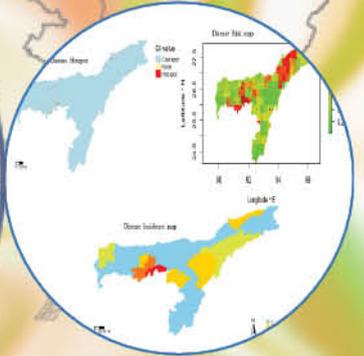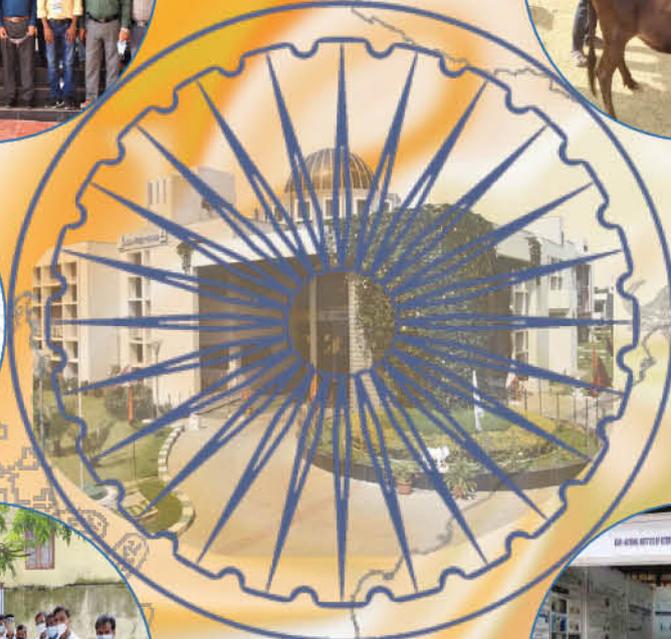75
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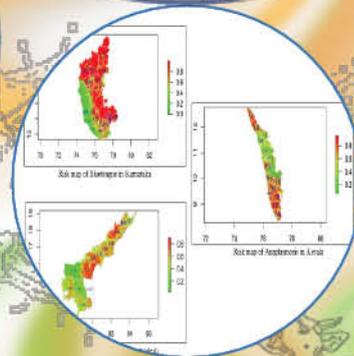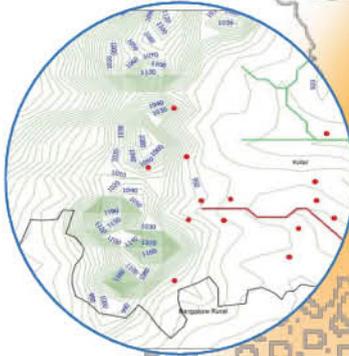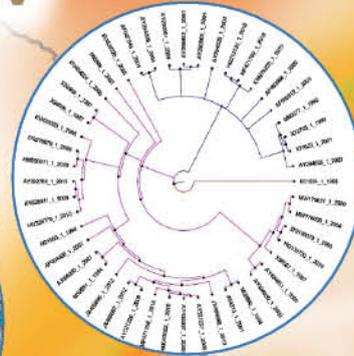
ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (ICAR–NIVEDI)
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ICAR

NIVEDI

Annual Report
2021

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

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Annual Report: ICAR-National Institute of Veterinary Epidemiology and Disease Informatics, 2021. Prepared and Edited by Editorial committee members.

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ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (ICAR-NIVEDI), expresses its sincere gratitude to Hon'ble Secretary, DARE and Director General, ICAR, Dr. Trilochan Mohapatra, for his vision, constant guidance and generous support. ICAR-NIVEDI also thanks Deputy Director General (Animal Science), ICAR, Dr. B.N. Tripathi for his sincere support and interest in the field of epidemiology and disease informatics research. We profusely thank Assistant Director General (Animal Health), ICAR, Dr. Ashok Kumar for his cooperation, encouragement and support. We also thank Dr. Jyoti Misri, Principal Scientist (Animal Health), ICAR for her constant administrative and technical support and guidance. Our sincere thanks are also due to the Directors and Heads of ICAR institutes located in Bengaluru for their moral and logistic support extended from time to time. The institute conveys sincere thanks to all PIs, Co-PIs and the staff of National Animal Disease Epidemiology Network (NADEN) centres located in different states/ UT's and their respective Animal Husbandry Departments / Universities for their valuable inputs, suggestions, and consistent co-operation. Last but not the least, I thank all the staff members of ICAR-NIVEDI for their timely support in executing various mandated activities of the institute

(B. R. Shome)
Director (A)

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EXECUTIVE SUMMARY

In 2021, besides providing monthly disease forewarning for 13 major livestock diseases in the country, disease forewarning SMS alerts were sent directly to the farmers in Karnataka who had registered in FRUITS (Farmers Registration and Unified Beneficiary Information System). The risk maps for Bluetongue occurrence in southern states and risk & hotspot maps for CSF, FMD and PPR for the northeastern region were developed. Further, the sampling plan for 14 identified diseases under one health programme and FMD and Brucellosis under NADCP (National Animal Disease Control Programme) were provided. The draft genomes of three virulent *P. multocida* serotype B:2 strains (NIVEDIPm32, NIVEDIPm34 and NIVEDIPm35) were analysed following whole-genome sequencing, assembly, annotation and compared with existing global genomes (n=43) of bovine origin in the database. Multi-locus sequence analysis based on RIRDC scheme showed the presence of ST122 in all three strains. wgMLST based phylogenic analysis suggested that HS causing Indian virulent field strains differed geographically and showed diversity from existing HS vaccine strain P52.

