Uttarakhand Widow Pension Scheme are as under.

- **Benefits of the Scheme:** The widows of the State of Uttarakhand can avail the pension of Rs. 1000/- as per the Widow Pension Plan. It reduces the financial crisis of widows and especially those who belong to Below Poverty Line (BPL); hence their financial position will be improved from the poor economic condition under the Uttarakhand widow pension scheme.
- **Eligibility Criteria:** The applicant should be a widow and a resident of the State of Uttarakhand. The minimum age of applicant for joining the scheme is 18 years, and the maximum is 60 years and must belong to the Below Poverty Line (BPL). Besides, her monthly income should not exceed Rs. 4,000.

8.4 Indira Gandhi National Old Age Pension Scheme (IGNOAPS)

Ministry of Rural Development of India has introduced Indira Gandhi National Old Age Pension Scheme (IGNOAPS) under National Social Assistance Programme (NSAP) in the year 2007. IGNOAPS also called as National Old Age Pension Scheme (NOAPS). The old age pension scheme aims to provide social protection to the eligible beneficiaries.

❖ **Features of the Scheme: Key features of Indira Gandhi National Old Age Pension Scheme are:**

- Under IGNOAP scheme, senior citizens of India will receive monthly pension.
- It is a non-contribution pension which means that the beneficiary does not have to contribute any amount to receive the pension.

❖ **Eligibility Criteria: Following criteria should be met to obtain Indira Gandhi National Old Age Pension.**

- The age of the applicant (male and female) should be 60 years and above.

- Applicant must belong to household living below poverty line according to the criteria prescribed by the Government.
- Applicant must be destitute and having no regular source of financial support from family members or any other sources is eligible for old age pension.
- BPL widows and BPL persons with severe and multiple disabilities in the age group of 60 -79 years are not eligible for **IGNOAP** scheme.

Sl. No.	Name of scheme	Age of senior citizen	Central Govt. Share	Uk Govt. Share	State Pension Amount
1	Old Age Pension	60-79 years	300	700	1000.00
2	Widow pension	18-60 years	300	900	1200.00

8.5 Methodology for validation proposed for all 3-sub indicator would be similar

- i. Beneficiaries under disability pension scheme
- ii. Beneficiaries under widows' pension scheme
- iii. Beneficiaries under old age pension scheme

Both primary and secondary data should be collected through structured instruments at different levels. The secondary data should be obtained through the State, District, and Block questionnaires. Information should be collected about financial and physical performance and adequacy of the implementation mechanism for the schemes. Detailed discussions should be held with the officials at various levels to gather information on the implementation of the scheme. The primary data should be collected through field surveys from beneficiaries as well as non-beneficiaries of the scheme.

The questionnaires should cover a host of areas starting with the socio-economic characteristics of the beneficiaries, level of awareness about the schemes, eligibility criterion, procedures, problems encountered, utilization of the funds and impact of the scheme, etc. Information should be collected from the non-beneficiaries including their socioeconomic status, knowledge of the schemes and experiences with the implementation of the scheme. The experiences of the beneficiaries and non-beneficiaries will be gathered in order to identify as well as analyse the possible shortcomings in the implementation of the scheme.

- 1. Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand
- 2. Sampling design:** Multi-stage stratified random sampling
- 3. Selection of districts:** All 13 districts of Uttarakhand should be categorized according to geographical locations (Upper Hill, Mid Hill and Plains).

1. Upper hills — Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar

2. Middle hills — Tehri-Garhwal, Garhwal, Almora, Champawat and Nainital

3. Foothills- Dehradun, Haridwar, Udham Singh Nagar

2 districts each from upper and middle hills, should be taken for study, one with highest and second with lowest number of beneficiaries. From foothills both 'aspirational districts' i.e., Haridwar and Udham Singh Nagar should be taken.

4. **Selection of blocks:** Community Development Blocks (CDBs) should be divided into two groups of high and low performance, based on the information on key indicators of development. The indicators used are literacy level, percentage of villages electrified, percentage of villages having safe drinking water facility and percentage of villages having health centres. One block from each of the two groups should be selected on random basis in the district. Accordingly, 12 blocks should be selected from the six selected districts. Details about the schemes should be collected from the district social welfare officers/District Development Officers and Block Development Officers
5. **Selection of Village Panchayats:** 10 village panchayats per block should be selected randomly. Thus, a total of 120 village panchayats will be covered.
6. **Selection of Beneficiaries:** From the list of selected village panchayats, a sample of 9 beneficiaries per village panchayat under each scheme should be selected from the list provided by the offices of Block Development Officers (BDOs). Thus, total 1080 beneficiaries will be validated.

8.6 Status of De-addiction Centre

Addiction of drugs and drinks has negative impact on physical and mental health of human being which also adversely affect social and cultural harmony as well as prosperity. Drug addiction in Uttarakhand has been a severe problem among youths particularly teenagers due to easy availability in the State.

The Government of Uttarakhand has made rules and regulations vis-à-vis created several Nasha Mukti Kendra and rehabilitation centres to prevent the addiction from spreading.

India's approach towards Narcotic Drugs and Psychotropic Substances (NDPS) is enshrined in Article 47 of the Constitution of India which mandates that the '...State shall endeavour to bring about prohibition of the consumption except for medicinal purposes of intoxicating drinks and of drugs which are injurious to health'. Following symptoms/effects are found in drug abusers:

- (a) Depression;
- (b) Violent behaviour;
- (c) Respiratory failure;
- (d) Memory loss;
- (e) Social withdrawal;
- (f) Loss of interest in school, work, family and friends;
- (g) Mood swings;
- (h) Abdominal pain and nausea;
- (i) Sleep disorders;
- (j) Risk of heart attacks; and
- (k) Death risk.

Furthermore, the National Policy on NDPS aims to “Re-assert India's commitment to combat the drug menace in a holistic manner”. In the year 2015, National Legal Service Authority (NALSA), formulated Legal Services to the Victims of Drug Abuse and the Eradication of the Drug Menace Scheme, 2015. The objectives of the said scheme are: -

- i. To disseminate awareness amongst the general masses regarding the Legal Provisions, various Policies, Programmes and Schemes, in respect of Narcotic Drugs and Psychotropic

Substances as well as to create awareness about the ill effects of drug abuse amongst the children in schools and colleges, street children, urban slum children, injective drug user(s), families concerned, prisoners, workers in unorganized Sector, Chemists, drug pedlars, sex workers and general masses etc.

ii. Organizing literacy camps for sensitizing the farmers who are carrying out permissible cultivation of various substances/source plants about the adverse health and life-threatening effects of consumption of such drugs and substances.

iii. To spread awareness amongst the parents, teachers and students about the ill effects of the substance abuse.

iv. To sensitize the various stakeholders viz; Judiciary, Prosecution, Members of Bar, Police, Forensic Laboratories, De-addiction Centres, Corrective Homes, Rehabilitation Centres, School, College and University administration, Children Homes, Old-age Homes, Nari Niketans, Schools for Special Children, Ministerial Staff of Courts, etc. about the drug menace and effective measures to curb it.

v. To mobilize the available infrastructure in identifying the victims of drug abuse, their treatment and post detoxification rehabilitation.

vi. To tap the potential of the Panchayati Raj Institutions/Local Bodies at grass root level for intervention and prevention of drug abuse and destruction of illicit cultivation of plants used to derive the drugs/ substances.

vii. To maintain effective coordination with the Drug De-Addiction Centres and Rehabilitation Centres etc. for better facilities and respect for the rights of the victims and to intervene, if any breach is noticed.

viii. To co-ordinate the activities of the various stakeholders working in the field.

ix. To ensure essential legal services to the victims of drug trafficking and drug abuse.

8.6.1 Methodology for validation of the Status of De-addiction centres in Uttarakhand is proposed.

❖ ***Research approach:*** Mixed method approach (both quantitative and qualitative) should be followed for collecting the relevant data.

➤ Research process for quantitative data collection:

According to website <https://rehab.in>, there are 65 De-addiction / rehabilitation centres in Uttarakhand across 13 districts.

- ***Selection of Rehabilitation centres:*** A sample of 30 percent centres to the maximum of 20 centres should be selected randomly for the study.
- ***Selection of service users:*** From each selected centres 10 service users should be selected. The selection of service user should be done based on availability and their oral- informed consent. Thus, a total of 200 service users should be interviewed.

➤ Research process for qualitative data collection

- ***Selection of service providers & key informant's:*** From each selected centres, 2 service providers from each centre, thus a total 40 service providers should be selected randomly. We should select 5 key informants across all 13 districts for the study.

Qualitative data should be collected from service providers as well as Key informants.

9 Tourism

9.1 Preamble

Uttarakhand's rich cultural and natural heritage, its ancient civilization, vibrant culture, many landscapes, and rich biodiversity has immense potential for attracting worldwide tourist which contributes significantly developing tourist market and infrastructure for socio economic growth of the State and give it a tremendous potential for tourism development. In 2002, the Government set a new policy for the development and regulation of the sector. It recognized the role of tourism in achieving socioeconomic goals and catalysing broad-based growth. It also made a commitment to (i) mobilize the state governments for tourism development, (ii) encouraging private sector provision of tourism facilities and services supported by public sector infrastructure development, and (iii) providing regulatory support to ensure environmentally and culturally sustainable tourism.

Uttarakhand is a mystical land of mountains and mythologies, exquisite landscapes and exhilarating adventure, and wellness and yoga. This State is popularly known as Devbhoomi, the land of gods. the state is framed by the Himalayas and divided into two main regions, Garhwal and Kumaun. Uttarakhand has several well-known destinations like Nainital, Mussoorie, Corbett National Park and Auli, and pilgrimage sites like Kedarnath, Badrinath, Rishikesh and Haridwar, besides several little known but of paramount importance places in all the 13 districts.

In modern parlance, tourism means all types of tourism such as religious Tourism, Cultural Tourism, Pilgrimage Tourism, Adventure Tourism, Sports Tourism, Medical & Wellness Tourism, Heli tourism, Ecotourism, Film Tourism, Wildlife Tourism, etc. For the development of tourism, a robust infrastructure is needed. Infrastructure means power, water, and sewerage, market, health, accommodation, transport infrastructure facilities.

It is proposed to carry out the study under 3 sub- indicators

1. Market demand of Tourism sector
2. Status of Tourism Infrastructures & Services
3. Number of Tourist Arrival Annually

9.2 Status and market demand of tourism sector

The Major Themes in which destinations across Uttarakhand are divided based on Uttarakhand Tourism Policy 2018 are presented below. All the eleven major themes should be covered in this study.

S.no.	Major Themes	Destination Sites
1.	Pilgrimage, Cultural & Festivals	Gangotri, Yamunotri, Kedarnath, Badrinath, Rishikesh, Haridwar, Jageshwar, Baijnath, Piran Kaliyar, Hemkund Sahib, Nanda Devi, Chota Kailash, Patal Bhuvaneshwar, Nanakmatta, Panch Prayag, Panch Kedar, Panch Badri, Nanda Rajjat Yatra, Uttarayani Mela, Kumbh Mela, Ramman Festival etc.

2.	Wildlife & Bird Sanctuaries	Jim Corbett National Park, Rajaji National Park, Binsar Wildlife Sanctuary, Kedarnath Musk Deer Sanctuary, Nanda Devi National Park, Askot Musk Deer Sanctuary, Neel Dhara Pakshi Vihar, Benog Wildlife Sanctuary, Govind Wildlife Sanctuary, Gangotri National Park, Kedarnath Sanctuary etc..
3.	Adventure	Rafting: - Shivpuri, Tons, Kali Skiing: - Auli, Dayara, Khaliya Top Trekking: - Gangotri Kalindi khal – Badrinath, Devariatal – Chandershila, Govindghat: - Ghangariya – Valley of Flowers, Almora: - Jageshwar- Binsar, Bedni Bugyal, Chopta, Pindari Glacier Trek, Milam Glacier Trek, Om Parvat: - Aadi Kailash etc. Aero Sports: - Helium & Hot Air Balloons/Blimps - Pithoragarh, Naukuchiyatal, Tehri, Bedni Bugyal, Chopta etc. Mountain Biking- Nainital, Mussoorie, Almora etc.
4.	Heritage Tourism	Narendranagar (Tehri), Gujругarhi (Pauri), Uppugarhi (Tehri), Pithoragarh Fort (Pithoragarh), Chandpurgarhi (Chamoli), Vairat Kila (Chakrata), Katarmal Sun Temple (Almora), Devalgarh (Pauri), Nelong Valley (Uttarkashi) etc.
5.	Nature and Landscape	Mussoorie, Nainital, Chakrata, Dhanaulti, Almora, Kausani, Lansdowne, Mukteshwar, Ranikhet, Chaukauri, Pithoragarh, Khirsu etc.
6.	Health, Rejuvenation & Medical	Rishikesh, Haridwar, Tapovan, Dehradun, Haldwani etc
7.	Eco/ Rural Tourism	Mana, Chopta, Chakrata, Deoriatal, Pallyu, Shaukiyathal, Bageshwar, and Munsyari, Dodital, Dayara Bugyal, Kanatal, Sattal, Chaiinsheel, Mori etc.
8.	Water sports, Cruise, Yachts	Tehri Dam Reservoir, Nainital, Nanaksagar, Baur Jalashaya, Naukuchiyatal, Bhimtal, Sattal, Maneri etc.
9.	Meeting Incentives Convection Exhibitions (MICE)	Dehradun, Nainital, Haridwar, Rishikesh
10.	Buddhist	Rock Edict Kalsi Dehradun, Govisairn (Kashipur)

11.	Ropeways and Funicular	Auli, Haridwar, Ranibagh, Dehradun, Mussoorie, Jankichatti, Yamunotri, Govindghat, Ghangaria Gaurikund, Kedarnath, Hemkund Sahib etc.
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Source: - Uttarakhand Tourism Policy 2018

1. **Research Approach:** Quantative cum Qualitative data collection process should be used.
2. **Sampling Design:** Purposive sampling should be used to select two destination sites from each of the eleven major themes based on the maximum arrival of tourist. Thus, a sample size of 22 destinations sites will be covered.
 - **Selection of tourists:** From each destination sites, 30 tourists should be interviewed (25 domestic and 5 international tourist). Thus, a sample of 660 tourist should be taken randomly from the Eleven major themes.
 - **Domestic Tourists** – to be interviewed at destination sites
 - **Foreign Tourists** – to be interviewed at the following locations
 - Destination sites and hotels
 - Exit locations like airport, railway stations
 - **Selection of Tourist Operator:** A total of 44 tourist operators (2 per destination sites) should be selected randomly for in-depth interview to gather relevant information in order to supplement the information already collected from tourists.
 - **Selection of Localized Shops:** 5 shops from each destination sites should be selected randomly for in-depth interview. Thus, a total of 110 shops are to be surveyed.
 - **Selection of Inhabitant:** 5 Inhabitants from each destination sites should be selected randomly for in-depth interview. Thus, a total of 110 inhabitants may be surveyed.

