# Sampling Plan for Serosurveillance of FMD in Small Ruminants in Karnataka under National Animal Disease Control Programme

# (NADCP) - 2024

**ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI)**
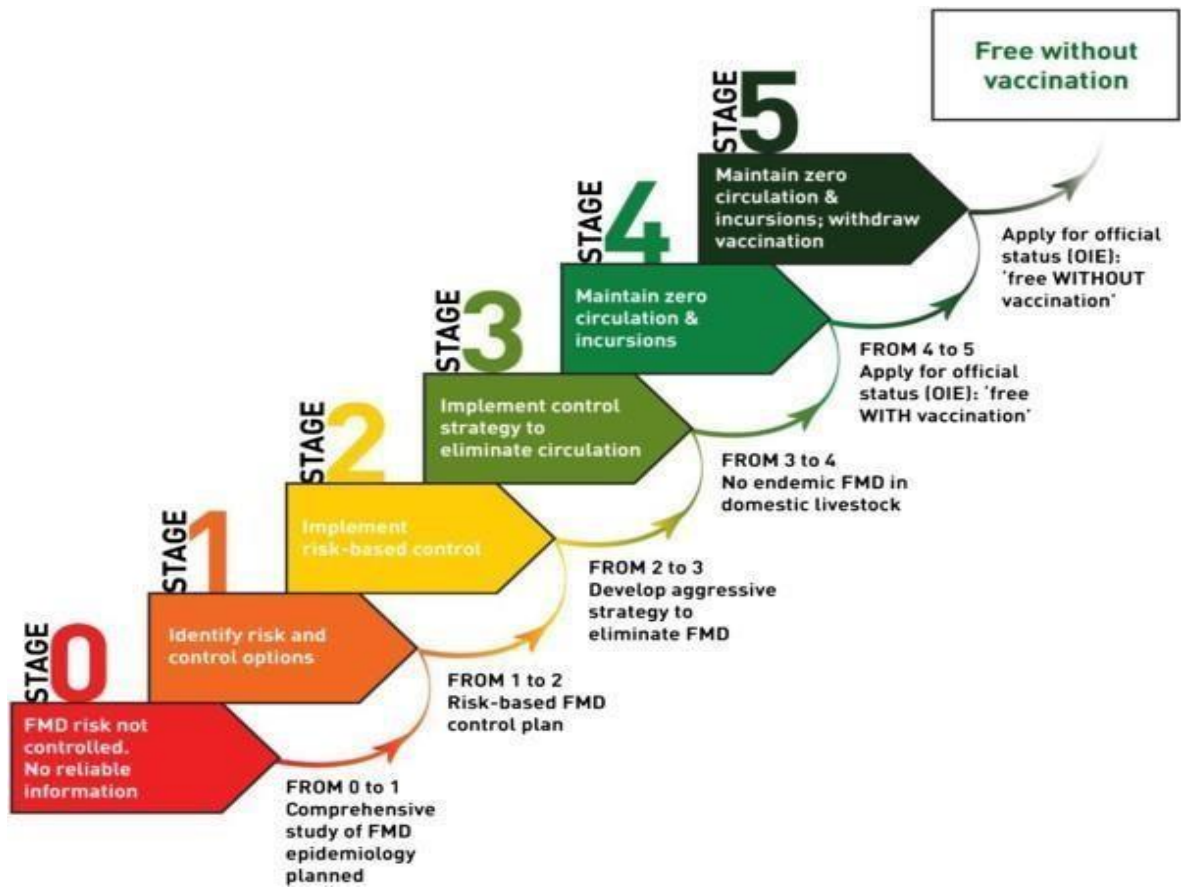
Dr K P Suresh,
Principal Scientist

Dr S S Patil,
Principal Scientist

Dr Divakar Hemadri,
Principal Scientist

**Institute of Animal Health and Veterinary Biologicals, KVASFU**

Dr Raveendra Hegde,
Director

Dr Dharanesh N K,
Assistant Professor

STAGE 0 — FMD risk not controlled. No reliable information

STAGE 1 — Identify risk and control options

STAGE 2 — Implement risk-based control

STAGE 3 — Implement control strategy to eliminate circulation

STAGE 4 — Maintain zero circulation & incursions

STAGE 5 — Maintain zero circulation & incursions; withdraw vaccination

Free without vaccination

FROM 0 to 1
Comprehensive study of FMD epidemiology planned

FROM 1 to 2
Risk-based FMD control plan

FROM 2 to 3
Develop aggressive strategy to eliminate FMD

FROM 3 to 4
No endemic FMD in domestic livestock

FROM 4 to 5
Apply for official status (OIE): 'free WITH vaccination'