The LSD outbreak investigations revealed that the cutaneous lesions were more in numbers in the case of indigenous breeds whereas the size and / or severity of gross lesions were more in crossbred animals. For brucellosis S19 post-vaccination sero monitoring, a total of 2921 serum samples received from six states/UT's (Chandigarh, Karnataka, Delhi, Mizoram, Sikkim and Dadra and Nagar Haveli) were screened, of which, the highest seroconversion was recorded in Chandigarh (99.49%) followed by other states/UT's. A total of 3085 pig serum samples received from 26 different states were screened for CSFV antibodies using CSFV Ab Check kit, of which 1071 samples were found positive (34.71%). The Japanese encephalitis (JE) immunophenotyping of TMC for CD4 and CD8 demonstrated that the count varied between JEV positive and negative samples.

A total of 1382 bovine serum samples screened for *Trypanosoma evansi* by recombinant VSG antigen-based indirect ELISA, revealed 42.47% positivity. Eventhough it is well established that *F. gignatica* infection in India is transmitted by *R. auricularia*, the study revealed the involvement of *Radix rufescens* as the intermediate host for *F. gigantica*. The institute besides supplying diagnostic kits for Brucellosis (nine kits) and IBR (four kits), diagnostic services were also provided to various organisations, and Animal Husbandry Departments for Brucellosis, IBR, PPR, BT, CSF, LSD, Leptospirosis, JE, cysticercosis and haemoprotozoan diseases in animals and humans.

Institute is maintaining 29 reference *Leptospira* serovars cultures in semisolid and liquid EMJH medium for the seroepidemiological study of Leptospirosis. The serotype confirmed 37 isolates of bluetongue virus were kept in lyophilized form in the BT-repository of NIVEDI and submitted to ICAR-NCVTC, Hisar. The details of the sera collected during 2017-18 & 2018-19 were updated along with the status of the sera against relevant diseases {bluetongue (n=25072 records), CCHF (n=24,743 records), PPR (n=24,499 records), PRRS (n=5987 records)}, with OD/percent positivity/percent inhibition values in serum bank database and among these selected sera were aliquoted, lyophilized and stored.

During the reported period, two patents viz. 'Recombinant VSG and monoclonal anti-body-based competitive inhibition enzyme-linked immunosorbent assay for the detection of anti-bodies against *Trypanosoma evansi*' (Patent Number: 36174) and 'Monoclonal antibody-based double antibody sandwich ELISA for the detection of *Trypanosoma evansi* antigen in animals (Patent Number: 369790) were granted.

ICAR-NIVEDI has been identified as a key institution in the Southern region for research on zoonotic diseases (Leptospirosis, Brucellosis, Anthrax, Rabies, Cysticercosis, Japanese encephalitis, and other viral Zoonotic diseases) by NCDC, GoI including Capacity Building, Surveillance & Diagnosis to serve as regional coordinator for the Karnataka, Kerala, and Lakshadweep region. Further, the institute is working on animal coronavirus epidemiology in collaboration with other research institutes in the country. The study on economic loss due to sheep and goat pox in Rajasthan state revealed one per cent disease incidence during 2021 and the estimated mortality loss was Rs. 6279 and Rs. 12250/animal in < 1-year and >1-year

old animals, respectively. Further, the system dynamic models are being used to understand the impact of PPR on the various value chain actors.

The institute conducted need-based training programmes on NADRES, epidemiological investigations, disease diagnostics and sensitization programme on disease control including webinars, workshops, and hands-on training on laboratory techniques to scientists/academicians/medical officers/ field veterinarians etc., working at various levels. As a part of outreach and extension activities, under the DAPSC programme, 15 training programmes on "Livestock production technologies, agriculture and allied activities" and animal health camps were organized. A total of 853 scheduled caste farmers from Karnataka got benefited. Under the MGMG programme, a meeting was conducted in the Shivkote village and created awareness of communicable diseases and the safe disposal of bio-degradable and non-bio-degradable wastes. The Swachha Bharat Abhiyan 2021 at ICAR-NIVEDI was organized keeping in view the mission mode programs of the Government of India which includes Swachhta Pakhwada, Digital India,

COVID-19 guidelines, Swasth Bharat, waste water management and rain water harvesting, Atmanirbhar Bharat (waste-to-wealth), doubling farmer's income, and women empowerment. Besides cleaning activities in the institute, the denizens of Ramagondanahalli village were appraised on "*Swachh Bharat - Ek Kadam Swachhta Ki Ore*", "*Clean Village-Healthy Village*" and proper disposal of household waste and waste segregation. ICAR-NIVEDI was bestowed with Swachhta Pakhwada Award 2021 (First Prize) by Hon'ble Shri. Narender Singh Tomar, Union Minister for Agriculture and Family Welfare during Director's conference at NASC Complex, New Delhi.