Particulars	Units	Total Coverage
Themes	11	11
Destination sites	2 (per circuit)	22
Domestic Tourist	25 (per site)	550
International Tourist	5 (per site)	110
Tourist Operator	2 (per site)	44
Localized Shops	5 (per site)	110
Inhabitant	5 (per site)	110
Total		950

10 Food & Civil Supply

10.1 Preamble

Food availability is the crucial factor of food security and economic development of any society. Domestic production particularly agriculture and imported food items contribute significantly towards food availability and its sufficiency. MS Swaminathan Research Foundation (MSSRF) study indicates that in this era of globalization, one can visualize the possibility of food imports and industrial exports. The imported food items can be utilized to stabilize the prices of food items if the production of food falls short. Under Indian conditions, however, the industrial exports are very much limited to allow any dependence on imports. Under this scenario, therefore, domestic food production cannot be ignored.

In our country, rapid changes in technology have led to decreasing importance of agriculture in national economy, and in many quarters, it is known as structural change. Though there appears to be a shift from agriculture to service sector, we have to go a long way to complete the process. Both in agriculture and industry, the change has to be accompanied by improved productivity. Till the time higher paid jobs are not available in non-agriculture sector, agriculture will continue to provide livelihood to a majority of our population and thus the role of agriculture in food production and employment will continue to be crucial for India.

In the present chapter, an attempt has been made to examine various aspects of food availability in details. We have taken into account both present and likely food availability in this study. Following 4 indicators are proposed for this purpose.

1. Availability of Food in Kg/Per capita per year
2. Evaluation of Public Distribution System
3. Household using clean cooking fuel /Households using LPG or PNG
4. Available Capacity of Post-harvest storage and distribution losses of food grains

10.2 Availability of Food in Kg/Per capita per year

Food items (both vegetative and non-vegetative product) that contribute to wellbeing of individual are termed as food.

- **Food items**

- i. **Cereals (rice, wheat and coarse cereals)** – Pulses, Tubers (potato, sweet potato and tapioca), Vegetables, Fruits
- ii. **Edible Oil** – Sugar, Milk, Eggs, Meat and Fish

As an example, the ICMR norms kg per capita per annum of net production per head is given in order to validate the availability of food in Kg/Per capita per year, following procedure as given below should be used.

The average production of two or three years was taken. In order to obtain net production, 13 percent of the total production of cereals, pulses, tubers, and vegetables has been deducted for seed, feed, and wastage, while 70 percent from oilseeds (conversion factor when oil is extracted) and 50 percent for fruits has been deducted to arrive at net production. Production of sugar has been taken as it is. Table 10.1 describes per capita net food production across the districts.

Triennium average production of 2016-2017, 2017-18, 2018-19 is considered for cereals,

pulses, tubers, vegetables, fruits, edible oil, sugar, and fisheries. For the production of eggs and meat the two years average of the 2017-18 and 2018-19 is considered. The production of milk the triennium average of 2013-14, 2014-15 and 2015-16. Triennium average production indicates the level of production free from fluctuations.

Production of each of these items in metric tonnes is divided by the projected population of the year 2018-19 to obtain per capita production in kg/annum. Similarly, one egg is taken as 0.125 kg for the purpose of converting the number of eggs into tonnes.

S. No.	Districts	1	2	3	4	5	6	7	8	9	10	11
		Cereals	Pulses	Tubers	Vegetables	Fruit	Edible Oil	Sugar	Milk	Eggs	Meat	Fish
	ICMR Norms	153.30	14.60	27.38	45.63	18.25	8.03	10.95	54.75	16.43	9.13	9.13
1	Almora	153.72	8.45	72.29	65.15	135.23	0.74	0.00	236.76	0.03	1.96	0.08
2	Bageshwar	141.32	3.24	14.29	22.13	20.52	0.11	0.00	219.85	0.03	1.96	0.11
3	Chamoli	120.36	4.96	34.55	24.08	15.42	0.60	0.00	176.90	0.01	1.50	0.23
4	Champawat	99.07	8.03	7.63	62.71	23.30	1.64	0.00	198.07	0.03	2.05	0.09
5	Dehradun	36.64	1.70	3.75	33.38	11.15	0.14	14.71	76.53	0.05	2.11	0.12
6	Haridwar	76.13	0.14	0.94	36.03	23.80	0.29	133.31	129.21	0.01	2.73	0.56
7	Nainital	91.44	2.53	29.95	48.86	50.07	2.21	0.00	149.29	0.03	5.51	0.04
8	Pauri Garhwal	126.41	7.86	7.05	36.83	22.10	0.49	0.00	161.57	0.01	2.53	0.09
9	Pithoragarh	129.10	11.16	18.56	110.44	43.80	1.11	0.00	227.88	0.02	1.91	0.14
10	Rudrapur	145.79	0.70	3.65	11.31	6.65	0.26	0.00	186.27	0.02	2.04	0.10
11	Tehri Garhwal	123.72	9.81	17.03	27.24	5.35	0.52	0.00	180.07	0.01	2.03	0.53
12	U S Nagar	395.81	1.96	2.52	45.04	14.45	0.84	56.12	120.82	0.29	4.20	1.25
13	Uttarkashi	113.17	9.99	47.80	84.04	44.38	0.78	0.00	168.87	0.02	2.64	0.15
	Uttarakhand	143.83	3.81	14.03	43.87	28.15	0.69	9.35	145.51	0.07	2.87	0.41

Net Production = Production less Seed, Feed and Wastage at the rate of 13% for cereals, tubers, pulses, vegetables. 70% for edible oils and 50% for fruits. No wastage for Sugar

Source: - Food and Nutrition Insecurity Atlas of Uttarakhand 2019-20

10.2.1 Net Production Index with ICMR norm as the base

Separate indices are computed for net production. Net production is nothing but food production after deducting certain percentages for seed, feed and wastage for some of the food items.

Net production index is computed to compare the sufficiency of food production with consumption norms given by the Indian Council of Medical Research (ICMR).

Production of food cannot be directly compared with consumption norms, as the consumption norms are related to edible portions whereas production is the total raw weight including seed, feed and wastage.

Per capita net production is calculated by deducting 13 percent of per capita production for seed, feed and wastage in respect of cereals, pulses, tubers and vegetables. The present level of wastage is no more than 12 percent. The requirement for seed, feed and wastage is expected to increase in future.

No wastage is deducted for sugar, milk, eggs, and fish to compute availability index. 70 percent and 50 percent of the weight is deducted as seed, feed and wastage for oil seeds and fruits respectively.

The net production index in percentage is computed using ICMR recommended levels of intake as the basis for indexing.

$$INP_{ij} = (X_{ij}/X_{iICMR}) * 100$$

Where,

INP_{ij} = Index of food availability of the j^{th} district for ' i^{th} food item

X_{ij} = Per capita availability of i^{th} food item per annum in the j^{th} district

X_{iICMR} = Per capita per annum recommended intake of the i^{th} food item

10.3 Evaluation of Public Distribution System

Targeted Public Distribution System (TPDS) was introduced in India in 1997 as a revamped PDS scheme with the focus on poor. TPDS is administered under the Public Distribution System (Control) Order 2001, notified under the Essential Commodities Act, 1955 (ECA). The ECA regulates the production, supply, and distribution of essential commodities including edible oils, food crops such as wheat, rice, and sugar, among others. It regulates prices, cultivation and distribution of essential commodities. The PDS (Control) Order, 2001 specifies the framework for the implementation of TPDS. It highlights key aspects of the scheme including the method of identification of beneficiaries, the issue of foodgrains, and the mechanism for distribution of foodgrains from the centre to states. The National Food Security Act 2013 (NFSA) gives statutory backing to the TPDS. This legislation marks a shift in the right to food as a legal right rather than a general entitlement. The Act classifies the population into three categories: excluded (i.e., no entitlement), priority (entitlement), and Antyodaya Anna Yojana (AAY; higher entitlement). It establishes responsibilities for the centre and states and creates a grievance redressal mechanism to address non-delivery of entitlements

TPDS is a mechanism to deliver subsidized foodgrains and fuel to the poor through a multi-level process with the responsibilities shared by state and districts. Under TPDS food grains like wheat and rice are procured/ purchased from farmers by centre at minimum support price; which is then allocated to a central depot in each state based on a set formula. The Food Corporation of India (FCI) is the nodal agency at the centre that is responsible for transporting

foodgrains to the state godowns. The state governments identify the eligible households within the total number of poor households and transfer the grains from depots to each ration shop within the state from where the beneficiaries buy the food.

TPDS currently face challenges of leakage in delivery system, in lieu of which, end to end computerization of TPDS operations was proposed in 12th five-year plan to facilitate proper tracking of foodgrains and lifting by consumers using smart cards. Modernization of the TPDS including its end-to-end computerization is a priority area for the Department of Food, Civil Supplies & Consumer Protection of the Government of Uttarakhand. Department has taken initiatives for computerization of TPDS. The first phase of digitization of TPDS is almost complete and now the State is going for automation of PDS shops in order to bring down the leakages and improve the consumer satisfaction.

10.3.1 Objectives of the study

The main objective of the study is to have an understanding of the TPDS currently in Uttarakhand. The broad objectives are to:

- a. **Measure coverage of TPDS** (percent distribution of the food grains, fuel and other commodities to the beneficiaries)
- b. **Measure the awareness levels and perceptions among beneficiaries about TPDS** (knowledge about commodities and subsidy provided under TPDS, eligibility to become a beneficiary, appropriateness of subsidy rates etc.)
- c. **Analyse the current delivery system of TPDS from the perspective of beneficiaries** (stock availability and functioning of PDS shops, quality of commodities provided under TPDS, TPDS requirement at household level according to age group and activities of family members and actual supply of PDS to the family etc.)
- d. **Analyse the current delivery system of TPDS from the perspective of Fair Price Shopkeepers (FPS)** (timely supply and appropriateness of stock made available at shop according to the population, quality of the supply, storage facilities etc.)
- e. **Analyse the leakages in the current delivery system of TPDS** (inaccurate identification of households, leakage of food grains during transportation to the ration shop and from the ration shop into the open market, procurement vis-à-vis requirement, storage capacity and quality etc.)

10.3.2 Methodology for validation proposed for sub-indicator Evaluation of Public Distribution System

➤ Study area

The study should be conducted in randomly selected 6 districts (3 districts from Kumaun and 3 districts from Garhwal division) of Uttarakhand.

➤ Primary sampling Units (PSUs)

30 cluster design approach of sampling suggested by WHO should be adopted to select the PSUs. Per district 30 PSUs (20 panchayats and 10 urban wards) be selected by PPS (Probability Proportional to Size) method in order to obtain a representative sample from whole district. Thus, a total of 180 PSUs should be selected for the study.

➤ Selection of TPDS beneficiaries

a) At household level

14 beneficiaries may be selected randomly from each PSUs giving priority to those households having AAY ration cards and size up to 4 and 4+ members. Thus, a total of 2520 beneficiaries from 180 PSUs should be covered.

b) At fair price shops (for exit interview)

30 TPDS beneficiaries selected randomly from each selected district for exit interview. (Total of 180 exit interview)

c) Selection of Fair Price Shops

30 Fair Price Shops per district should be randomly selected from all Fair Price Shops in urban and rural area. Thus, survey of total of 180 Fair Price Shops may be done.

S.no.	Particulars	Total Sample
1.	Districts	6
2.	Village Panchayats	120 (@20 per district)
3.	Urban Ward	60 (@10 per district)
4.	Households	2520 (@14 per PSU)
5.	Beneficiaries (for exit interview)	180 (@30 per district)
6.	Fair Price Shops	180 (@30 per district)

10.4 Household using clean cooking fuel /Households using LPG or PNG

A general hypothesis is that with income growth, there is also an increase in the use of modern fuels for cooking. In India (like many other developing countries) even though the overall poverty rates have been falling for several decades, the reliance of households on solid biomass and traditional inefficient cookstoves has remained a reality (Ministry of Finance 2019). It is estimated that over 800 million people in India lacked access to clean cooking fuel in 2014 (Sustainable Energy for All 2017). This implies that rural households that are not poor have also been using solid biomass for meeting their cooking energy needs

10.4.1 Methodology for validation proposed for sub-indicator Household using clean cooking fuel /Households using LPG or PNG

1. **Selection of districts:** All 13 districts of Uttarakhand are categorized according to geographical locations (Upper Hill, Mid Hill and Plains).