Apply for official status (OIE): 'free WITHOUT vaccination'

# Sampling Plan for Serosurveillance of FMD in Small Ruminants in Karnataka under National Animal Disease Control Programme

# (NADCP) - 2024

**ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI)**

Dr K P Suresh,
Principal Scientist

Dr S S Patil,
Principal Scientist

Dr. Divakar Hemadri,
Principal Scientist

**Institute of Animal Health and Veterinary Biologicals, KVASFU**

Dr Raveendra Hegde,
Director

Dr Dharanesh N K,
Assistant Professor

Research team

1. Keerthana G S, SRF, NADCP, ICAR-NIVEDI

2. Nandan A S, YP-II, NADCP, ICAR-NIVEDI

3. Navnath M.Kamble, YP-II, INSTITUTE, ICAR-NIVEDI

4. Vinay Kumar Reddy, YP-II, CSF, ICAR-NIVEDI

5. Raaga R, SRF, NICRA, ICAR-NIVEDI

6. Jayashree A, RA, OHAI, ICAR-NIVEDI

7. Archana V Patil, SRF, PPR-EP, ICAR-NIVEDI

8. Ashwini M, SRF, NADCP, ICAR-NIVEDI

9. Yashaswini Rathore, YP-II, IAH&VB

# ACKNOWLEDGEMENTS

Table of Contents

# Introduction:

Livestock plays a pivotal role in the Indian economy, as it is an essential sector of agriculture providing income to the farmers directly or indirectly. Sustainable growth of the livestock sector can be achieved by increasing nutritional security and controlling major livestock diseases. Foot-and-mouth disease (FMD) is a clinically acute, contagious disease of cloven-footed animals (cattle buffalo, sheep, goat, pig) and causes a severe threat to the livestock economy. Karnataka state has a considerable FMD susceptible population of 29 million animals which includes Cattle (8.45 million), Buffalo (3.0 million), Goat (6.2 million), Sheep (11 million), Pig (0.3 million). FMD causes significant economic losses due to the mortality of young animals, drop in the milk production, declined productivity, and international trade restrictions. In India, the annual direct loss due to FMD is 20897 crores. As FMD is endemic in India, control strategies have the foremost importance for protecting the livestock population and revamping farmers' livelihood.

FMD control demands strict zoo sanitary measures and vaccination. Low vaccination coverage, multiple serotypes, poor cold chain maintenance infrastructure in rural areas, and unrestricted movement of animals exacerbate the control program in India. Continuous surveillance, disease monitoring, vaccine matching, and vaccine quality improvement will significantly change the Indian scenario of FMD control. In 2003-2004, the Government of India launched FMD control program with regular vaccination to prevent economic losses due to the disease and develop herd immunity in cattle. The FMD control programme is being implemented in the state since 2011, where all the eligible cattle and buffalos are vaccinated twice a year. At present the FMD vaccination programme is carried out under National Animal Disease Control Program of Government of India.

The systematic vaccination of cattle and buffaloes against FMD has resulted in considerable reduction in the number of clinical diseases, as well as number of animals getting affected. The Seromonitoring of vaccination has revealed that there is gradual building up of herd immunity in the population. The serosurveillance under National FMD Serosurveillance program has revealed reduction in infection status among cattle and buffaloes.

The small ruminants are equally susceptible to FMD, but these are not vaccinated under FMD control programme. In recent times, outbreak of FMD has been confirmed and is increasing in small ruminants. Hence, there is a necessity to study the infection status among small ruminants too. This will help to implement the strategy of FMD control in small ruminants. Therefore, random serum samples are collected from small ruminants across the state and screened by DIVA-ELISA to know the infection status and virus activity in these population.

## Sampling Strategy currently used for Sero-surveillance

All form of epidemiological investigations requires the scientific sampling plan for collection of data on health problems. Estimation of prevalence of a disease is a prerequisite to establish the disease control program, hence sampling the populations in order to estimate the level of disease prevalence is common task for epidemiologists. In sampling, one should ensure that animals are representative of the target population so that the estimated value/s are unbiased and precise (low standard error). Simple random sampling, systematic or stratified random samplings are the most commonly used sampling methods.