During the reported period, Agri-Business Incubator (NaaVic) at ICAR-NIVEDI invited five cohort calls and processed the application under NEO and NEST programmes. Several startups were funded and also organized the training programme on agripreneurship. Promoted Agri India Hackathon-2021 and two startups incubated at ICAR-NIVEDI Viz., M/s Jeevabharu Bioinnovation Pvt Ltd and M/s. Froots Technologies Pvt Ltd won the Agri India Hackathon -2021 challenge award.

About ICAR-NIVEDI

Convergence of Animal Health and Research Par Excellence

Historical Background

ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), (Formerly, Project Directorate on Animal Disease Monitoring and Surveillance, PD_ADMAS) under the Indian Council of Agricultural Research (ICAR), a pioneer research institute in veterinary epidemiology is carrying out disease surveillance, monitoring and analysis of livestock diseases in India. The AICRP on animal disease monitoring and surveillance (AICRP_ADMAS) initiated by the ICAR, made a humble beginning during the VII five-year plan and became fully functional in 1987 with the establishment of four Regional Research Units (RRUs) at Bengaluru, Hyderabad, Pune and Ludhiana. The Central Coordinating Unit (CCU) was established at the Institute of Animal Health and Veterinary Biologicals, Bengaluru to coordinate the research activities of the regional units. In the VIII plan, the institute was strengthened with the support of ICAR and European Union by taking up the major responsibility under National Project on Rinderpest Eradication (NPRE) involving 32 state-level diagnostic/disease investigation laboratories in the country. On 1st April 2000 (during the IX plan), the CCU was given the status of Project Directorate and named 'Project Directorate on Animal Disease Monitoring and Surveillance (PD_ADMAS)' with ten collaborating units under the AICRP_ADMAS component. In the X and XI Five-year plan period, five more collaborating units were added for providing impetus to a nationwide animal disease monitoring and surveillance. Appreciating the contributions made by the Directorate to the country's livestock health sector and the need to strengthen the effort, the council rechristened PD_ADMAS as 'National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI)' on 25th October 2013 (XII plan period) with its exclusive campus at Bengaluru. Further, during the same plan period, 17 additional collaborating units covering other states were added under the AICRP_ADMAS component totaling 31 collaborating units for providing the needed impetus to a strong nationwide animal disease monitoring and surveillance network.

On 9th January, 2015, NIVEDI's newly constructed administrative building and Biosafety Laboratory (BSL-2) were dedicated to the nation by Shri Radha Mohan Singh, Hon'ble Union Minister for Agriculture, New Delhi in the presence of Shri D.V. Sadananda Gowda, Hon'ble Minister of Law and Justice, GOI and Shri T. B. Jayachandra, Hon'ble Minister for Law, Justice & Human Rights, Parliamentary Affairs and Legislation and Animal Husbandry, Govt. of Karnataka and Dr. S. Ayyappan, Secretary DARE and Director General, ICAR. The centralized administrative and laboratory complex of the institute is located in a sprawling campus at Yelahanka, Bengaluru. During 2018-19, the newly constructed Training cum Farmers' Hostel and Laboratory Block was inaugurated by Hon'ble Dr. Trilochan Mohapatra, Secretary (DARE) and Director General (ICAR) in the presence of Dr. Joykrushna Jeena, DDG (AS) and Dr. Ashok Kumar, ADG (AH) on 30th June 2018. From April 2021 onwards, National Animal Disease Epidemiology Network (NADEN) was established as an internal network of laboratories of ICAR-NIVEDI with exisiting 31 laboratories and it is enviasaged to increase the centers to forty-plus collaborative centres in future, which are involved in animal disease epidemiology across every state of India. The network came into existence after the closure of AICRP on ADMAS on 31st March 2021 by the council.

ICAR-NIVEDI, a pioneer research institute has been entrusted to conduct R&D in the field of veterinary epidemiology and surveillance of economically important livestock diseases in the entire country, its role is extremely pivotal for developing models for animal disease forewarning, forecasting, economic impact, risk assessment, and need-based animal disease diagnostics. The institute has developed various technologies covering both products and processes and some of them are marketed and/or patented/copyright protected, which are being utilized by various institutes/ organizations and different stakeholders in the country. The role of this institute in the eradication of Rinderpest disease in India and the development of the National Animal Disease Referral Expert System (NADRES) - interactive software for forecasting are noteworthy. The institute conducts various training programmes related to basic epidemiology, sampling frame and sampling techniques, outbreak investigation, research

methodologies, and disease diagnosis protocols for various stakeholders associated with animal healthcare. Overall, NIVEDI has been proving its worthiness to the Indian animal health sub-sector covering critical gaps in diagnostic techniques, animal disease modelling, economic impact assessment and analysis of animal diseases, and human resource development in the form of skill development and empowerment, capacity building programmes etc. Further, NIVEDI envisions to provide newer direction to undertake in-depth R & D activities on the epidemiology of emerging and re-emerging, transboundary animal diseases to others involved in the sub-sector in the country, leading finally to prevention, control and eradication of the diseases for achieving animal welfare and safer animal-human interface under one health approach.