Upper hills - Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar

Middle hills - Tehri-Garhwal, Pauri-Garhwal, Almora, Champawat and Nainital

Plains - Dehradun, Haridwar, Udham Singh Nagar

One district from each geographical zone should be selected randomly for the study.

2. **Selection of blocks:** From each district, 2 blocks should be selected randomly.

3. **Selection of village:** 5 villages per block should be selected by PPS method. Thus, total 30 villages may be covered.

4. Selection of households: 25 households per village should be selected randomly. Thus, total 750 households should be covered.

10.5 Available Capacity of Post-harvest storage and distribution losses of food grains

The available capacity of post-harvest storage is already known with the Government. In regard to distribution of losses of food grains, the methodologies have been given in the Chapter2 of Agriculture.

11 Education

11.1 Preamble

The aim of education is to transmit knowledge or fostering skills and character for the development of understanding, rationality, and inculcating kindness and honesty. Education is categorized into three categories.

- *Formal education* is imparted in school, where pupil learn basic, academic or trade skills. Formal education begins in elementary school, secondary school, and higher level.
- *Non-formal education* includes adult literacy education, school equivalency preparation and distance learning.
- *Informal education* is a type of education help developing the knowledge by reading books or Internet Surfing for educational websites. It also termed as called self-education.

The primary education in India is divided into two parts, namely Lower Primary (Class I-IV) and Upper Primary (Middle school, Class V-VIII). The Indian government lays emphasis on primary education (Class I-VIII) also referred to as elementary education, to children aged 6 to 14 years old. Elementary education is the first stage in formal education.

Secondary education refers to the second stage of traditional education and serves as a bridge between elementary and higher education. The age range for the start of secondary education is 11-13, and it ends around 15-18.

To validate the situation of education it is proposed to carry out the study under 6 sub-indicators:

1. Adjusted Net Enrollment Ratio at elementary (class 1-8) and secondary (class 9-10) School
2. Correct responses on learning outcomes in language, mathematics' and EVS for class 5th students and Languages, mathematics, Science and Social Science for class 8th student
3. DROP Out rates (primary, upper primary, elementary, secondary and higher secondary)
4. Schools with separate toilet facility for girls
5. Percentage of elementary and secondary schools with Pupil Teacher Ratio less than/equal to 30
6. Percentage of School Teachers Professionally Qualified

11.2 Adjusted Net Enrolment Ratio at elementary (class 1-8) and secondary (class 9-10) School

Adjusted net enrolment of the official age group for a given level of education either at that level at the levels above, is as a percentage of the population in that age group. Children of official primary school age are defined by the International Standard Classification of Education. The customary or legal age of entrance to primary school is not younger than five years. The most widespread or common structure is used for determining the official school age group.

11.2.1 Methodology for validation proposed for sub-indicator (Adjusted Net Enrolment Ratio at elementary (class 1-8) and secondary (class 9-10) School)

1. **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand should be covered.

2. **Sampling Plan/ Sample Selection procedure:** The sample selection should be done by purposive method of sampling.
3. **Selection of districts:** Two districts (one with highest performance and another one with lowest performance) from each division on the basis of records available in Sustainable Development Goals Index of Uttarakhand (2019-2020) should be covered for validation of Adjusted Net Enrolment Ratio.

Table 11.1: Performance of the Districts on Adjusted Net Enrolment Ratio (%)

Sl.No.	District	Adjusted Net Enrolment Ratio at elementary (class 1-8) (%)	Adjusted Net Enrolment Ratio at secondary (class 9-10) School (%)
Kumaun Division			
1.	Almora	96.82	66.20
2.	Bageshwar	97.84	65.74
3.	Champawat	96.79	57.94
4.	Pithoragarh	101.05	74.37
5.	Nainital	93.22	74.02
6.	U.S. Nagar	100.35	66.79
Garhwal Division			
7.	Chamoli	100.40	67.55
8.	Dehradun	94.85	70.94
9.	Haridwar	91.9	59.9
10.	Pauri Garhwal	98.50	74.58
11.	Rudraprayag	95.99	69.59
12.	Tehri Garhwal	93.44	63.79
13.	Uttarkashi	95.88	68.51
State	Uttarakhand	95.93	67.76

Source - Sustainable Development Goals Index of Uttarakhand (2019-2020)

Table 11.2: Selected Districts

Division	Adjusted Net Enrolment Ratio at elementary (class 1-8)	Adjusted Net Enrolment Ratio at secondary (class 9-10) School
Kumaun	Pithoragarh and Nainital	Champawat and Pithoragarh
Garhwal	Chamoli and Haridwar	Haridwar and Pauri Garhwal

4. **Selection of Schools:** The list of government and government aided school and private schools should be prepared for each selected district. 25 percent of schools should be selected randomly.
From each selected schools, identify the village from where students are enrolled in order to find out the population of eligible pupil.

11.2.2 Method of computation

To calculate the value of sub-indicator Adjusted Net Enrolment Ratio, it is necessary to first determine the population of official elementary/secondary school age

Then, the number of pupils of the official elementary /secondary school age who are enrolled in elementary /secondary education is divided by the population for the same age-group and the result is multiplied by 100

$$NER_t^{e/s} = \frac{E_{e/s,a}^t}{P_{e/s,a}^t} * 100$$

$NER_t^{e/s}$ → Net enrolment rate in elementary ‘e’/secondary education ‘s’ in school year t

$E_{e/s,a}^t$ → Enrolment of the population of age group ‘a’ in elementary ‘e’/secondary education ‘s’ in school year t

$P_{e/s,a}^t$ → Population of age group ‘a’, which officially corresponds to elementary ‘e’/secondary education ‘s’ in school year t

Some children of elementary school age might enter elementary school early and advance to secondary school before they reach the official upper age limit of elementary education. The NER does not include those children, underestimating the number of children who actually receive a full course of elementary education. (i.e., when elementary school age group (6-13) enter into the secondary school age group (14-15) in that particular situation adjusted net enrolment ratio is calculated.)

To overcome this limitation, an adjusted net enrolment rate is calculated.

- Adjusted net enrolment ratio in elementary education is calculated by dividing the number of children in the official primary school age who are enrolled in primary or secondary education by the population of the same age group and multiplying by 100

$$NERA_t^e = \frac{E_{e,a}^t}{P_{e,a}^t} * 100$$

$NERA_t^e$ = Adjusted net enrolment ratio in elementary education ‘e’ in school year t

$E_{e,a}^t$ → Total enrolment of age group 6 to 13 either in elementary education ‘e’ or secondary ‘s’ in school year t

$P_{e,a}^t$ → Population of age group 6 to 13, which officially corresponds to elementary education ‘e’ in school year t

- Adjusted net enrolment ratio in secondary education is calculated by dividing the number of children in the official secondary school age who are enrolled in secondary or higher-level education by the population of the same age group and multiplying by 100.

$$NERA_t^s = \frac{E_{s,a}^t}{P_{s,a}^t} * 100$$

$NERA_t^s$ = Adjusted net enrolment ratio in secondary education s in school year t

$E_{s,a}^t$ → Enrolment of the population of age group 14 -15 either in secondary education s or higher-level education in school year t

$P_{s,a}^t$ → Population of age group 14 -15, which officially corresponds to secondary education s in school year t

11.3 Correct responses on learning outcomes in language, mathematics’ and Environmental Sciences for class 5th students and Languages, mathematics, Science and Social Science for class 8th students

The National Achievement Survey (NAS) for 2021, conducted to obtain information about the learning achievement of students of Classes 3, 5, 8 and 10 studying in state govt schools, shows the performance of students in Uttarakhand at par with the national average of 49 percent,

however according to 2017 survey report the performance of Uttarakhand students was 37 percent.

The performance of students in all four classes in science was 37 percent, which is same as the national average. In English, the state average was 44 percent, against the national average of 43 percent. In social sciences, both the state and the national average was 38 percent. In Mathematics the state average was 39 percent against the national average of 42 percent. In environmental studies, the state performance is 49 percent against the national average of 53 percent.

11.3.1 Methodology for validation proposed for sub-indicator (Correct responses on learning outcomes in language, mathematics' and Environmental Sciences for class 5th students and Languages, mathematics, Science and Social Science for class 8th students)

1. **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand should be covered.
2. **Sampling Plan/ Sample Selection procedure:** The sample selection should be done by purposive method of sampling.
3. **Selection of districts:** Two districts from each division for class 5 and class 8 (one highest performance and another one lowest performance) on the basis of records available in **National Achievement Survey 2017** should be covered for validation of Correct responses on learning outcomes.

Table 11.3: Average Performance of the District on Correct responses on learning outcomes

Sl.No.	District	Class 5	Class 8
Kumaun Division			
1.	Almora	58	43
2.	Bageshwar	67	50
3.	Champawat	52	41
4.	Pithoragarh	58	52
5.	Nainital	61	46
6.	U.S. Nagar	62	46
Garhwal Division			
7.	Chamoli	55	48
8.	Dehradun	58	48
9.	Haridwar	68	51
10.	Pauri Garhwal	69	55
11.	Rudraprayag	65	54
12.	Tehri Garhwal	68	56
13.	Uttarkashi	55	42

Source - National Achievement Survey 2017, Uttarakhand State Learning Report for Class 5 and 8

Table 11.4: Selected Districts

Division	Class 5	Class 8
Kumaun	Bageshwar and Champawat	Champawat and Pithoragarh
Garhwal	Chamoli and Pauri Garhwal	Tehri Garhwal and Uttarkashi

4. **Selection of blocks:** From each selected district, 25 percent blocks with a minimum of one block may be randomly selected.
5. **Selection of urban wards:** From each selected district, 25 percent of urban wards may be selected randomly.
6. **Selection of Schools:** From each selected block/urban ward, 25 percent of government schools should be selected and all the private schools should be covered.
From each selected school, 20 students may be selected randomly from the total students present in school and they should be assessed individually.

11.4 DROP Out rates (primary, upper primary, elementary, secondary and higher secondary)

DROP Out rates -The percentage of pupils/students who leave school during the year for any reason and students who complete the previous grade/year level but fail to enrol in the next grade/year level for the following school year to the total number of pupils/students enrolled during the previous school year. In Uttarakhand, dropout rate is 8.16 percent while for girls it is 6.63 percent.

11.4.1 Methodology for validation proposed for sub-indicator (DROP Out rates)

1. **Selection of districts:** Two districts (one highest performance and another one lowest performance) on the basis of records available in Sustainable Development Goals Index of Uttarakhand should be covered for validation of DROP Out rates.

Table 11.5: Performance of the Districts on Drop Out Rates

Sl.No.	District	DROP Out rates primary %	DROP Out rates upper primary %	DROP Out rates secondary %
1	Almora	4.18	3.38	15.20
2	Bageshwar	2.81	1.64	8.41
3	Chamoli	3.31	4.17	11.33
4	Champawat	2.68	2.62	15.69
5	Dehradun	0.46	1.50	5.38
6	Haridwar	6.3	7.5	14.6
7	Nainital	0.78	2.15	8.79
8	Pauri Garhwal	3.93	3.19	7.78
9	Pithoragarh	1.55	1.80	10.01
10	Rudraprayag	7.05	1.72	8.83
11	Tehri Garhwal	3.17	2.34	9.94
12	US Nagar	5.38	5.94	14.72
13	Uttarkashi	6.29	4.11	11.35
State	Uttarakhand	3.77	3.72	10.94

Source - Sustainable Development Goals Index of Uttarakhand 2019-2020

Table 11.6: Selected Districts

	DROP Out rates primary	and	DROP Out rates upper primary	and	DROP Out rates secondary
Districts	Dehradun and Rudraprayag		Dehradun and Haridwar		Champawat and Dehradun

- 2. Selection of blocks:** From each selected district, 25 percent blocks with a minimum of one block may be randomly selected.
- 3. Selection of urban wards:** From each selected district, 25 percent of urban wards should be selected randomly.
- 4. Selection of Schools:** From each selected block/urban ward, 25 percent of government schools should be selected and all the private schools should be covered. From each selected schools, identify the village from where students are enrolled to find out the population of eligible pupil.

11.5 Schools with separate toilet facility for girls

India has around 1.4 million schools, and the government has a good track record for providing funds for buildings and basic school amenities. Across the country, many schools have toilets that are in dilapidated condition and many more have no toilets at all. According to UNICEF guidelines, school should have a minimum of one toilet per 25 girls. Over half of primary schools in developing countries don't have access to water and sanitation facilities. The availability of toilets can encourage children, especially girls, to go to school and remain in the school system.

11.5.1 Methodology for validation proposed for sub-indicator (Schools with separate toilet facility for girls)

- 1. Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand should be covered.
- 2. Sampling Plan/ Sample Selection procedure:** The sample selection should be done by purposive method of sampling.
- 3. Selection of districts:** Two districts from each division (one highest performance and another one lowest performance) on the basis of records available in Sustainable Development Goals Index of Uttarakhand should be covered for validation of Schools with separate toilet facility for girls.