In the developed world, which practice two stage sampling, the individual livestock farm forms the primary sampling unit. However, this concept cannot be adopted in our country as farm wise details are not available to prepare a sampling frame. Additionally, in a country where small farms (2-3 animals/household) are a norm, the farm becomes too small a unit to do the sampling. In such a situation, taking the village as primary sampling unit makes sense as fairly homogeneous population of animal exist in a village and these form a natural cluster. It is argued that in a large population where animals are separated into herds (villages in our context), disease has a strong tendency to cluster. This is because the disease agent or agents (whether infectious, environmental or genetic) are generally not evenly distributed throughout the population. With rare diseases, this clustering is usually even more pronounced. As a result, a particular disease may affect a very low proportion of herds-but within those affected herds, the prevalence of the disease amongst animals may be quite high. If a survey designed to detect the presence of disease fails to take into account the clustering of disease in the population, the results of the survey are likely to be very unreliable. This is because the probability formulae that the surveys are based on assumption that every unit in the population has the same probability of being affected. Another problem with large-area surveys is the logistics of sampling. The solution to both these problems is to use a two- stage sampling strategy in which villages form the primary sampling units (first stage), and individual animals within selected villages make secondary sampling units (second stage). In this way, the sample sizes at each stage can be adjusted to reflect the different disease prevalence's (the proportion of villages affected in the first stage, and the proportion of animals affected in the village at the second stage). Two-stage sampling also means that the construction of sampling frames is much simpler. At the first stage, only a list of all villages (defined epi unit) in the population is required, and at the second stage, only animals in each of the selected villages are to be included in the list.

In this sampling scheme we employed two stage stratified random sampling, with district as stratification variable for Sheep & Goat population in different states. The present sampling strategy is a deviation from the previous sampling methodology. The input requirements used for sampling plan were;

a. The estimated animal level prevalence for NSP protein ( Data obtained from surveillance of 2023)  as shown in Table 1,

b. The requirement of Cluster or Village level proportion was derived by adjusting the district level population and levels of herd immunity of previous data of Seromonitoring so that herd level prevalence is proportional to the probability of population size.

c. The sampling plan strategy is accounted for variations in diagnostic sensitivity and specificity for NSP protein.

d. Village level livestock population has been set with minimum criteria of population size for deriving the village random sample, so as to enable to have good compliance rate of sampling.

e. Village level livestock population frame (list of villages with livestock population) was created without replacement (WOR) strategy, which takes into account of villages already sampled during the previous surveillance plans. State level frame was stored in csv files with pre-defined state and district level codes for generating plans.

f. The standard imputation technique was implemented for estimating the missing animal and cluster level prevalence for the states for which data is unavailable.

Two -stage stratified random sampling plan was generated at reasonably high confidence (0.9) using in-house developed using epi-calculator under NADRES v2 by ICAR-NIVEDI, Bengaluru. (https://www.nivedi.res.in/Nadres_v2/Epical/stratified/random_sampling.php). The summary of sampling plan generated using two-stage stratified random sampling scheme is presented in Table 2 &3. The Phase II of Sampling plan was done for the year 2023 and the results obtained from the DIVA-ELISA are presented in the Table 1.

## Choosing random samples in selected village

It is to suggest that the random approach must be adopted to choose the animals with in the selected village. It is better to divide the selected village into four to eight directional part (viz. North, East, South, West, North-East, South-East, South-West and North-West) and each directional part equal number of animals are required to be chosen randomly. The number of animals to be chosen for each selected village is mentioned in the respective state-wise sampling plan.

For example, 16 number of animals are to be drawn from the selected villages, 2 animals to be drawn randomly from each direction of village.

Table 1: Results obtained from DIVA –ELISA test for SeroSurveillance of FMD in Small Ruminants in Karnataka 2023.

| Sl no | Name of District | Total no of serum samples tested | No. of Samples positive for DIVA test | Percentage prevalence (CI) |
|---|---|---|---|---|
| 1 | Bagalkot | 18 | 0 | 0 |
| 2 | Bangalore Rural | 27 | 0 | 0 |
| 3 | Bangalore Urban | 27 | 4 | 14.8 |
| 4 | Belgavi | 72 | 5 | 6.9 |
| 5 | Bellary | 18 | 1 | 5.5 |
| 6 | Bidar | 9 | 1 | 11.1 |
| 7 | Chikkaballapur | 54 | 0 | 0 |
| 8 | Chikmagalur | 27 | 3 | 11.1 |
| 9 | chitradurga | 27 | 0 | 0 |
| 10 | Dakshina Kannada | 18 | 0 | 0 |
| 11 | Davangere | 9 | 0 | 0 |
| 12 | Dharwad | 18 | 2 | 11.1 |
| 13 | Gadag | 17 | 0 | 0 |
| 14 | Hassan | 63 | 0 | 0 |
| 15 | Haveri | 27 | 4 | 14.8 |
| 16 | Kalaburagi | 45 | 0 | 0 |
| 17 | Kodagu A | 9 | 1 | 11.1 |
| 18 | Kodagu B | 9 | 0 | 0 |
| 19 | Kolar | 54 | 2 | 3.7 |
| 20 | Koppal | 10 | 3 | 30 |
| 21 | Mandya | 45 | 0 | 0 |
| 22 | Mysuru | 45 | 0 | 0 |
| 23 | Ramanagara | 18 | 2 | 11.1 |
| 24 | Shivamogga | 63 | 13 | 20.6 |
| 25 | Tumkuru | 72 | 3 | 4.2 |
| 26 | Uttara kannada | 63 | 2 | 3.1 |
| 27 | Vijayanagara | 9 | 0 | 0 |
| 28 | Vijaypur | 18 | 2 | 11.1 |
| 29 | yadgiri | 18 | 3 | 16.6 |
| | **Total** | **909** | **51** | **5.6** |