(i) Vision Achieving freedom from animal diseases, animal welfare, food and nutritional security through healthy foods of animal origin, poverty alleviation and economic growth of rural India.

(ii) Mission Capacity building in frontier areas of Veterinary Epidemiology: dynamics of animal diseases including zoonosis and animal healthcare intelligence.

(iii) Mandate of Institute

- ✦ Epidemiology, informatics and economics of animal diseases including zoonosis
- ✦ Surveillance, forecasting and forewarning for management of animal diseases including Zoonosis
- ✦ Repository and Capacity Development

(iv) Focus

- ✦ Improving disease monitoring and surveillance through the development of population assays and pen side diagnostics
- ✦ Risk assessment for the occurrence of economically important animal diseases
- ✦ Adapting strategies to improve animal disease data quality
- ✦ Understanding the threat from animal diseases in the background of climate change and globalization
- ✦ Developing early warning system and disease modeling/forecasting
- ✦ Understanding economic impacts of animal diseases and the management strategies

- ✦ Promoting innovations and improving human resource capacity
- ✦ Fostering linkages and collaborations with public and private, national and international organizations
- ✦ Improving knowledge management system

(v) Thrust Areas

- ✦ Development of robust forecasting & forewarning models for important livestock diseases along with risk analysis.
- ✦ Epidemiological investigation, surveillance and monitoring of endemic, and re-emerging diseases of animals including zoonosis.
- ✦ Development of diagnostics for population survey of economically important diseases including zoonosis.
- ✦ Molecular epidemiology of pathogens, disease outbreaks and detection and control of infectious diseases.
- ✦ Socio-economic impact and policy analysis of prioritized diseases.

(vi) National Animal Disease Epidemiology Network (NADEN)

The National Animal Disease Epidemiology Network (NADEN) is a newly established network of laboratories, which are involved in animal disease epidemiology, across every state of India. The network came into existence after the closure of All India Coordinated Research Project on Animal Disease Monitoring and Surveillance (AICRP on ADMAS) on 31st March, 2021. As an internal network, ICAR-NIVEDI, plans to function with forty plus collaborative centers, as compared to existing 31 centres of AICRP_ADMAS. NADEN includes 6 Regional Disease Diagnostic Laboratories (RDDLs), 6 AQCS (Animal Quarantine and Certification Service), a center from Ladakh and an additional center each from the state of Uttar Pradesh, Rajasthan in addition to existing 31 centers. The focus of NADEN would be on the understanding the nationwide animal disease epidemiology to better inform control strategies.

Objectives

- ✦ To participate in R & D in animal disease epidemiology and informatics by collecting/generating and collating livestock disease data and systematic outbreak investigation.

- To analyse disease data for risk mapping, epidemiological trends, forewarning for taking appropriate intervention strategies for disease control
- To undertake seroepidemiological studies
- To devise epidemiological solutions for effective control of animal diseases.

Mandates

- Strengthening of National Animal Biological Repository
- Effective updating of NADRES with active disease data, climatic and non-climatic factors
- Surveillance of diseases/pathogens in domestic companions, laboratory and wild animals
- Analysis of economic losses due to animal diseases and impact of control measures adopted for their management.
- Sero-monitoring of animal diseases based on strategic sampling
- Investigation of endemic, emerging and re-emerging animal disease outbreaks using innovative technologies.
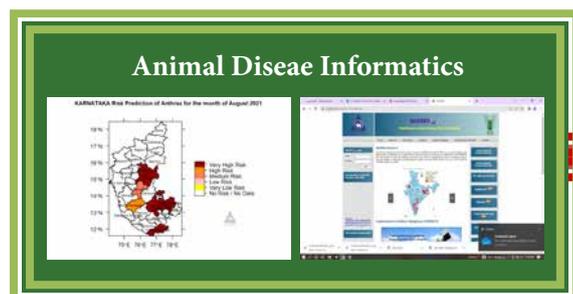- Working with all stakeholders in the public and private domain for the welfare and health care of animals.