Table 11.7: Performance of the Districts on Proportion on of Schools with separate toilet facility for girls

Sl.No.	District	Proportion on of Schools with separate toilet facility for girls
Kumaun Division		
1.	Almora	92.82
2.	Bageshwar	94.38
3.	Champawat	96.1
4.	Pithoragarh	90.65
5.	Nainital	90.82
6.	U.S. Nagar	93.61

Garhwal Division		
7.	Chamoli	97.32
8.	Dehradun	96.53
9.	Haridwar	98.3
10.	Pauri Garhwal	94.1
11.	Rudraprayag	96.37
12.	Tehri Garhwal	93.34
13.	Uttarkashi	91.3
State	Uttarakhand	93.97

Source - Sustainable Development Goals Index of Uttarakhand 2019-2020

Table 11.8: Selected Districts	
Division	Proportion on of Schools with separate toilet facility for girls
Kumaun	Pithoragarh and Champawat
Garhwal	Haridwar and Uttarkashi

4. **Selection of blocks:** From each selected district, 25 percent blocks with a minimum of one block may be randomly selected.
5. **Selection of urban wards:** From each selected district, 25 percent of urban wards should be selected randomly.
6. **Selection of Schools:** From each selected block/urban ward, 25 percent of government schools should be selected and all the private schools should be covered.
7. **Selection of Girls:** From each selected schools, 10 girls should be selected randomly for in depth interview regarding proper facility in the toilet.

11.6 Percentage of elementary and secondary schools with Pupil Teacher Ratio less than/equal to 30

The pupil/teacher ratio measures the number of students per teacher. It reflects teacher workload and the availability of teachers' services for their students. The lower the pupil/teacher ratio, the higher the availability of teacher services to students.

The RTE Act, 2009 in its Schedule lays down Pupil-Teacher Ratio (PTR) for both primary and upper primary schools. At primary level, the PTR norm is 30:1 and at the upper primary level it is 35:1.

11.6.1 Methodology for validation proposed for sub-indicator (Percentage of elementary and secondary schools with Pupil Teacher Ratio less than/equal to 30)

1. **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand should be covered.
2. **Sampling Plan/ Sample Selection procedure:** The sample selection should be done by purposive method of sampling.
3. **Selection of districts:** Two districts from each division (one highest performance and another one lowest performance) on the basis of records available in Sustainable

Development Goals Index of Uttarakhand should be covered for validation of Pupil Teacher Ratio.

Table 11.9: Performance of the Districts on Percentage of elementary and secondary schools with Pupil Teacher Ratio less than/equal to 30 (%)

Sl.No.	District	Percentage of elementary and secondary schools with Pupil Teacher Ratio less than/equal to 30 (%)
Kumaun Division		
1.	Almora	97.00
2.	Bageshwar	94.00
3.	Champawat	91.00
4.	Pithoragarh	96.00
5.	Nainital	92.00
6.	U.S. Nagar	68.00
Garhwal Division		
7.	Chamoli	97.00
8.	Dehradun	88.00
9.	Haridwar	72.00
10.	Pauri Garhwal	98.00
11.	Rudraprayag	96.00
12.	Tehri Garhwal	96.00
13.	Uttarkashi	89.00
State	Uttarakhand	92.00

Source - Sustainable Development Goals Index of Uttarakhand 2019-2020

Table 11.10: Selected Districts	
Division	Percentage of elementary and secondary schools with Pupil Teacher Ratio less than/equal to 30 (%)
Kumaun	Almora and U.S. Nagar
Garhwal	Haridwar and Pauri Garhwal

4. **Selection of blocks:** From each selected district, 25 percent blocks with a minimum of one block should be randomly selected.
5. **Selection of urban wards:** From each selected district, 25 percent of urban wards should be selected randomly.
8. **Selection of Schools:** From each selected block/urban ward, 25 percent of government schools should be selected and all the private schools should be covered.

11.7 Percentage of School Teachers Professionally Qualified

As per District Information System for Education' (DISE) 2015-16, data on Professionally qualification of teachers in Uttarakhand shows that 22.56 percent of the teachers own a diploma in teacher training. Only 2.83 percent of the total teachers have a degree of Bachelors in Elementary Education while 58.71 percent of the total teachers have done Bachelors in Education, other Professionally course of teacher education (12.7%). Out of the total number of teachers around 3.71 percent of government school teachers do not have any Professionally qualification of teacher education. Hence, as per the DISE data, Bachelors in education appears to be most common Professionally course among the teaching cadre in Uttarakhand.

11.7.1 Methodology for validation proposed for sub-indicator (Percentage of School Teachers Professionally Qualified)

1. **Geographical coverage:** Both Garhwal and Kumaun division of Uttarakhand should be covered.
2. **Sampling Plan/ Sample Selection procedure:** The sample selection should be done by purposive method of sampling.
3. **Selection of districts:** Two districts from each division (one highest performance and another one lowest performance) on the basis of records available in Sustainable Development Goals Index of Uttarakhand should be covered for validation of Percentage of School Teachers Professionally Qualified

Table 11.11: Performance of the Districts on Percentage of School Teachers Professionally Qualified (%)

Sl.No.	District	Percentage of School Teachers Professionally Qualified (%)
Kumaun Division		
1.	Almora	98.92
2.	Bageshwar	98.40
3.	Champawat	96.80
4.	Pithoragarh	96.93
5.	Nainital	97.02
6.	U.S. Nagar	98.04
Garhwal Division		
7.	Chamoli	98.50
8.	Dehradun	98.12
9.	Haridwar	98.60
10.	Pauri Garhwal	98.27
11.	Rudraprayag	98.42
12.	Tehri Garhwal	97.36
13.	Uttarkashi	96.80
State	Uttarakhand	97.88

Source - Sustainable Development Goals Index of Uttarakhand 2019-2020

Table 11.12: Selected Districts

Division	Percentage of School Teachers Professionally Qualified
Kumaun	Almora and Champawat
Garhwal	Haridwar and Uttarkashi

4. **Selection of blocks:** From each selected district, 25 percent blocks with a minimum of one block should be randomly selected.
5. **Selection of urban wards:** From each selected district, 25 percent of urban wards should be selected randomly.
6. **Selection of Schools:** From each selected block/urban ward, 25 percent of government schools should be selected and all the private schools should be covered.
7. **Identification of Teacher:** All the teachers should be interviewed in order to access their qualification.

Some useful Statistical Techniques

12.1 Principal component analysis

Use of multiple indicators is helpful in understanding the various aspects and processes of development, which is a multi-dimensional phenomenon. However, to form a judgment about the overall development status of a district/region in UP one has to combine these indicators into a single or composite development indicator of food security or insecurity at a sectoral and/or aggregate level. This raises issues regarding the weights assigned to different indicators and the technique use for their aggregation. The most commonly used methods for preparing a composite index are the ranking method, indexing method and multivariate data analysis techniques i.e., principal component analysis and cluster analysis.

The ranking method is the simplest and the most commonly used method for preparing composite index of food security / development. This method consists of assigning ranks for each indicator separately and simply totalling the ranks for each district/unit/region to arrive at the aggregate rank. In this method all indicators are implicitly assigned equal weights, which may not always be appropriate. This method also fails to take into account the extent of variations in the magnitude of differences between units.

The indexing method removes this limitation. Under this method the value of an indicator for a region is expressed as a ratio or percent of the average value of all the units studied, which is often expressed as 100. The values are then added together to arrive at the total score on the basis of which the units can be arranged in an hierarchical order. This method also assigns equal weights to all indicators and is also sensitive to extreme values of the indicators.

The principal component method is statistically a more sophisticated method of analysis than the ranking of the index method. Under this method weights are assigned to each variable on the basis of the correlation matrix. This method redefines a set of original variables into a new set of orthogonal variables called principal components. The component loading, which represent the correlation between the original variables and the derived components are used to calculate component scores to order the regional units. Normally the first principal component alone is used to calculate the scores but sometimes weighted average of more than one component may be used. Use of computers becomes essential in using this method due to the complex procedure and vast numbers of calculations required. Number of homogeneous groups can be formed for drawing the valid conclusions of food security / insecurity by plotting the PCA 1 vs PCA 2. Plotting of data becomes difficult with more than three variables. But if the first two components account for a large proportion of the total variation, then it will often be useful to plot the values of the first two component scores for each individual. In other words, PCA enables us to plot the data in two dimensions. In particular, one can then look for outliers or for groups of 'clusters' of individuals. This is an important use of PCA and often reveals groupings of variables which would not be found by other means.

12.2 Randomised Response Technique

For conducting surveys related to socio economic and the related fields and health and nutritional aspects of children, researchers are many a times faced with the problem of extracting accurate information on sensitive issues like drug abuse, inappropriate sexual behaviour, and tax evasion etc. Respondents in general are reluctant to respond truthfully to 'sensitive questions.' This many a times lead to erroneous inferences. In such a situation, use of Randomized Response Technique (RRT) is recommended which guarantees the privacy of the respondent. It allows the interviewer to gather the information more accurately. RRT allows estimation of the proportion of the population possessing a sensitive characteristic. The technique utilizes a randomized device based on a probability, which ensures confidentiality of the respondent. As the status of the respondent (whether he/she belongs to a sensitive group) is not revealed to the interviewer, the technique is likely to provide a much more reliable estimate, than the one obtained through direct questioning. The response in RRT is dichotomous (yes or no). The validity of RRT has been established in various studies by comparing the known estimates obtained by other methods and estimates obtained using RRT. The technique has been used extensively in some countries to gather information on many sensitive issues like the proportion of tax evaders in the country. In India, however, its use appears to be rather scarce. In this communication, we describe as to how RRT can be employed fruitfully to collect useful and correct information about sensitive issues like child sexual abuse. The contents of this write up are based on an article by Srivastava et.al. (2015).

1. Preliminaries

Randomized response is a research method used in structured survey interview. Warner (1965) was originator of this technique, and it was later modified by Greenberg et al (1969). This technique allows respondents to respond to sensitive issues (such as criminal behaviour or sexuality) while maintaining confidentiality. Chance decides, unknown to the interviewer, whether the question is to be answered truthfully, or "yes", regardless of the truth. In Warner's (1965) version, the sensitive question is worded in two dichotomous alternatives, and chance decides, unknown to the interviewer, which one is to be answered honestly. The interviewer receives a "yes" or "no" response without knowing to which of the two questions it belongs. Let p be the probability to answer the sensitive question and π the true proportion of those interviewed bearing the embarrassing property, then the proportion of "yes"-answers λ is composed as follows:

$$\lambda = p\pi + (1-p)(1-\pi)$$

Yielding

$$\pi = \frac{\lambda + p - 1}{2p - 1}$$

If the number of YES responses in a sample of size n is X , say, we estimate π with

$$\hat{\pi} = \frac{X/n + p - 1}{2p - 1}$$

The variance of the estimate of π is given by

$$V(\hat{\pi}) = \frac{\pi(1 - \pi)}{n} + \frac{p(1 - p)}{n(2p - 1)^2}$$

The ideas described above are illustrated through an example.

Example 1: This example relates to estimation of the proportion of respondents consuming marijuana. The respondents were given to respond to following alternative questions.

- Alternative 1: "I have consumed marijuana."
- Alternative 2: "I have never consumed marijuana."

The interviewees were asked to secretly throw a die and answer the first question only if they throw a 6, otherwise the second question ($p=1/6$). The "yes"-answers are now composed of consumers who have thrown a 6 and non-consumers who have thrown a different number. Let the result be 75 "yes"-answers out of 100 interviewed ($\lambda=3/4$). Inserted into the formula we get

$$\hat{\pi} = \frac{3/4 + 1/6 - 1}{1/3 - 1} = 1/8$$

This leads to the inference that if the respondents have answered truthfully then 12.5 percent respondents had consumed marijuana.

There are several other methods related to RRT that are more efficient. We however limit ourselves to Warner (1965) and its variants.

2. Use of RRT in surveys carried out by IASDS

IASDS used RRT successfully in two studies.

3.1. Targeted Intervention among Truck Operators in Lucknow district to increase the levels of STD/HIV/AIDS information and awareness and distribution of Condoms

The study involved 606 (397 national, 209 domestic) truck operators. One of the objectives of the study was to estimate the proportion of truckers who belong to high-risk category in terms of contracting HIV infection. RRT was employed to ascertain information on high-risk sexual behavior by truck operators.

1. I did not have sex with other than wife/ I had sex with other than wife but invariably used condoms.
2. I had sex outside but did not always use condom.

The first option indicates safe sex whereas the second reflects risky sexual behaviour. This procedure looked attractive to truckers because of confidentiality of their response. After being convinced of confidentiality the truckers responded in an enthusiastic manner.

The RRT response estimate of the second group of truckers after adjusting for few direct questions was 53 percent. The percentages of truckers belonging to high-risk behaviour for the National and UP/local categories were respectively 58 percent and 45 percent. Thus, large proportion of truckers was at the risk of contracting HIV infection due to unsafe sex.

3.2 Invisible Crime: A Study Report on Child Sexual Abuse: This study was undertaken by IASDS on behalf of Vatsalya which was financed by Plan India in the year 2011 under Child Centered Community Programme, Uttar Pradesh. Focus of the study was to assess the status of sexual abuse in children in the age groups 5-10 years and 11-17 years.

For children in the age group 5-10 years, information was gathered by direct questioning method. The children belonging to 11-17 years age group were classified into four categories viz.; (i) Children in family environment (ii) School going children (iii) Working Children and (iv) Children in institutional care.

Following indicators of sexual abuse were used.

<i>Table 12.1: Indicators of Child sexual abuse</i>	
Sexual Abuse (Severe Form)	Sexual Abuse (Mild Form)
Sexual assault	Forcible kissing
Make the child fondle private parts	Forcible kissing during travel situations
Make the child exhibit private parts	Kissing/molestation attempt during marriage
Exhibit private parts to the child	Forced to view private body parts of others
Photograph the child in the nude	Forced to view pornographic video/photographs

Information regarding sexual abuse in the children in the age group 11- 17 years belonging to family environment and working children was gathered using DQ method while for school going children and children in institutional care was obtained by using RRT. An overall sample of 512 (223 males, 289 females) for school going children and 630 (292 males, 338 females) for children in institutional care was used in the study. Further, the study was carried out in five zones of the state. RRT was applied in the following manner.