Table 2: Summary of sampling plan using Two-stage stratified random sampling for SeroSurveillance of FMD in Small Ruminants in Karnataka 2024.

| STATE | NO OF DISTRICTS | NO OF BLOCKS | Total no of Sheep + Goat ** | No of Animals to be Sampled | Average No of Samples Per Districts |
|---|---|---|---|---|---|
| Karnataka | 29 | 93 | 17220120 | 1588 | 55 |

** **20th Livestock Census (DAHD, GoI)** *Animals within 6-18 months of age must be sampled.*

*Note: Samples to be collected preferably within 1-2 months before vaccination or 4-5 months after vaccination*

Table 3: Summary of district wise sampling plan using Two-stage stratified random sampling for SeroSurveillance of FMD in Small Ruminants in Karnataka State 2024.

| Sl No | District Names | No of Blocks (to be sampled) | Total no of population (Sheep + Goat) ** | Total No of Sheep and Goat population in the sampled villages | Total no of samples to be Drawn |
|-------|----------------|------------------------------|------------------------------------------|--------------------------------------------------------------|--------------------------------|
| 1 | Bagalkot | 1 | 1006782 | 2032 | 17 |
| 2 | Bangalore Rural | 3 | 213944 | 1176 | 51 |
| 3 | Belgaum | 6 | 1459420 | 13218 | 103 |
| 4 | Bellary | 2 | 1258684 | 8134 | 35 |
| 5 | Bengaluru Urban | 2 | 145337 | 685 | 60 |
| 6 | Bidar | 2 | 268802 | 1220 | 34 |
| 7 | Bijapur | 2 | 916168 | 2676 | 34 |
| 8 | Chamarajanagar | 2 | 279954 | 1346 | 34 |
| 9 | Chikballapur | 5 | 801585 | 3595 | 85 |
| 10 | Chikmagalur | 2 | 139002 | 1067 | 34 |
| 11 | Chitradurga | 3 | 1737145 | 29617 | 53 |
| 12 | Dakshin Kannad | 2 | 32504 | 542 | 34 |
| 13 | Davangere | 2 | 630172 | 2462 | 34 |
| 14 | Dharwad | 2 | 153938 | 893 | 34 |
| 15 | Gadag | 2 | 587555 | 3169 | 34 |
| 16 | Gulbarga | 3 | 558587 | 2420 | 51 |
| 17 | Hassan | 7 | 328445 | 6919 | 120 |
| 18 | Haveri | 2 | 458174 | 2490 | 34 |
| 19 | Kodagu | 2 | 8253 | 322 | 34 |
| 20 | Kolar | 5 | 577605 | 2352 | 85 |
| 21 | Koppal | 2 | 797945 | 2918 | 34 |
| 22 | Mandya | 5 | 693563 | 2880 | 85 |
| 23 | Mysore | 5 | 411669 | 2452 | 85 |
| 24 | Raichur | 2 | 940351 | 2461 | 34 |
| 25 | Ramanagara | 2 | 278118 | 1155 | 34 |
| 26 | Shimoga | 5 | 102245 | 1343 | 85 |
| 27 | Tumkur | 8 | 1717934 | 7887 | 137 |
| 28 | Uttar Kannada | 5 | 19192 | 1029 | 85 |
| 29 | Yadgir | 2 | 693940 | 4113 | 35 |
| | Total | 93 | 17217013 | 112573 | 1588 |

# Standard Operating Procedure (SOP) for Collection and Dispatch of Sheep and Goat Serumunder National FMD Serosurveillance

**General requirements:** Aseptic precautions should be observed right from collection of blood to dispatch of serum. It is advisable to wear gloves at all times (be it removal of stopper from vacutainer, centrifugation, pipetting, disposal of contaminated tubes, and clean-up of any spills) while handling the specimens. Used vacutainers, needles, and pipets must be properly disposed in accordance with biosafety/institutional requirements.