Tree Plantation Drive on the Ocassion of Independence Day, 15th August 2021 at ICAR-NIVEDI

NATIONAL INSTITUTE OF VETERINARY EPIDEMIOLOGY AND DISEASE INFORMATICS
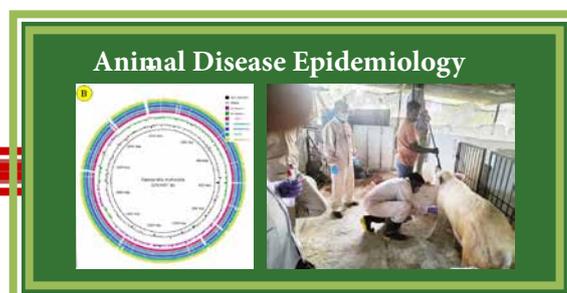
MAJOR RESEARCH AREAS

Animal Diseae Informatics

Animal Disease Epidemiology

One Health

Animal Disease Socio-economics

Capacity Building

1. ANIMAL DISEASE INFORMATICS

A. National Animal Disease Referral Expert System (NADRES)

A dynamic, online Geographic Information System (GIS) based animal health information system called National Animal Disease Referral Expert System (NADRES) (www.nadres.res.in) was developed to facilitate efficient storage, transmission and retrieval of animal health information system and it is the first of its kind in the country. ICAR-NIVEDI has identified 13 priority diseases, based on the past incidence patterns and has built a strong database of these diseases. The database, which is the backbone of the National Animal Disease Referral Expert System (NADRESv2), is used for providing monthly livestock disease forewarning, which is compiled in the monthly bulletin to alert the animal husbandry departments, both at the national/state level to take appropriate preventive and control measures two months in advance. This forewarning bulletin will assist the field Veterinarians in adopting appropriate preventive and control measures, thereby reducing the occurrence of livestock disease outbreaks. In addition to NADRES V_2 (The National Animal Disease Referral Expert System), ICAR-NIVEDI collaborated with NIC, Govt. of Karnataka for sending the SMS alerts (information alerts on risk prediction of six livestock diseases) directly to farmers who have registered in FRUITS (**Table 1**).

Table 1: Number of farmers who received the SMS alert through FRUITS application from September 2021 to December 2021

Disease	Month /Year	Total SMS	Disease	Month /Year	Total SMS
Anthrax	Sep-21	354371	FMD	Sep-21	734486
	Oct-21	288256		Oct-21	532079
	Nov-21	157123		Nov-21	588230
	Dec-21	155220		Dec-21	718718
TOTAL		**954970**	**TOTAL**		**2573513**
BQ	Sep-21	229955	BT	Sep-21	217162
	Oct-21	438731		Oct-21	375438
	Nov-21	327032		Nov-21	408633
	Dec-21	560624		Dec-21	282691
TOTAL		**1556342**	**TOTAL**		**1283924**
Babesiosis	Sep-21	24939	Theileriosis	Sep-21	116935
	-	-		Nov-21	81206
	TOTAL	**24939**		**TOTAL**	**198141**

The Cattle Disease Diagnosis Expert System (CaDDES), a web application was developed, validated internally, and improved further with additional features. The copyright application for CaDDES web application has been submitted to the Registrar of Copyrights, New Delhi.

B. National Surveillance Programme for Aquatic Animal Diseases (NSPAAD)

National Aquatic Animal Disease Database: A Dynamic Web Application is state-of-the-art interactive software that supports data entry, data edit or management, verification, validation and reporting and is deployed at the NBFGR server. There are 28 centers having access to the database and each center has three logins for the data entry operator, verifier, and validator. Monitoring and surveillance of aquatic animal diseases are necessary for the prevention and control of aquatic animal disease on one hand and complying with the international disease reporting on the other hand for trade and commerce. This will give an overall different functionality to the architecture

of the database for data capturing, analysis and reporting. Implemented baseline hatcheries data for finfish and shrimp, query reporting of baseline and biological samples, and disease outbreaks (**Table 2**). Epidemiological analysis was carried out and aquatic disease maps were generated at the validator level. In the reports, three functionalities *viz.*, view, edit, and download were implemented. Admin functionalities include user management, master forms, database management, etc.

Table 2: Data of all baseline, biological, disease outbreaks, and hatcheries are collected and reported

Description	No. of entries
Baseline Data	14808
Biological– Finfish	4260
Biological–Crustaceans	9861
Biological– Molluscs	337
Disease Outbreaks– Finfish	260
Disease Outbreaks– Crustaceans	1578
Disease Outbreaks – Molluscs	18
Baseline Landing Centre	153
Baseline data of Finfish Hatcheries	618
Baseline data of Shrimp Hatcheries	262

C. Disease Risk Modelling and Assessment

(i) Modeling the Effects of Climate Variability on Transmission of vector-borne diseases