12.2.2 Methodology

Children (11-17years) were divided into two groups. Two sets of different urns were prepared with tokens of different colours as follows

<i>Table 12.2: Children (11-17years) were divided into two groups</i>		
	Urn1	Urn2
	4 (red)	3 (red)
	3 (Green)	4 (Green)
	3 (yellow)	3 (yellow)
Total	10	10

Group 1 was asked to pick a token from Urn1 and the following action was taken

Table 12.3: Colour of the token

Colour of the token	Action
Red	Ask the child to respond YES/NO whether there was any time in the past Sexual assault, or was made to fondle or exhibit private parts, or he/she exhibited his/her private parts, was photographed in the nude. Put the answer sheet in box 1
Green	Ask the child to respond YES/NO whether he/she was kissed forcibly, or somebody tried to kiss/molest him/her during travel, or somebody tried to kiss/molest him/her during marriage, or he/she was forced to view private body parts of others, or he/she was forced to view pornographic video/photographs Put the answer sheet in box 1
Yellow	Ask the child to respond YES/NO whether he/she was never sexually abused. Put the answer sheet in box 1

Similar procedure was carried out for Group 2 and answer sheets were collected in box 2.

The problem now is to estimate π_1, π_2, π_3 the true proportions of each statement, $0 < \pi_j < 1$ and $\sum_{j=1}^3 \pi_j = 1$. Abul-Ela et al (1967) RRT variant of Warner (1965) was utilized for this. SRS without replacement of sizes n_1 and n_2 were drawn independently from the population. For $i=1,2$ and $j=1,2,3$ P_{ij} denotes the proportion of cards belonging to j^{th} statement from i^{th} sample. Then $\sum_{j=1}^3 P_{ij} = 1$ and the probability of ‘yes’ for any interview in i^{th} sample is

$$\lambda_i = \sum_{j=1}^3 P_{ij} \pi_j, \quad i = 1, 2$$

In our case

$$\lambda_1 = P_{11}\pi_1 + P_{12}\pi_2 + P_{13}\pi_3$$

$$\lambda_2 = P_{21}\pi_1 + P_{22}\pi_2 + P_{23}\pi_3$$

Remembering that $\sum_{j=1}^3 \pi_j = 1$ we have in matrix notation

$$\mathbf{P}\boldsymbol{\pi} = \boldsymbol{\xi}$$

Where

$$\mathbf{P} = \begin{pmatrix} P_{11} - P_{13} & P_{12} - P_{13} \\ P_{21} - P_{23} & P_{22} - P_{23} \end{pmatrix}$$

$$\boldsymbol{\pi} = \begin{pmatrix} \pi_1 \\ \pi_2 \end{pmatrix} \text{ and } \boldsymbol{\xi} = \begin{pmatrix} \lambda_1 - P_{13} \\ \lambda_2 - P_{23} \end{pmatrix}$$

If in the i^{th} sample n_{i1} persons report ‘yes’ then an unbiased estimate of λ_i is $\hat{\lambda}_i = n_{i1} / n_i$.

Therefore writing $\mathbf{c} = \begin{pmatrix} \hat{\lambda}_1 - P_{13} \\ \hat{\lambda}_1 - P_{23} \end{pmatrix}$ we have

$\hat{\boldsymbol{\pi}} = \mathbf{P}^{-1}\mathbf{c}$ provided inverse exists, we may otherwise use Moore-Penrose inverse. Since π_1 and π_2 have been estimated, π_3 can easily be estimated.

Dispersion matrix of \mathbf{c} is given by $\text{disp}(\mathbf{c}) = \text{diag}(V_{11}, V_{22}, V_{33})$ and dispersion matrix of $\boldsymbol{\pi}$ is given by $\text{disp}(\boldsymbol{\pi}) = \mathbf{P}^{-1}\text{diag}(V_{11}, V_{22}, V_{33})$ and $V_{ii} = \lambda_i(1 - \lambda_i)/n_i$

In our case

$$P_{11} = P_{22} = 4/10$$

$$P_{12} = P_{13} = P_{21} = P_{23} = 3/10$$

The estimating equations are

$$\hat{\pi}_1 = 10\hat{\lambda}_1 - 3,$$

$$\hat{\pi}_2 = 10\hat{\lambda}_2 - 3;$$

$$\hat{\pi}_3 = 1 - (\hat{\lambda}_1 + \hat{\lambda}_2)$$

Where,

π_1 = Proportion of severe sexual abuse

π_2 = Proportion of mild sexual abuse

π_3 = Proportion of no sexual abuse

λ_1 = Proportion of yes response in group 1

λ_2 = Proportion of yes response in group 2

• *Limitations*

It can be seen from estimating equations that following should hold under the above set up

$$0.3 < \lambda_1, \lambda_2 < 0.4$$

And

$$0.6 < \lambda_1 + \lambda_2 < 0.7$$

Where-ever these two conditions do not hold the estimation through Randomized Response Technique by subgroups is not possible.

This in simple terms means that proportions of ‘yes’ responses in individual groups should be between 30 percent 40 percent and when two groups are taken together the total of ‘yes’ responses should be between 60 percent to 70 percent.

This exercise yielded the following results

- *Sexual Abuse across the zones*

Table 12.4 provides a comparative scenario of incidence of overall child sexual abuse across various categories of children. It may be observed randomized response technique has been able to capture higher incidence of abuse among children of *school going* and *institutional care* categories with the latter category having higher percentages. A possible reason of this could be relatively higher exposure to outsiders for ‘children in institutional care’ category children due to residential nature of the institution. However, one should also take note of the fact that children of Family environment spend more time at home and are more protected.

Table 12.4: A comparative view of incidence of sexual abuse in children (11-17yrs) across the Categories- percent

Zone	Category			
	Family environment	Working	School going*	In institutional care*
Eastern U.P.	64.1	61.3	76.4	94.6
Central U.P.	45.5	53.8	75.0	90.4
Western U.P.	71.1	65.1	76.8	86.1
Bundelkhand	36.6	41.5	91.1	84.2
U.P. Overall	64.1	61.3	76.4	94.6

* *Estimated using Randomized Response Technique*

Table 12.4 relates to severity of sexual abuse. Here the reporting gives higher percentages (over 20%) in all categories of children who were put to direct questioning. However, the children who were administered Randomized Response technique had lower percentages of severe abuse. It could be because of this technique capturing the two types of abuse more correctly and because of confounding (mix-up) between severe and mild abuses when the questions are put directly.

Table 12.5: Age-wise child sexual abuse in U.P.

Type of sexual abuse (%)	5-10 yrs	11-17 yrs			
		Family environment	Working	School Going*	In institutional care*
Sexual Abuse	41.1	53.7	55.1	80.2	88.7
Severe Sexual Abuse	22.7	24.1	27.6	16.6	18.4

* *Estimated using Randomized Response Technique*

12.3 Small Area Estimate (SAE) Techniques.

In most of the Large-Scale Sample Surveys being conducted by National Agencies / Institutions like NSSO, NFHS, NNNB, NIN etc provide estimates of socio economic parameters and Health Indicators at the State level. However, bottom-up planning process for development of micro-regions (Domain/Sub- Populations), there is requirement of statistics at small area such as District, Tehsils / Community Development Block, Panchayat etc. The Sample drawn for the state level survey is sufficient to provide precise estimate at the state level. It is however, not possible to conduct independent sample survey for each district or similar small area due to limited resources. Small Area Estimation (SAE) techniques use data contained in the sample drawn at State Level to develop estimate for small area. SAE techniques is briefly described below.

1) Direct Estimate: The Sample drawn for State Level is classified at district level (small area). The direct estimates for small area are developed based on sample available for the small area. Two problems are generally faced with direct estimation methodologies are:

- i. The direct estimates suffer with large sampling error because it is based on a small sample, and
- ii. Some of the districts may remain unrepresentative while classifying the State level sample to district level. That means some districts are missing with the sample data i.e., there is no information for such district based on sample. Hence, even direct estimate can not be developed for such district.

2) Model based estimation of small areas

To overcome the problems of Direct estimation for small areas as mentioned above, some statistical models are used for the estimation of small area. One of the best models is area level random effect model due to Fay and Herriot (1979). This is actually a mixed model exhibiting random area specific effects. In such model, the direct estimates are used as dependent variable and a set of covariates related to direct estimates as independent variable.

This model has two components of error terms, one involved with direct estimates and other inhibited in the model. Techniques are available to fit such model. This improves the direct estimates and fitted model also provide the estimates for those districts which remained unrepresentative with sample data.

This SAE technique can be used for verification of the data /estimates on various aspects being reported by the State.

IASDS has used Small Area Estimation Methodology for the estimation of Chronic Energy Deficiency (CED) under the project “Food Insecurity Atlas of Rural Uttar Pradesh, 2011” sponsored by Central Statistical Office (CSO).

12.4 Snowball Sampling

There are situations when the sampling frame is not known/available. In such cases, it is very difficult to draw any conclusions about such populations. Some of the examples are street children and drug addicts etc. The use of snowball sampling is recommended in such situations. The term snowball sampling derives its name from the fact that if a ball is rolled in snow as it gathers more snow while traveling. In this situation, information is gathered from one individual about other individuals with whom he or she is acquainted. This process is continued until a sizable number of individuals is obtained. We describe below an 's' stage 'k' name snowball sampling procedure.

Step 1: Select a random sample from a finite population. This is stage 0.

Step 2 (Stage1): Ask everyone in the sample to name 'k' individuals who are acquainted with him/her. The set of named individuals who are not in stage 0 is termed stage 1.

Step 2: (Stage 2): Continue this process with individuals in the first stage. The set of individuals who are not in stages 0 and 1 is termed the second stage.

The process is continued until the individuals in sth stage name 'k' individuals. This provides us with a fairly good number of members from which to gather the desired information. To put it simply this process is continued until same 'k' names start appearing again. The process is completed when no new names are identified. A good use of snowball sampling can be seen in Singh et al. (2007) where it was used to estimate the maternal mortality rate (MMR).

Recommendations

1. Data Validation is a continuous process. Right from the formative stages, Prof Nigam has emphasized this aspect with Dr. Manoj Pant. It was also agreed to that it would not be limited to only administrative reporting of data and all the new additions of topics were mutually agreed to.
2. There is a need to sensitize officials of individual department for clarity of the process and making them understand as to how it can be applied for validation of data.
3. Capacity building is most important part for proper implementations. After completing the process of capacity building; identify a nodal officer at desired level in the protocol.
4. Administrative data validation process requires effective monitoring within the Department by the Nodal Officer. For example, in immunization validation process it is suggested to select a sample of children from ANM tally sheets for its validation at household level.
5. In the report state level validation process is suggested. For covering the entire State, some of the districts are to be selected using standard sample methodologies and below district level selection of blocks, gram panchayats, villages and households are also given. Same process is applicable for remaining districts.
6. Finally, it is commented that the Report is more like a Research Document. This is not true. If implemented the Report will do lot of value addition to Uttarakhand state as has been the case with our earlier studies. The State has already received lot of country-wide recognition from our earlier efforts – Construction of SDG Index and Monitoring Framework in the State of Uttarakhand and Food and Nutrition Insecurity Atlas of Uttarakhand.

In view of limitations of existing methodology for construction of SDG Index, the methodology developed in a paper of Prof AK Nigam and Dr. Manoj Kumar Pant has shown relative advantage.

None of the new areas (randomized response, small area estimation, snow ball sampling principal component analysis) suggested in the Report are research material any more as they have already been practiced and even published. They have received appreciation from World Bank, Chief Statistician of India, and other leading organizations.

7. Surprisingly, some topics suggested in your comments are high level research topics. These are use of remote sensing data, use of artificial intelligence data etc. These are not yet applicable in public domain. You require experts of these areas (remote sensing, and computer expert in machine learning and artificial intelligence) in every Department. This condition is stringent ruling out the application of these techniques at present.