## Serum Collection

Sample collection
Samples were collected from sheep and goat

### *Materials required*

- Vacutainers 5 ml capacity (Red Top, BD Catalogue No. 366430)
- Desktop Centrifuge (refrigerated preferably) with swinging bucket rotor
- Sterile 15ml polypropylene centrifuge tubes
- Sterile Cryovials (preferably internal threaded)
- 2ml, 5ml pipettes or 1ml micro pipettes and 1 ml sterile pipette tips.
- Ice Buckets
- Laminar Flow cabinet

### *Serum Separation Procedure*

- ❖ Keep the vacutainer in a slanting position after the blood is drawn (draw blood only up to 2/3 of the maximum volume) at room temperature for a minimum of 30 to a maximum of 60 minutes to allow the clot to form.

- ❖ If the blood is not centrifuged immediately after the clotting time, the tubes should be placed on ice or refrigerated. (4ºC).

- ❖ Transfer the content of the vacutainer to a sterile 15 ml centrifuge tube (if you are doing this in the lab kindly use laminar flow).

- ❖ Centrifuge the blood sample at in a swing-out rotor for 20 minutes at 1100-1300 g at room temperature.

| |
|---|
| **Warning:** Excessive centrifuge speed (over 2000 g) may cause tube breakage |

❖ At the end of the centrifugation transfer the serum (Recommendation: do not pour!) to a sterile labelled cryovial (preferably internal threaded) using a pipette. Close the caps on the vials tightly.

> **Note:** It would be wise to keep the pipet above the red blood cell layer and leave a small amount of serum in the tube so as avoid picking up red blood cells.

❖ Check that all aliquot vial caps are secure and labelled.
❖ Place all aliquots upright in a specimen box or rack in $-20^0$C or colder freezer. All specimens should remain at $-20^0$C or below prior to shipping.

*Serum Shipping Instructions*

❖ Use at least 1-inch thick walled thermocol box for shipping of serum
❖ The serum samples should be preferably shipped in dry ice, if not add sufficient number of ice packs which were earlier stored in $-80^0$C. If ice packs are used for shipping, ensure that samples are placed within layer of icepacks.
❖ Kindly ensure that there is no leakage during shipment. To do this it wise to keep the vials in a cryo box.
❖ Ship the serum as quickly as possible, preferably by overnight courier.
❖ Inform DFMD/relevant laboratory through telephone call about the shipping.
❖ Ensure that the samples are accompanied by standard proforma attached herewith in appendix II (proforma for serum dispatch to ICAR-DFMD/Relevant Lab)

**Please contact for any clarifications on SOP and Sampling plan issues:**

1. Dr. K.P. Suresh, Principal Scientist :     7892791174

2. Dr. Raveendra Hegde, Director :       9448358705

# Proforma for serum collection in the field

**Sample ID:**                                    **Date of Sampling (DD/MM/YYYY):**

**Owner's Name:**                                 **Mob No.:**

**Village:**                                      **Tehsil/Block:**

**District:**                                     **State:**

**Pin code:**

**Species of animals (Tick the correct one)**

Sheep                      Goat

**Sex (Tick the correct one)**

Male                       Female

**Age in Months (write the age)**

**Health status of the animal** (Tick the correct one)

Apparently Healthy                        Diseased: Yes/No

                                          Suspected disease (If Yes):

**Vaccination History**

Vaccinated/not vaccinated

**Date of vaccination**

**Remarks if any:**

**Proforma for Serum Dispatch to FMD Regional Centre, IAH&VB, Bangalore**

**Ref No.:**                                                                                                                                    **Date:**

**Sender:**

| Sl. No. | Sample ID | Date of Sampling | Owner's Name | Mob No. | Village | Block/Tehsil | District | PIN Code | Animal Species | Age in Months | Sex |
|---------|-----------|------------------|--------------|---------|---------|--------------|----------|----------|----------------|---------------|-----|
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |

Download The Result Generated on 12/02/2024 04:27:49pm

**SRK/SEROSUR/NIVEDI/Phase-III/Karnataka_16/2024**

**Stratified Random Sampling:**

Species Selected for Stratification = Sheep + Goat

Number of Villages Having 100 + (Sheep + Goat) = 19261

Animal Level Prevalence = 0.15

Cluster Level Prevalence = 0.03

Sensitivity of the test used = 0.9

Total No of Villages (Clusters) Selected = 93

Total No of Animals to be Sampled = 1588

| DISTRICT_NAME | BLOCK_NAME | VILLAGE_NAME | Goats | Sheep | Sheep + Goat | Number of units to sample | Goat Proportion | Sheep Proportion |
|---|---|---|---|---|---|---|---|---|
| Bagalkot | Badami | Ugalawat | 873 | 1159 | 2032 | 17 | 7 | 10 |
| Bangalore Rural | Hosakote | Ittasandra | 113 | 215 | 328 | 17 | 6 | 11 |
| Bangalore Rural | Dod Ballapur | Mukkadigatta | 108 | 274 | 382 | 17 | 5 | 12 |
| Bangalore Rural | Hosakote | Oblahalli | 161 | 305 | 466 | 17 | 6 | 11 |
| Belgaum | Hukeri | Hukkeri (Rural) | 74 | 56 | 130 | 17 | 10 | 7 |
| Belgaum | ARABHAVI | Arabhavi-Ward No.4 | 264 | 0 | 264 | 17 | 17 | 0 |
| Belgaum | Belgaum | Bhendigeri | 270 | 814 | 1084 | 17 | 4 | 13 |
| Belgaum | Gokak | Avaradi | 636 | 565 | 1201 | 17 | 9 | 8 |
| Belgaum | Hukeri | Wantmuri | 1385 | 488 | 1873 | 17 | 13 | 4 |
| Belgaum | Raybag | Nidagundi | 3646 | 5020 | 8666 | 18 | 8 | 10 |
| Bellary | Hospet | Danayakanakere | 438 | 1391 | 1829 | 17 | 4 | 13 |
| Bellary | Bellary | Yalpi | 1426 | 4879 | 6305 | 18 | 4 | 14 |
| Bengaluru Urban | Bangalore North | Challahalli | 52 | 200 | 252 | 17 | 4 | 13 |
| Bengaluru Urban | Bangalore North | Shivakote | 135 | 298 | 433 | 17 | 5 | 12 |
| Bidar | Aurad | Torna | 441 | 41 | 482 | 17 | 16 | 1 |
| Bidar | Bidar | Ghodepalli | 585 | 153 | 738 | 17 | 13 | 4 |
| Bijapur | Indi | Miragi | 967 | 0 | 967 | 17 | 17 | 0 |
| Bijapur | Indi | Bhuyar | 958 | 751 | 1709 | 17 | 10 | 7 |
| Chamarajanagar | Chamarajanagar | Bandigere | 189 | 201 | 390 | 17 | 8 | 9 |
| Chamarajanagar | Kollegal | GANIGAMANGALA | 676 | 280 | 956 | 17 | 12 | 5 |
| Chikballapur | Chikkaballapura | Gudisihalli | 186 | 167 | 353 | 17 | 9 | 8 |
| Chikballapur | Chintamani | Bhoomi Setti Halli | 64 | 471 | 535 | 17 | 2 | 15 |
| Chikballapur | Bagepalli | Kothakote | 179 | 417 | 596 | 17 | 5 | 12 |
| Chikballapur | Gauribidanur | Pothenahalli | 314 | 679 | 993 | 17 | 5 | 12 |
| Chikballapur | Gauribidanur | H.Nagasandra | 310 | 808 | 1118 | 17 | 5 | 12 |
| Chikmagalur | Tarikere | Udeva | 209 | 147 | 356 | 17 | 10 | 7 |
| Chikmagalur | Kadur | G.Thimmapura | 105 | 606 | 711 | 17 | 3 | 14 |
| Chitradurga | Hosdurga | Ajjikamasagara | 125 | 885 | 1010 | 17 | 2 | 15 |
| Chitradurga | Hosdurga | Doddabyladakere | 367 | 2130 | 2497 | 18 | 3 | 15 |
| Chitradurga | Hiriyur | Pilali | 3387 | 22723 | 26110 | 18 | 2 | 16 |
| Dakshin Kannad | Bantval | Netlamudnur | 236 | 0 | 236 | 17 | 17 | 0 |
| Dakshin Kannad | Bantval | Phajeer | 306 | 0 | 306 | 17 | 17 | 0 |
| Davangere | Channagiri | Maravanji | 341 | 642 | 983 | 17 | 6 | 11 |
| Davangere | Jagalur | Doddabommanahalli | 152 | 1327 | 1479 | 17 | 2 | 15 |
| Dharwad | Hubballi-Dharwad | Hubli-Dharwad (M Corp.) - Ward No.29 | 193 | 109 | 302 | 17 | 11 | 6 |
| Dharwad | Hubli | Umachigi | 395 | 196 | 591 | 17 | 11 | 6 |
| Gadag | Ron | Kuntoji | 49 | 1202 | 1251 | 17 | 1 | 16 |
| Gadag | Shirhatti | Bellatti | 779 | 1139 | 1918 | 17 | 7 | 10 |
| Gulbarga | Aland | Munhalli | 454 | 20 | 474 | 17 | 16 | 1 |
| Gulbarga | Afzalpur | Atnoor | 872 | 43 | 915 | 17 | 16 | 1 |
| Gulbarga | Chincholi | Hodebeeranhalli | 479 | 552 | 1031 | 17 | 8 | 9 |
| Hassan | Hole Narsipur | Ganjikuppahalli | 18 | 101 | 119 | 17 | 3 | 14 |