Bluetongue outbreak data from 2001 to 2019 for Karnataka (954), Andhra Pradesh (221), and Tamil Nadu (414) states were extracted from the database and latitude/longitude of outbreaks, Normalized Difference Vegetation Index (NDVI), Land Surface Temperature (LST), weather parameters were extracted and used for risk map generation. Further, for Karnataka and Tamil Nadu, EL-NINO and LA-NINA effects on the Bluetongue outbreaks were studied. Anaplasmosis data from 2015-2019 for Kerala and Babesiosis, Theileriosis, and Trypanosomiasis data for Haryana were collected and risk maps were generated (**Fig. 1**). The prioritization of livestock diseases in Karnataka state was carried out by calculating the R_0 (basic reproduction number) for the livestock diseases that occurred during the past 11 years (**Fig. 2A & B**). The herd immunity level and vaccination coverage required for the livestock diseases in Karnataka state were obtained using the R_0 values.
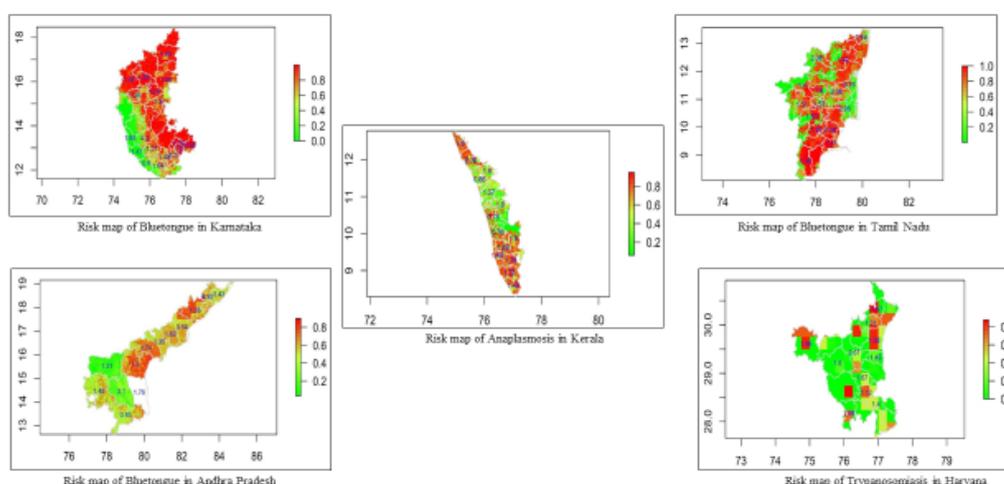
Fig. 1: Risk maps generated for different animal diseases

(ii) Risk, hotspot, and incidence maps of different diseases in North Eastern region

Development of ICT based, farmer-centric, syndromic analytics-enabled knowledge-based system (KBS) for early detection, forecasting, and disease alert system by calibrating machine learning algorithms for pig diseases in NER of India and up-gradation of the mobile app of (ADMaC) for better utility among the stakeholders and validation are the main objectives of the NER project. The KAP tool developed was used to measure the clinical score for pig diseases in NER region. Implementation and deployment of mobile applications for seamless information exchange between farmers, veterinarians, paravets, and animal health care centers and establishing linkages with DBT-One health program and utilization of this system for further validation were carried out. Filled forms (n=21) have been received from the respondents. The data were extracted and analyzed. Risk, Hotspot, and incidence maps of different diseases *viz.*, CSF, FMD, and PPR for North Eastern region have been prepared
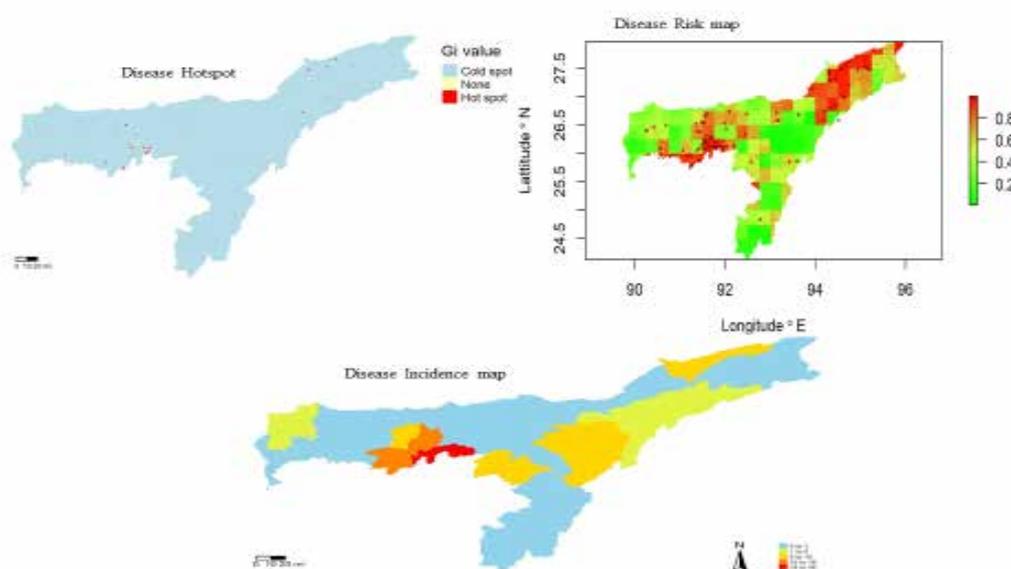
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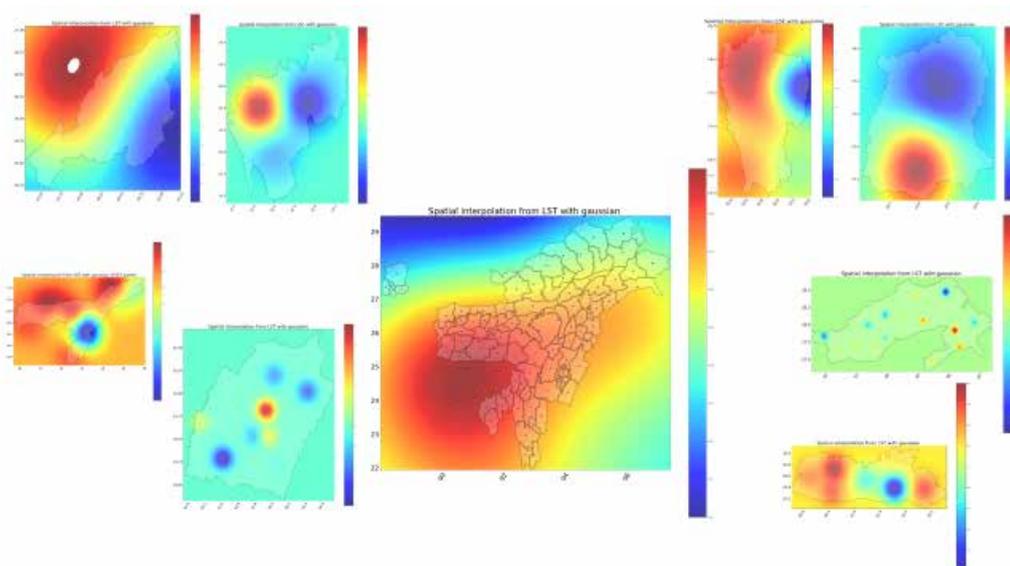
Fig. 2: (B) Kriging with remote sensing and outbreaks data