8. Frequency of validation is proposed below which can be modified, if necessary, by the concerned Department.

Sector	Topic/Indicator	Periodicity
AGRICULTURE	Area, Production & Productivity of Major crops, millets and coarse grains	Annually
	Status of farmers crop insurance Scheme	Half yearly
	Post-Harvest losses of Major food Crops (including Horticulture and vegetable crops) millets and coarse grains	Half yearly
	Area and productivity under organic Farming	Annually
	Status of Soil-Health Card	Quarterly
	Status of agrarian Indebtedness	Half yearly
	Medicinal and aromatic plants productivity and status	Annually
HORTICULTURE	Scope and Status of Vegetable Farming	Annually
	Production and Productivity of Major fruits and Vegetables Crop	Annually
	Status and coverage under protected cultivation (Poly houses)	Half yearly
	Scope and Status of Floriculture	Half yearly
	Scope and Status of Sericulture	Half yearly
ANIMAL HUSBANDRY & DAIRYING	Production & Productivity of Milk per animal /year	Monthly
	Production & Productivity of wool per animal /year	Monthly
	Production & Productivity of Egg per Bird	Monthly
	Status of Milch Animal insurance	Half yearly
	Status of Cow & buffaloes covered under Artificial Insemination (AI)	Monthly
HEALTH AND FAMILY WELFARE	Status of Cross Breeds cattle & buffaloes	Half yearly
	Status and Coverage of health insurance scheme Including Ayushman Bharat Yojna	Annually
	Health and Nutrition Status of Children Under-5	Annually
	Health and Nutritional Status of Pregnant women and Nursing Mothers	Annually
	Maternal Mortality Rate (per 100000 live birth) as well as causes of mortality	Annually
	Child Mortality Rate (per 1000 live birth) as well as causes of mortality	Annually
	Neo-Natal Mortality Rate (per 1000 live birth) as well as causes of mortality	Annually
	Status and Coverage of Institutional Birth	Monthly
	Status of Integration of AYUSH Health Personnel's with health delivery systems in Uttarakhand	Half yearly
	Status of Immunization of Children & Pregnant Women	Monthly
	Status and Progress of Rastriya Bal Suraksha Karyakram (RBSK)	Annually
	Communicable and non-communicable diseases	Half yearly
	Status of Birth & death registration	Monthly
Status of Modern Family Planning Methods User (Currently Married women)	Half yearly	
WATER SUPPLY	Status of households with access to safe and potable drinking water	Quarterly
	Status of households having access to toilet facility	Quarterly

	Progress of Jal Jeevan Mission	Quarterly
	Urban Households covered with sewage system and Progress of water sewage treatment	Quarterly
RURAL AND URBAN DEVELOPMENT	Population living below the poverty line and status of households lifted from poverty and challenges and households provided livelihood under different scheme	Quarterly
	Status of P.M. Awas Yojna	Quarterly
	Population and Socio-Economic Condition of Urban household living in slums of Uttarakhand	Quarterly
	Employment Status and challenges of Youth in Uttarakhand	Quarterly
	Self Help Development Groups (SHGs) formed and working	Quarterly
	Village link under PMGSY	Quarterly
	Employment status under MGNREGA	Quarterly
	SOCIAL WELFARE	Beneficiaries under disability pension scheme
Beneficiaries under widows' pension scheme		Quarterly
Beneficiaries under old age pension scheme		Quarterly
Status of De-addiction Centre		Half yearly
TOURISM	Market demand of Tourism sector	Annually
	Status of Tourism Infrastructures & Services	Annually
	Number of Tourist Arrival Annually	Annually
FOOD & CIVIL SUPPLY	Availability of Food in Kg/Per capita per year	Annually
	Evaluation of Public Distribution System	Quarterly
	Household using clean cooking fuel /Households using LPG or PNG	Quarterly
	Available Capacity of Post-harvest storage and distribution losses of food grains	Half yearly
EDUCATION	Adjusted Net Enrollment Ratio at elementary (class 1-8) and secondary (class 9-10) School	Annually
	Correct responses on learning outcomes in language, mathematics' and EVS for class 5th students and Languages, mathematics, Science and Social Science for class 8th student	Quarterly
	DROP Out rates (primary, upper primary, elementary, secondary and higher secondary)	Quarterly
	Schools with separate toilet facility for girls	Quarterly
	Percentage of elementary and secondary schools with Pupil Teacher Ratio less than/equal to 30	Quarterly
	Percentage of School Teachers Professionally Qualified	Half yearly

9. Table based validation

It is the continuous process of validation in which same set of indicators and respondents will be considered in consecutive time span in order to check the validity of results. It is suggested to validate some of indicators in Health (such as Maternal Mortality, Neo-Natal Mortality and Child Mortality), Education, Water Supply and Rural and Urban Development.

APPENDIX I

<i>Symbols and Notations used in the Analytical Tools</i>	
\hat{Y}_i	Estimate of quantity handled for a particular farm operation of the crop/commodity in i^{th} district (by inquiry)
B_i	Total number of blocks in i^{th} district
b_i	Number of selected blocks in i^{th} district
V_{ib}	Total number of villages in b^{th} selected block of i^{th} district
v_{ib}	Number of selected villages in b^{th} selected block of i^{th} district for a farm operation
F_{ibv}	Total number of farmers growing a particular crop/commodity in v^{th} selected village of b^{th} selected block from i^{th} district
f_{ibv}	Number of selected farmers growing a crop/commodity in v^{th} selected villages of b^{th} selected block of i^{th} district for a farm operation
y_{ibvf}	Quantity handled for a farm operation of a crop/commodity by the f^{th} selected farmer in v^{th} selected village of b^{th} selected block of i^{th} district (by inquiry)
$\hat{\delta}_i$	Estimate of quantity lost for a farm operation of a crop/commodity in i^{th} district (by inquiry)
δ_{ibvf}	Quantity of crop/commodity lost at a particular farm operation by the f^{th} selected farmer in v^{th} selected village of b^{th} selected block for i^{th} district (by inquiry)
\hat{L}_i	Estimate of percent loss by inquiry for i^{th} district
$\hat{V}(\hat{L}_i)$	Estimate of variance of percent loss by inquiry for i^{th} district
$\hat{V}(\hat{\delta}_i)$	Estimate of variance of quantity lost (by inquiry) for an operation in the crop for i^{th} district
$\hat{V}(\hat{Y}_i)$	Estimate of variance of quantity handled (by inquiry) for an operation in the crop for i^{th} district
\hat{Y}'_i	Estimates of quantity handled at a particular farm operation of the crop/commodity in i^{th} district (by observation)
y'_{ibvf}	Quantity handled at a particular farm operation of the crop/ commodity of the f^{th} selected farmer in v^{th} selected village of b^{th} selected block of i^{th} district (by observation)
$\hat{\delta}'_i$	Estimates of quantity lost for a particular farm operation of the crop/ commodity in i^{th} district (by observation)
δ'_{ibvf}	Quantity lost at particular farm operation of the crop/ commodity by the f^{th} selected farmer in v^{th} selected village of v^{th} selected block of b^{th} selected block of i^{th} district (by observation)
\hat{L}'_i	Estimate of percent loss by observation for i^{th} district
$\hat{V}(\hat{L}'_i)$	Estimate of variance of percent loss by observation for i^{th} district
$\hat{V}(\hat{\delta}'_i)$	Estimate of variance of quantity lost (by observation) for an operation in a crop / commodity of i^{th} district
$\hat{V}(\hat{Y}'_i)$	Estimate of variance of quantity handled (by observation) for an operation in a crop/commodity for i^{th} district
$\hat{L}_i^{(c)}$	Estimate of combined percent loss in a farm operation of i^{th} district for c^{th} crop
\hat{S}'_i	Standard error estimate of loss% in a farm operation of i^{th} district obtained by observation.
\hat{S}_i	Standard error estimate of loss% in a farm operation of i^{th} district obtained by inquiry
n_i	Number of data points obtained through method of actual observation in a particular farm operation for a particular crop/commodity in i^{th} district
n'_i	Number of data points obtained through method of inquiry in a particular farm operation for a particular crop/commodity in i^{th} district

\hat{S}_i	Estimate of standard error of combined loss% in a farm operation of i^{th} district
\hat{P}_{iz}	Production of crop/commodity for the i^{th} district falling in z^{th} zone in the agricultural year 2012-13
\hat{L}_{iz}	Estimate of percent loss (by inquiry) of the crop/commodity in a farm operation for the i^{th} district falling in z^{th} zone
\hat{L}_z	Estimated percent loss of the crop/commodity in a operation for z^{th} agro-climatic zone (by inquiry)
\hat{L}'_{iz}	Estimate of percent loss (by observation) of the crop/commodity in the operation for the i^{th} district falling in z^{th} zone
\hat{L}'_z	Estimated percent loss of the crop/commodity in an operation for z^{th} Agro-climatic zone (by observation)
$\hat{L}_N^{(c)}$	Loss percent of crop/commodity at national level.
\hat{L}'_{iN}	Estimated loss% of crop/commodity after pooling the inquiry and observation data of i^{th} agro-climatic zone.
\hat{L}'_s	Loss during storage at agro-climatic zone level.
$\hat{L}_{SN}^{(c)}$	Loss during storage at national level
\hat{P}_{iN}	Production of crop/commodity in i^{th} agro-climatic zone
\hat{S}_{iz}	Standard error estimate of loss% in a farm operation of i^{th} district in z^{th} agro-climatic zone by inquiry / observation
\hat{S}_z	Estimate of standard error of estimated loss percent in a farm operation of z^{th} agro-climatic zone by inquiry/observation
\hat{L}_z	Combined estimated percent loss of a crop/commodity in the operation of z^{th} Agro-climatic zone
\hat{S}_z	Combined standard error estimate of percent loss of a crop/commodity in a farm operation for z^{th} Agro-climatic zone
P_z	Production of crop/commodity for the z^{th} zone in the agricultural year 2013-14
\hat{L}_N	Estimated percent loss of the crop in an operation at National Level
\hat{S}_N	Standard error estimate of loss (%) of the crop in a farm operation at National Level
\hat{P}_i	Total quantity withdrawal from the store of crop/commodity from selected farmers of the i^{th} district during total inquiry period.
p_{ibvft}	Quantity withdrawal from the storage of crop/commodity between previous and t^{th} visit to f^{th} selected farmer in v^{th} selected village of b^{th} selected block of i^{th} district (by inquiry)
$\hat{\epsilon}_i$	Estimate of total quantity loss of crop/commodity of selected farmers of the i^{th} district during total inquiry period.
ϵ_{ibvft}	Quantity loss of crop/commodity between previous and t^{th} visit to f^{th} selected farmer in v^{th} selected village of b^{th} selected block of i^{th} district (by inquiry)
d_{ibvft}	Weight/number of crop/commodities damaged in the sample drawn at the time of t^{th} visit to f^{th} selected farmer in v^{th} selected village of b^{th} selected block of i^{th} district (by observation)
u_{ibvft}	Weight/number of crop/commodity undamaged in the sample drawn at the time of t^{th} visit to f^{th} selected farmer in v^{th} selected village of b^{th} selected block of i^{th} district (by observation)
TG_{ibvft}	Total weight/number of crop/commodities of the sample drawn at the time of t^{th} visit to f^{th} selected farmer in v^{th} selected village of b^{th} selected block of i^{th} district (by observation)
$\hat{S}'_i(d_i)$	Estimate of standard error of weight/number of crop/commodities damaged in stores of farmers of i^{th} district (by observation)

$\hat{S}'_i(TG_i)$	Estimate of standard error of total weight/number of crop/ commodities drawn from stores of farmers of i^{th} district (by observation)
d_{ibt}	Weight/number of crop/commodities damaged in the sample drawn at the time of t^{th} visit to b^{th} respondent (Godown/wholesaler/retailer/ processing unit) of i^{th} district (by observation)
u_{ibt}	Weight/number of crop/commodity undamaged in the sample drawn at the time of t^{th} visit to b^{th} respondent (Godown/ wholesaler/ retailer/ processing unit) of i^{th} district (by observation)

1.1 Sampling Design and District Selection

Sampling is a process of selecting a subset of number of respondents of population for a study. This study was planned to estimate the harvest and post-harvest losses of crops/ livestock produce at national level. Therefore, stratification of the country was carried out on the basis of climatic conditions, agricultural practices and crops grown. Stratification done by Planning Commission of India in the form of agro-climatic zones was found to be the most appropriate for Assessment of Quantitative Harvest and Post-Harvest Losses of Major Crops/Commodities in India,2016. The whole country is divided into 15 agro-climatic zones. The island region was not included in the survey as the total contribution in Indian agricultural production from this zone is negligible. Remaining 14 zones were taken for sampling.

Districts were selected as the sampling unit in the sampling design for further selection of respondents. To estimate the post-harvest losses accurately using sample survey, it is essential to cover at least 10 percent units of first stage sampling. Hence total 120 districts were selected from 14 agro-climatic zones (about 20% of the total districts in India, excluding the urban districts where cultivation is not practiced). The number of districts in each agro-climatic zone was proportionately taken rounded off to the nearest integer.

1.2 Selection of Blocks

Two blocks from each selected district are selected randomly using Simple Random Sampling without replacement (SRSWOR).

Five village growing the crop under consideration are randomly selected by SRSWOR from each selected Block.

1.3 Selection of Farmers

Frame of Farmers in the selected village should be prepared keeping in mind that the farmers listed in the frame must grow the identified crops /commodities in the agro-climatic zone. The farmer was further divided into two categories, i.e.(i) farmers growing more than 70 percent of the selected commodities available in the village and (ii) farmers growing less than 70 percent of the selected commodities Random Sample of six farmers is selected by SRSWOR from first list of category and random sample of 4 farmers in selected by SRSWOR from 2nd list of categories. In case the number of farmers in the first category is less than 6, then all farmers are selected and rest of the farmers are taken from the second list of categories.

1.4 Selection of field and plot

This selection is for recording the losses data for each field crop such as cereals, pulses, oilseeds, spices, sugarcane, fruits and vegetables etc during farm operations by observation. A list of

fields of selected farmers growing the selected crop is prepared. One field for particular crop is selected randomly and plots of 5mx5m (for plains) or 2mx10m (for hilly regions having contour or terrace farming) were demarcated to assess the losses by actual observation.

1.5 For Horticultural Crops, the orchard (A cluster of minimum 12 fruit bearing trees of particular crop on a single piece of land) is demarcated for assessment of losses by observation. Four fruit bearing trees are selected randomly from this demarcated area for harvesting.

iv. Selection of wholesalers:

A list of market yards/mandies at the district headquarter is prepared and one grain mandi and one fruits/vegetables mandi are selected randomly. The market yard/mandi is enumerated and two wholesalers for each commodity are selected randomly from the list. Priority is given to the wholesalers handling more than one crop/commodity.

v. Selection of retailers: A list of main retail markets at district headquarters including the retail fruit and vegetable markets is prepared. One market for food grains and another market for fruits and vegetables are randomly selected and enumerated. Two retailers are selected randomly for each allocated crop giving priority to the retailer handling more than one crop.

vi. Selection of processing units: A list of processing units for the identified crops/livestock produce is prepared for each district and two units are selected randomly for each crop/commodity. In case the processing unit is not available in the identified districts, units located in neighboring district are taken.