| DISTRICT_NAME | BLOCK_NAME | VILLAGE_NAME | Goats | Sheep | Sheep + Goat | Number of units to sample | Goat Proportion | Sheep Proportion |
|---|---|---|---|---|---|---|---|---|
| Hassan | Belur | Hulikere | 160 | 0 | 160 | 17 | 17 | 0 |
| Hassan | Channarayapatna | Byaladakere | 142 | 91 | 233 | 17 | 10 | 7 |
| Hassan | Arkalgud | Doddabemmathi | 263 | 4 | 267 | 17 | 17 | 0 |
| Hassan | Arsikere | CHIKKANANAKOPPLU | 102 | 309 | 411 | 17 | 4 | 13 |
| Hassan | Hassan | Veerapura | 332 | 1443 | 1775 | 17 | 3 | 14 |
| Hassan | Hassan | Doddabaganahalli | 428 | 3526 | 3954 | 18 | 2 | 16 |
| Haveri | Hirekerur | Neshwi | 91 | 341 | 432 | 17 | 4 | 13 |
| Haveri | Hangal | Shivapura | 216 | 1842 | 2058 | 17 | 2 | 15 |
| Kodagu | Virajpet | Hebbale | 150 | 0 | 150 | 17 | 17 | 0 |
| Kodagu | Somvarpet | Thorenur | 70 | 102 | 172 | 17 | 7 | 10 |
| Kolar | Robertson Pet | Robertson Pet (CMC) - Ward No.20 | 216 | 2 | 218 | 17 | 17 | 0 |
| Kolar | Mulbagal | H.Byappalli | 82 | 283 | 365 | 17 | 4 | 13 |
| Kolar | Kolar | Marjenahalli | 121 | 387 | 508 | 17 | 4 | 13 |
| Kolar | Srinivaspur | Hebbata | 142 | 486 | 628 | 17 | 4 | 13 |
| Kolar | Srinivaspur | M.Thummalapalli | 131 | 502 | 633 | 17 | 4 | 13 |
| Koppal | Kushtagi | Kodatgeri | 196 | 784 | 980 | 17 | 3 | 14 |
| Koppal | Kushtagi | Nidsesi | 528 | 1410 | 1938 | 17 | 5 | 12 |
| Mandya | Maddur | Huligerepura | 111 | 264 | 375 | 17 | 5 | 12 |
| Mandya | Nagamangala | Manchenahalli | 181 | 319 | 500 | 17 | 6 | 11 |
| Mandya | Maddur | Malagaranahalli | 235 | 273 | 508 | 17 | 8 | 9 |
| Mandya | Maddur | Sompura | 277 | 469 | 746 | 17 | 6 | 11 |
| Mandya | Mandya | Holalu | 384 | 367 | 751 | 17 | 9 | 8 |
| Mysore | Hunsur | Yamagumbha | 184 | 21 | 205 | 17 | 15 | 2 |
| Mysore | Nanjangud | Yelachagere | 96 | 335 | 431 | 17 | 4 | 13 |
| Mysore | Tirumakudal - Narsipur | Chandahalli | 209 | 242 | 451 | 17 | 8 | 9 |
| Mysore | Heggadadevankote | Rajegowdanahundi | 500 | 116 | 616 | 17 | 14 | 3 |
| Mysore | Nanjangud | Saragooru | 222 | 527 | 749 | 17 | 5 | 12 |
| Raichur | Manvi | Harvi | 328 | 513 | 841 | 17 | 7 | 10 |
| Raichur | Sindhnur | Belgurki | 579 | 1041 | 1620 | 17 | 6 | 11 |
| Ramanagara | Magadi | Bettahalli | 271 | 170 | 441 | 17 | 10 | 7 |
| Ramanagara | Channapatna | Nunnuru | 577 | 137 | 714 | 17 | 14 | 3 |
| Shimoga | Shikaripura | Mallenahalli | 148 | 9 | 157 | 17 | 16 | 1 |
| Shimoga | Bhadravati | Arahatholalu | 90 | 108 | 198 | 17 | 8 | 9 |
| Shimoga | Shikaripura | Kenchigondanakoppa | 157 | 46 | 203 | 17 | 13 | 4 |
| Shimoga | Sorab | Kathuvalli | 315 | 27 | 342 | 17 | 16 | 1 |
| Shimoga | Shikaripura | Kittadahalli | 53 | 390 | 443 | 17 | 2 | 15 |
| Tumkur | Chiknayakanhalli | Kodalagara | 93 | 36 | 129 | 17 | 12 | 5 |
| Tumkur | Gubbi | Benchagere | 146 | 124 | 270 | 17 | 9 | 8 |
| Tumkur | Chiknayakanhalli | Barakanahalu | 468 | 0 | 468 | 17 | 17 | 0 |
| Tumkur | Tiptur | Shivara | 290 | 351 | 641 | 17 | 8 | 9 |
| Tumkur | Madhugiri | Chikkamalur | 102 | 651 | 753 | 17 | 2 | 15 |
| Tumkur | Kunigal | Besinele | 254 | 903 | 1157 | 17 | 4 | 13 |
| Tumkur | Sira | Devagondanahalli | 144 | 1324 | 1468 | 17 | 2 | 15 |
| Tumkur | Pavagada | Thimmammanahalli | 312 | 2689 | 3001 | 18 | 2 | 16 |
| Uttar Kannad | Yellapur | Madnur | 8 | 123 | 131 | 17 | 1 | 16 |
| Uttar Kannad | Sirsi | Kuppagadde | 134 | 30 | 164 | 17 | 14 | 3 |
| Uttar Kannad | Mundgod | Agadi | 144 | 85 | 229 | 17 | 11 | 6 |
| Uttar Kannad | Mundgod | Wadagatta | 110 | 132 | 242 | 17 | 8 | 9 |
| Uttar Kannad | Mundgod | Katur | 245 | 18 | 263 | 17 | 16 | 1 |
| Yadgir | Shorapur | Horatti | 464 | 579 | 1043 | 17 | 8 | 9 |
| Yadgir | Yadgir | Chaler | 302 | 2768 | 3070 | 18 | 2 | 16 |
| | | Total | 34420 | 78153 | 112573 | 1588 | 751 | 837 |