D. Sampling plan

For the robust, scientifically accepted and field level sampling, the institute has developed a robust sampling frame for drawing random, representative and independent samples for epidemiological studies of livestock diseases. For generating a sampling frame, the database on the list of villages with livestock population, and geo-coordinates across the country at the block/district level was developed. The estimation is based on the animal/ fish level prevalence, herd/ pond level prevalence, test sensitivity, herd-level sensitivity and system sensitivity. The sampling frame is provided to all the NADEN centres to carry out the livestock disease surveillance in the country.

The sampling plan for 14 diseases under DBT One health consortium was prepared and submitted. Initially, based on meta-analysis, percent prevalence was derived for the diseases and based on this, sample size was estimated. The diagnostic test parameters used were sensitivity of 90% and specificity of 90%. The two-stage stratified random sampling plan was generated at 95% confidence using an in-house developed epi-calculator under NADRES v2 by ICAR-NIVEDI, Bengaluru: https://nivedi.res.in/Nadres_v2/Epical/stratified/random_sampling.php. Further, the number of villages to be selected at the state level and the number of animals to be sampled from each selected village were also provided (**Table 3**).

Table 3: Sampling plan for one health disease

Disease	Overall Prevalence (%)	Species to be covered	No. of sampled villages	No. of Samples	No of samples per village/herd
Brucellosis	12	Cattle, Buffalo, Sheep, Goat, Pig	160	3228	18-21
Coxiella/Q-fever	10	Cattle, Buffalo	185	4517	21-25
Cysticercosis	18	Pig	152	2205	13-15
CCHF	11	Cattle, Goat, Buffalo	154	3695	20-23
Scrub typus	22	Rodents*	134	1553	11-12
Swine influenza	28	Pig	105	1075	09-10
Tuberculosis	12	Cattle, Buffalo	158	3230	18-21
Japanese encephalitis	14	Pig	134	2389	16-18
Listeriosis	9	Food*	156	4183	23-27
Cryptosporidiosis	27	Cattle, buffaloes (calf)	116	1161	09-10
Salmonella	14	Cattle, Pig, Chicken, Duck	133	2341	16-18
PRRS	29	Pig	115	1045	8-9
LSD	18	Cattle	157	2250	13-15
ASF	19#	Pig	135	1888	12-14

*Human population used

The National Animal Disease Control Programme (NADCP), aims to control livestock diseases *viz.*, FMD and Brucellosis by 2025 and eradicate these diseases by 2030. The epidemiological investigation requires a scientific sampling plan for the collection of data on health problems including serum samples for surveillance or monitoring in a specific population. In this scheme, stratified random sampling was employed with the district as a stratification variable for cattle and buffalo populations in different states using an in-house developed epi-calculator under NADRES v2 by ICAR-NIVEDI, Bengaluru: https://nivedi.res.in/Nadres_v2/Epical/stratified/random_sampling.php.