1.6 Data Collection by Inquiry

Five schedules are prepared for data collection by inquiry. The schedules 1 and 3 are for complete enumeration of the selected villages and market channels, respectively. Based on the enumeration, farmers and respondents from market are selected. Schedule 2A is for collection of lost data from farm operations such as harvesting, collection, threshing/ dehusking, sorting/ grading, winnowing/ cleaning, drying packaging and transportation. Data of losses during storage at farm/ household level and market channels are collected in Schedules 2B and 4, respectively.

1.6.1 Complete enumeration of households of the selected village (Schedule 1)

This schedule is filled with information of all the households in the selected village at the beginning of survey. The information collected in this schedule pertains to identification of particulars such as agro-climatic zone, state, district, tehsil, block, name of village etc and details of farmer including operational holding, crop/commodities grown or expected to grow in current year, area under crop etc. Information regarding new post-harvest technologies adopted by the farmer in past 10 years and their benefit is also recorded. Every household of the selected villages is enumerated in this schedule and the selection of farmers for data collection is carried out based on information collected in this schedule.

1.6.2 Losses during farm operations by inquiry (Schedule 2A)

It covers the data collected by inquiry for losses during harvesting and other farm operation prior to storage. The data are collected at the time of harvest or within one week after harvest. Subsequent visits are made to record the loss in other operations. Season of crop is also recorded. In case the crop is grown more than once in a year, the data of losses are recorded

for each harvest. In case of fruits, plantation crops, meat, fish, egg & poultry, multiple harvesting within the considered year is performed. The field investigator therefore visits at the end of each operation or within 5 days from completion of operation of at least three harvests (preferably first harvest, middle harvest and final harvest). The data for operation, method of operation, equipment used, quantity handled and quantity lost etc are recorded. Reasons of loss for each operation are also recorded. The farmers are interviewed and asked to give their superior judgment about the quantitative loss in each farm operation.

1.6.3 Losses at producer level during storage (Schedule 2B)

This schedule is prepared to collect the data of losses during storage at farmers' level. The periodicity of data collection is once in every month for durables and continued for a year. Available stocks from previous year, addition/ withdrawal, total quantity stored, and loss during the inquiry period are recorded. Type of storage and causes of loss are recorded carefully after cross-verification. More visits within a month in case of fruits, vegetables and plantation crops are undertaken, as storage periods at farmers' level are expected to be less than a month. Design of this schedule automatically checks the validity of data because the total quantity stored at one visit should be equal to the previous balance in the next visit. In case of any difference, the corrections in data are made for maintaining accuracy.

1.6.4 Complete enumeration of market channels (Schedule 3)

This schedule is to enumerate the market channels after selecting the mandi, retail market, processing units etc. In this schedule, name of stockiest/ retailer/ processing unit/ godown and its address, crop/commodity handled, types of storage structure are recorded. Wholesalers, retailers, processing units and godowns are selected and allotted to the concerned AICRP on PHT center for recording the data.

1.6.5 Losses during storage at market level (Schedule 4)

This schedule is for recording the losses by inquiry during storage at market level. The frequency of data collection is once in every month for durables and continued for one year. Type of storage, quantity stored, withdrawal, addition, losses during storage, total quantity stored and causes of loss etc are also recorded. In case of processing units, the loss is recorded till the crop/commodity was in store and not processed. Design of this schedule automatically provides check for validity of data. In case of fruits, vegetables and plantation crops, frequent visits within a month are made as the storage periods are expected to be quite less.

This survey is planned to cover one-year crop cycle for all selected crops and livestock produce. Complete enumeration of the selected villages and market channels began in October 2012. Based on the enumeration reports, some of the villages were replaced with other villages of same block because of non-availability of selected crops. The data collection by inquiry and observation started in December 2012 and was completed in June 2014.

1.7 Data Collection by Observation

Survey schedules for data collection by observation developed in the previous study (Nanda et al, 2012) were adopted with minor modifications in guidelines based on experience. AICRP on PHT centers were asked to provide copy of guidelines to all field investigators and supervising scientists.

Altogether 18 schedules were developed for data collection by observation. These schedules were grouped into two categories namely data collection by observation in farm operations (group of schedule number 5, total 12 schedules) and data collection by observation during storage at farm and market channels (group of schedules 6, total 6 schedules). A brief description of schedules and type of data collected is described here under different subsections.

1.7.1 Losses at farm level in cereals and coriander (Schedule 5-C)

This schedule is for data collection of losses during harvesting, threshing and cleaning/winnowing of wheat, paddy, sorghum, bajra, maize and coriander due to similarity in operational protocols. Particulars of farmers, selected fields, variety of crops, soil conditions, dates of sowing, harvesting dates, method of harvesting, equipment used, etc were recorded. In case of traditional harvesting, manual harvesting or harvesting with reaper, a plot of 5m×5m / 2m×10m was demarcated and harvested with the method exactly followed by the farmer. Harvested crop was collected separately and the fallen grains were collected and weighed or counted as case may be. Yield of the demarcated plot was recorded after threshing it separately with usual practice.

In case of harvesting the crop with combine harvester, the production from demarcated field was recorded after completion of harvesting operation. After measuring actual area of the selected field in which harvesting was carried out by combine harvester, the yield from 5m×5m plot was estimated. Thereafter a plot of 5m×5m or 2m×10m as applicable was demarcated in the harvested field. The fallen grains from the demarcated area were collected and weighed or counted as the case may be.

For estimating the loss during threshing/shelling, the harvested crops of 5m×5m/ 2m×2m were threshed following the usual practice by the farmer. The produce and straw were weighed separately. A sample of 250g straws was drawn and grains coming in the straw were separated and weighed or counted.

To estimate the losses during cleaning/winnowing a sample of 10kg uncleaned grains-straw mixture was drawn or complete grain-straw mixture obtained from the demarcated plot of 5m×5m / 2m×10m after threshing was taken. Winnowing/cleaning of the lot was performed using the method followed by the farmer. Grain and straws were collected separately. A sample of 250g was drawn from the straws and grains escaped with the straws were separated and counted/ weighed.

1.7.2 Losses at farm level in oilseeds and pulses (Schedule 5-0)

Pulses and oilseeds belong to the family of Leguminosae and these are dicotyledonous crops. Therefore, these crops were grouped together and schedule was prepared for collecting the loss data during harvesting, threshing and winnowing stages of oilseeds and pulses (mustard, soybean, groundnut, sunflower, safflower, cottonseed, pigeon pea, chickpea, green gram and black gram).

For estimating losses during harvesting (for pulses, and safflower), a plot of 5m×5m was demarcated and loss was estimated by the method followed for cereals. In case of groundnut, the plants of 5m×5m plot were uprooted by the method followed by the farmer and pods obtained from the plants as well as pods left in the soil were collected and weighed. This resulted in the production from demarcated 5m×5m plot. Again, another plot of 5m×5m was

demarcated after a few days when farmer stopped ploughing and picking the left-over pods. The weight/number of remaining pods in the soil were recorded.

For mustard and soybean, 5m×5m area was demarcated in a field and 10 plants were randomly taken out from the selected area. Number of siliques/ pods present in each plant including shattered siliques/ pods, if any, were counted. Farmer was then allowed to harvest the complete field including the demarcated plot as usual. When all harvested crop of the field reached to the threshing floor, 10 plants were randomly selected once again after ensuring that the selected plants contain all branches and have been harvested from main stem. Number of shattered siliques/pods of each selected plant were counted and recorded.

For sunflower, same size of area was demarcated and ten plants were selected as followed in case of mustard crop. Number of seeds present in each plant prior to harvest were counted and marked. The farmer was then allowed to harvest the crop by his own method. After harvesting and before collecting the flowers for transporting to threshing floor, the same flowers were taken once again and numbers of seeds shattered from each flower were counted and recorded. In case of cottonseed, the farmer was allowed to pick the cotton bolls with usual practice. After last picking, a plot of 5m×5m was demarcated from which 10 plants were selected randomly. Number of bolls already plucked and opened balls remaining unplucked were counted/weighed for each plant and recorded. Then total number of cotton bolls obtained from 10 selected plants were calculated and recorded as production data from 10 plants.

For estimating the loss during threshing for pulses, safflower and groundnut, harvested crop of 5m×5m / 2m×10m plot was demarcated and threshed with the method followed by the farmer. The grain/pod and straw obtained after threshing were weighed separately. A sample of 250g straws was drawn and analyzed. The number/ weight of seeds in the straw were counted/ weighed. In case of sunflower, mustard and soybean, a sample of 3 bundles of harvested crop of the same field were drawn, threshed and analyzed with the method similar to that of cereals. To estimate losses during cleaning/ winnowing; the methodology was same as that for cereals. In cottonseed, losses during threshing and cleaning/ winnowing were not estimated because these operations are not performed at farmers' field.

1.7.3 Losses at farm level in fruits and plantation crops (Schedule 5-H)

Data on losses during farm operations such as harvesting, grading/sorting and transport of fruits and plantation crops were included in this schedule.

To estimate the losses during harvesting, the fruits were harvested from the selected trees using the method followed by the farmer. Multiple picking is common in some fruits, and therefore data of multiple pickings were recorded, if done by the farmer. Productions from all selected trees were recorded after each harvest. The harvested produce was thereafter analyzed for damages and injuries during harvesting, bird eaten, immaturity etc. The fruits not suitable for human consumption and thrown during the operation were taken as loss in this case. Causes of such loss were also recorded.

For estimating the losses during grading/sorting a sample of 10kg / 50 numbers of fruits were drawn randomly and graded or sorted following the usual method of farmer. The number/quantity of damaged or discarded fruits during this operation was recorded.

To estimate the loading, transportation and unloading loss (farm to market), a sample of 10 kg or 50 number or 5 boxes (if packed in boxes) were drawn randomly after unloading in the market. The undamaged and spoiled pieces were separated and their weights/numbers were recorded.

For Cashew, the sample size for loss estimation during grading/sorting and transport was taken 5 kg and methodology was followed similar to that of the fruit.

1.7.4 Losses at farm level in vegetable crops (Schedule 5-V)

Data on loss during farm operations in vegetables were collected in this schedule. For estimating losses during harvesting, a plot of 5m×5m / 2m×10m was demarcated and harvested with the method followed by the farmer to get the production data of the demarcated plot. To estimate the losses, the methods followed are described below.

For onion, potato and turmeric, in case of manual harvesting, the leftover produces in the soil of the demarcated plot were collected. In case of mechanical harvesting, the production of 5m×5m plot was recorded as usual and then again, a plot of 5m×5m (excluding the already selected plot) was demarcated and the leftover produce in the soil from the plot was collected. In chilies and tomato, the crop was harvested from the demarcated 5m×5m / 2m×10m plot following the usual method. The harvested produces of selected plot were analyzed for damages. The produce fallen on the ground were also collected. Weight of damaged produce and fallen one gave the loss in demarcate plot during harvesting. For cabbage, mushroom, cauliflower and green pea, the loss during harvest was not estimated by observation. In these cases, estimates were given by the research engineers through visual observation after harvesting of complete field.

For Tapioca, 10 plants in a row (continuous) in place of 5m×5m / 2m×10m plot were taken to estimate the loss during harvest. Harvesting was performed using the practice followed by the farmer. The leftover produce in the soil of the area of 10 selected plants were collected and taken as loss. To estimate the loss during grading/ sorting, the operation actually performed for tapioca is termed as trimming. Sample of 50 kg tapioca was drawn in place of 10kg / 50 numbers and the weights of produce/ part of produce rejected during trimming were recorded as loss.

For estimating the loss during grading/sorting and transportation of vegetables, the same methodologies as for fruits were followed. Samples of 10 kg were taken in case of green pea, mushroom, onion, potato and tomato, whereas 50 units were taken for estimating losses of cabbage and cauliflower. Weight of 50 fruits and damaged parts (leaves of cabbage, broken buds, crushed flowers etc) separated from the selected pieces were recorded to estimate the loss.

1.7.5 Losses at farm level in sugarcane (Schedule 5-S)

This schedule was used for estimation of loss in farm operations of sugarcane. In estimating the loss during harvest, a plot of 5m×5m was demarcated and then farmers were allowed to harvest their plot. The produce of the demarcated plot was collected separately and weighed to get the production data. After harvesting, the stubbles left in the demarcated plot were separated and collected. Weight of stubbles and unpicked sugarcane pieces in the selected plot gave the losses during the harvest.

To estimate the loss during staling of sugarcane, three bundles of sugarcane were prepared and weighed in the field. The weighed bundles were transported to the crushing unit/ sugar mills following the usual practice and kept them in the crushing yard till the farmer/mill went for crushing. These bundles were weighed again immediately before crushing. The period of staling was the time elapsed between bundling and immediately before crushing. The difference in the weight of bundles gave loss during staling.

1.8 Observation Schedules for Data Collection in Storage Channels

Estimation of losses during storage at farm and in market channels were recorded systematically in these observation schedules. For estimating losses during storage of cereals, pulses, oilseeds and coriander, samples were drawn from the stored produce (when respondent allowed for taking the sample). These samples were brought to the concerned AICRP on PHT center, where analyses of the samples were carried out to estimate the losses. In case of fruits, vegetables, plantation crops, egg, and fish, the appropriate size of samples were taken from the stored material of respondent. Analyses of samples were carried out on the spot and samples were returned to the respondent. Schedules and type of data collected for losses during storage of different crops/commodities by observations are briefly described hereunder.