# References:

1. Barman NN, Patil SS, Kurli R, Deka P, Bora DP, Deka G, Ranjitha KM, Shivaranjini C, Roy P, Suresh KP (2020) Meta-analysis of the prevalence of livestock diseases in North Eastern region of India, Veterinary World, 13(1): 80-91

2. Suresh, K.P. Kuralayanapalya, Sharanagouda S. Patil, Sudhakar Hamsapriya, Rajamani Shinduja, Parimal Roy, Raghavendra G. Amachawadi (2019) Prevalence of extended-spectrum beta-lactamase producing bacteria from animal origin: A systematic review and meta-analysis report from India, PLoS ONE 14(9): e0221771Sushma B, Shedole S, Suresh KP, Leena G, Patil SS, Srikantha G. An Estimate of Global Anthrax Prevalence in Livestock: A Meta-analysis.Vet World. 2021;14(5):1263-1271.

3. Krishnamoorthy P, Suresh KP, Jayamma KS, Shome BR, Patil SS, Amachawadi RG. An Understanding of the Global Status of Major Bacterial Pathogens of Milk Concerning Bovine Mastitis: A Systematic Review and Meta-Analysis (Scientometrics). Pathogens. 2021;10 (5):545. Published 2021 Apr 30.

## Authorship Contribution Statement

Suresh K.P: Sampling plan generation and methodology development, Patil S.S: Review of sampling plan, Hemadri D: Review of sampling plan, Raveendra Hegde: Data generation, verification of document and Review of sampling plan, Dharanesh N.K: Data generation, verification of document and Review of sampling plan.

ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (ICAR_NIVEDI), P. B. No.6450, Yelahanka, Bengaluru 560064

Phone: 23093111, Fax: +91-80-23093222, E-mail: director.nivedi@icar.gov.in