1.8.1 Losses during storage in different channels for cereals, pulses, oilseeds and coriander (Schedule 6-C)

Data on losses during storage of cereals, pulses, oilseeds and coriander at farm level and different channels were collected in this schedule. Samples of 50-100 g were taken every month subject to the availability with the respondent and willingness to provide the same. Addition in the stock, consumption, sale or processed stock in the previous month and remaining stock were recorded for the inquiry period. The samples were packed into polythene bags with the identity slips. These samples were brought immediately to concerned AICRP on PHT centre for further analysis. Parameters such as moisture content, 1000 grains weight, number of undamaged grains, and infested/damaged grains and their weight were recorded for computing losses during storage.

1.8.2 Losses during storage in different channels in fruits, vegetables and plantation crops (Schedule 6-H)

The data on losses during storage of fruits, vegetables and plantation crops in different channels were recorded in this schedule. The storage periods for some of these crops were less than one month in all channels. In those cases, the field investigator visited the respondent at the time of disposal even before one month. To estimate loss during storage, the data about increase or decrease owing to additional harvest / procurement or sale / consumption / quantity processed were recorded. Then, a sample of 10 kg or 50 numbers or 3 packets, whichever was applicable to produce, were drawn (when respondent allowed drawing the sample). The damaged produces were separated and weighed/counted. For Cashew, a sample of 5 kg was drawn for loss estimation and methodology for sample analysis remained the same as that of fruits/vegetables.

Loss during storage was not estimated by observation for black pepper because of high product cost and farmers were not willing to provide the sample.

1.9 Data Analysis Procedure

The estimations of losses were carried out at district level for inquiry and observation separately before pooling at agro-climatic zone level. Thereafter both data were merged to obtain final estimates of loss at district level. Then inquiry and observation data were pooled separately at agro-climatic zone level and final estimates of losses at agro-climatic zone level were obtained by merging inquiry and observation estimates. National level loss estimates of losses were obtained by pooling the final estimates of agro-climatic zone levels.

Different standard mathematical equations and formulas employed to estimate the post-harvest losses at various levels are described under here different subheads:

1.10 Estimation of loss at district Level

The estimation of losses was carried out at district level for inquiry and observation data separately before at agro-climatic zone level. Thereafter both data were merged to obtain final estimates of loss at agro-climatic zone and national level.

After maturity of crop, usually complete produce pass through a series of farm operations (harvesting, collection, sorting/grading, threshing, winnowing, drying, packaging and transportation). Each operation is performed separately and hence the losses are also different. Therefore, the estimation procedures of farm operations and storage channels were different and have to be computed separately both for data obtained by inquiry and observation method.

- **Data collected by inquiry:** Total quantity of a crop/commodity handled for a particular farm operation in a district was obtained using equation 1.1

$$\hat{Y}_i = \frac{B_i}{b_i} \sum_{b=1}^{b_i} \frac{V_{ib}}{v_{ib}} \sum_{v=1}^{v_{ib}} \frac{F_{ibv}}{f_{ibv}} \sum_{f=1}^{f_{ibv}} Y_{ibvf} \quad (1.1)$$

In the preceding equation, the quantity of produce handled in a given farm operation by a farmer is taken to the total quantity handled at the village level, then to the block level and finally to the district level. Total Quantity of the Crop/Commodity lost in the same farm operation in a particular district can be computed using equation 1.2.

$$\hat{\delta}_i = \frac{B_i}{b_i} \sum_{i=1}^{b_i} \frac{V_{ib}}{v_{ib}} \sum_{v=1}^{v_{ib}} \frac{F_{ibv}}{f_{ibv}} \sum_{f=1}^{f_{ibv}} \delta_{ibvf} \quad (1.2)$$

In eqn. 1.2, the quantitative loss in a given farm operation is taken from farmer level through the village level, block level and finally to the district level. The loss (%) obtained by inquiry for the crop/commodity in i^{th} district was estimated by dividing the total quantity lost by the total quantity handled, using the eqn. 1.3.

$$\hat{L}_i = \frac{\hat{\delta}_i}{\hat{Y}_i} * 100 \quad (1.3)$$

Estimated variance \hat{L}_i of was calculated using eqn. 1.4, after ignoring higher order terms:

$$\hat{V}(\hat{L}_i) = \left(\frac{\hat{\delta}_i}{\hat{Y}_i} * 100 \right)^2 \left(\frac{V(\hat{\delta}_i)}{(\hat{\delta}_i)^2} + \frac{V(\hat{Y}_i)}{(\hat{Y}_i)^2} \right) \quad (1.4)$$

in which the estimate of variance of $\hat{\delta}_i$ and \hat{Y}_i were obtained using the eqn. 1.5 and the following expression.

$$\hat{V}(\hat{X}_i) = \frac{1}{b_i(b_i-1)} \sum_{b=1}^{b_i} (\hat{X}_{ib} - \hat{\bar{X}}_i)^2 \quad (1.5)$$

$$\hat{X}_{ib} = \frac{V_{ib}}{v_{ib}} \sum_{v=1}^{v_{ib}} \frac{F_{ibv}}{f_{ibv}} \sum_{f=1}^{f_{ibv}} X_{ibvf}$$

$$\hat{\bar{X}}_i = \frac{1}{b_i} \sum_{b=1}^{b_i} \hat{X}_{ib}$$

where $\hat{\bar{X}}_i$ is the mean of variable (Quantity handled or Quantity lost) for i^{th} district and X_{ib} is estimate of quantity handled/lost for b^{th} block in i^{th} district.

- **Data collected by actual observation:** The estimates of quantity handled for an operation of a crop/commodity in the district was obtained in a manner similar to that of the data collected by inquiry, by using the following estimator (eqn. 1.6).

$$\hat{Y}'_i = \frac{B_i}{b_i} \sum_{b=1}^{b_i} \frac{V_{ib}}{v_{ib}} \sum_{v=1}^{v_{ib}} \frac{F_{ibv}}{f_{ibv}} \sum_{f=1}^{f_{ibv}} y'_{ibvf} \quad (1.6)$$

Similarly, estimate of quantity lost was obtained by eqn. 1.7.

$$\hat{\delta}'_i = \frac{B_i}{b_i} \sum_{b=1}^{b_i} \frac{V_{ib}}{v_{ib}} \sum_{v=1}^{v_{ib}} \frac{F_{ibv}}{f_{ibv}} \sum_{f=1}^{f_{ibv}} \delta'_{ibvf} \quad (1.7)$$

and the percentage loss for the district was calculated by eqn. 1.8.

$$\hat{L}'_i = \frac{\hat{\delta}'_i}{\hat{Y}'_i} * 100 \quad (1.8)$$

Estimate of variance of \hat{L} was obtained by the eqn. 1.9 (after ignoring higher order terms)

$$\hat{V}(\hat{L}'_i) = \left(\frac{\hat{\delta}'_i}{\hat{Y}'_i} * 100 \right)^2 \left(\frac{V(\hat{\delta}'_i)}{(\hat{\delta}'_i)^2} + \frac{V(\hat{Y}'_i)}{(\hat{Y}'_i)^2} \right) \quad (1.9)$$

in which the estimate of variance of $\hat{\delta}'_i$ and \hat{Y}'_i were obtained using employing eqn. 1.10 and the following expressions.

$$\hat{V}(\hat{X}'_i) = \frac{1}{b_i(b_i-1)} \sum_{b=1}^{b_i} (\hat{X}'_{ib} - \hat{X}'_i)^2 \quad (1.10)$$

where X is a variable for quantity handled / quantity lost in ith district as expressed below:

$$\hat{X}'_{ib} = \sum_{v=1}^{v_{ib}} \sum_{f=1}^{f_{ibv}} x'_{ibvf}$$

$$\hat{X}'_i = \frac{1}{b_i} \sum_{b=1}^{b_i} \hat{X}'_{ib}$$

- **Pooling of data obtained through inquiry and observation:** In order to estimate the loss during farm operations at district level for different crops/commodities, the loss % through inquiry and through observation were pooled using weighted estimator (eqn. 1.11):

$$\hat{L}'_i(c) = \frac{\hat{s}'^2_i \hat{L}'_i + \hat{s}_i^2 \hat{L}'_i}{\hat{s}'^2_i + \hat{s}_i^2} \quad (1.11)$$

The standard error of estimate of percent loss for the above pooled equation was obtained using eqn. 1.12.

$$\hat{S}_i = \sqrt{\frac{\hat{s}'^2_i \hat{s}_i'^2}{\hat{s}'^2_i + \hat{s}_i'^2}} \quad (1.12)$$

1.10.1 Estimation of Loss during Storage

In order to estimate loss percent from the data collected through inquiry and observation, district-wise estimates were computed separately and then pooled through optimum pooling technique.

1.10.1.1 Data collected through inquiry: Total quantity of crop/ commodity withdrawn in a district was computed eqn.1.13 and

$$\hat{P}_i = \frac{B_i}{b_i} \sum_{b=1}^{b_i} \frac{V_{ib}}{v_{ib}} \sum_{v=1}^{v_{ib}} \frac{F_{ibv}}{f_{ibv}} \sum_{f=1}^{f_{ibv}} (\sum_{t=1}^T p_{ibvft}) \quad (1.13)$$

the estimated total quantity lost in the i^{th} district was calculated using eqn. 1.14

$$\hat{\xi}_i = \frac{B_i}{b_i} \sum_{b=1}^{b_i} \frac{V_{ib}}{v_{ib}} \sum_{v=1}^{v_{ib}} \frac{F_{ibv}}{f_{ibv}} \sum_{f=1}^{f_{ibv}} (\sum_{t=1}^T \epsilon_{ibvft}) \quad (1.14)$$

The loss (%) through inquiry in i^{th} district was estimated using following formula (eqn.1.15)

$$\hat{L}_i = \frac{\hat{\xi}_i}{\hat{P}_i} * 100 \quad (1.15)$$

The estimated variance of \hat{L}_i was obtained using eqn. 1.4.

Data collected through observation: Formulae to estimate the Loss (%) for data collected through observation used was eqn. 1.16.

$$\hat{L}'_i = \frac{\frac{B_i}{b_i} \sum_{b=1}^{b_i} \sum_{v=1}^{v_{ib}} \sum_{f=1}^{f_{ibv}} (\sum_{t=1}^T d_{ibvft})}{\frac{B_i}{b_i} \sum_{b=1}^{b_i} \sum_{v=1}^{v_{ib}} \sum_{f=1}^{f_{ibv}} (\sum_{t=1}^T d_{ibvft} + \sum_{t=1}^T u_{ibvft})} * 100 \quad (1.16)$$

and approximate estimate of variance of above estimator was given by eqn. 1.17.

$$\hat{V}(\hat{L}'_i) = (\hat{L}'_i)^2 \left\{ \frac{(\hat{S}'_i(d_i))^2}{\left(\frac{B_i}{b_i} \sum_{ib=1}^{ib} \sum_{ibv=1}^{ibv} \sum_{ibvf=1}^{ibvf} (\sum_{t=1}^T d_{ibvft})\right)^2} + \frac{(\hat{S}'_i(TG_i))^2}{\left(\frac{B_i}{b_i} \sum_{ib=1}^{ib} \sum_{ibv=1}^{ibv} \sum_{ibvf=1}^{ibvf} (\sum_{t=1}^T TG_{ibvft})\right)^2} \right\} \quad (1.17)$$

The estimate of variance of d_i (numerator part-I of eqn. 1.12) and TG_i (numerator part-II of eqn. 1.12) were obtained as (eqn. 1.18):

$$\hat{V}(\hat{X}_i) = \frac{1}{b_i(b_i-1)} \sum_{b_i=1}^{b_i} (\hat{X}_{ib} - \hat{X}_i)^2 \quad (1.18)$$

in which, $\hat{X}_{ib} = \sum_{v=1}^{v_{ib}} \sum_{f=1}^{f_{ibv}} \sum_{t=1}^T x_{ibvft}$ and $\hat{X}_i = \frac{1}{b_i} \sum_{b=1}^{b_i} \hat{X}_{ib}$

where X is the variable d_i or TG_i .

Merging the estimates loss % by the data collected through inquiry and observation was carried out using eqns.1.11 and 1.12.

1.10.1.2 Estimation of Loss in storage and marketing channels (Wholesaler, Retailer, Godown and Processing Unit) at district level

Data for this purpose were collected from respondents of different marketing channels selected using stratified multistage random sampling. The estimate of loss % for different crops /commodity and its estimate of variance for data collected through inquiry were estimated using eqns.1.13, 1.14 and 1.15.

Data collected by actual observation: Estimates of loss (%) for data collected through actual observation were obtained using eqn.1.19:

$$\hat{L}_i = \frac{\sum_{b=1}^{b_i} \sum_{t=1}^T d_{ibt}}{\sum_{b=1}^{b_i} \sum_{t=1}^T d_{ibt} + \sum_{ib=1}^{ib} \sum_{t=1}^T u_{ibt}} * 100 \quad (1.19)$$

Where \hat{L}_i denotes loss % during storage in i^{th} district.

The approximate estimate of variance was obtained as given in eqn. 1.20:

$$\hat{V}(\hat{L}_i) = (\hat{L}_i)^2 \left\{ \frac{(\hat{S}'_i(d_i))^2}{(\sum_{b=1}^{b_i} \sum_{t=1}^T d_{ibt})^2} + \frac{(\hat{S}'_i(TG_i))^2}{(\sum_{b=1}^{b_i} \sum_{t=1}^T TG_{ibt})^2} \right\} \quad (1.20)$$

The estimate of variance of d_i and TG_i was obtained as given by eqn. 1.16. Again, merging the estimates of loss % from data collected through inquiry and observation were carried out using eqns. 1.11 and 1.1

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