E. Meta-Analysis

The literature on the prevalence of foot and mouth disease (FMD) in India was collected from offline and online databases. Based on the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines, the prevalence studies were systematically reviewed and selected for further analysis. By using the R software meta-package, the meta-analysis of FMD prevalence studies was carried out. The number of FMD prevalence studies included for systematic review and meta-analysis was 73. The percent prevalence estimates based on various subgroup analysis were 43, 44, 59, 53, 30, and 24 in the entire India, North, East, West, South and Central zones, respectively. Based on the subgroup analysis, the high-risk zones, states, species, methods, and serotypes have been identified for FMD in India. This will help the policymakers and stakeholders in making an informed decision regarding the control and prevention of FMD in India.

F. Bioinformatics

Duck hepatitis B virus (DHBV) appears to have a limited genetic variability due to a lack of cell surface receptors for the virus in the species. Determining the virus's spread, persistence, and evolution requires linking epidemiology and sequencing data. To explain the evolutionary dynamics of DHBV, data on molecular characterization of the 48 isolates were collected from 1993 to 2020. A Bayesian Coalescent Approach of Time-Estimated Evolutionary and Phytogeography analysis of DHBV was conducted. The Bayesian Markov Chain Monte Carlo approach was used to estimate the evolutionary rate of the virus, and

the SLAC (Single Likelihood Ancestor Counting) and FEL (fixed effects likelihood) approaches were used to analyze selection pressures in the DHBV **(Fig. 3)**. The evolutionary rate was estimated to be 2.45 with 95% lower and higher HPD as 0.94 and 4.03 respectively. The tMRCA was found to be in 1974, which shows that the virus has evolved 46 years ago. DHBV's effective population size is stable until 2019 and falls after 2020 showing that this virus is evolving slowly. There were unexposed positively selected sites detected but it was observed that it had 22 and 85 negatively selected sites from both the SLAC and FEL approaches respectively had led to the evolution of the virus. Bayesian Inference tree of DHBV obtained from Mr.Bayes, representing three different clades and showing that the evolution has occurred.
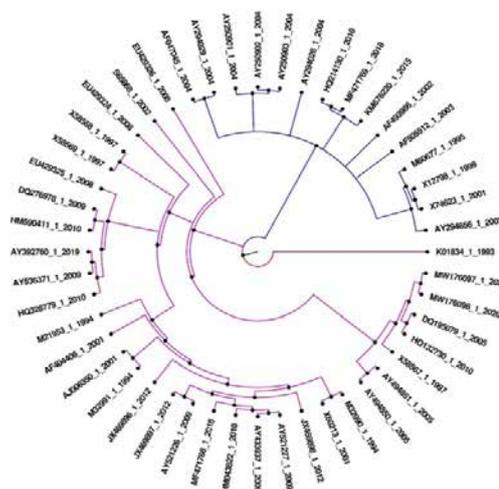
Fig. 3: Bayesian Inference tree of DHBV obtained from Mr. Bayes, representing three different clades and showing that the evolution has occurred

2. ANIMAL DISEASE EPIDEMIOLOGY

Currently, the institute is actively involved in research on the epidemiology of emerging and re-emerging transboundary diseases of animals (MCF, CSF, PRRS, TTV, BVD, BT, AI) including surveillance and molecular analysis of MRSA, MR-CoNS, VRE, ESBL and Carbapenemase-producing Gram-negative bacteria.

A. Bacterial Disease Epidemiology

(i) Haemorrhagic septicaemia (HS)

Although several conventional and molecular typing tools have been routinely used for differentiation

of HS causing *P. multocida* strains, limited attempts were made to whole-genome sequencing of virulent HS strains. A total of 45 clinical samples from suddenly dead bovines were analyzed. The draft genomes of three virulent *P. multocida* serotype B:2 strains (NIVEDIPm32, NIVEDIPm34 and NIVEDIPm35) were analyzed following whole-genome sequencing, assembly, annotation and compared with existing global genomes (n=43) of bovine origin in the database. Three draft genomes of NIVEDIPm strains consisted of 40-52 contigs with GC content of ~40.4%. The genome size and predicted genes content were ~2.3

Mb and 2811- 2189, respectively. Besides, the presence of various mobile genetic elements, antimicrobial resistance genes and biofilm-related genes suggested their vital roles in virulence; further, adaptation to the host immune system as well as host-pathogen interaction. Comparative circular genome (BLAST) visualization of *P. multocida* NIVEDIPm 32, 34 and 35 strains and HS vaccine strain P52 indicated different missing open reading frame region NIVEDIPm strains in comparison to reference genome, Pm70 strain (**Fig. 4**). Additionally, reference-based assembly and mapping of genome based on SNP and Indel suggested extensive gene evolution, especially for serogroup-A strains. The pan-genome of the 46 strains analyzed more unique (accessory) genes than the core gene. Multilocus sequence analysis based on RIRDC scheme showed the presence of ST122 in all three strains. wgMLST based phylogenic analysis suggested that HS causing Indian virulent field strains differed geographically and showed diversity from existing HS vaccine strain P52. The phylogenetic tree revealed that North Indian strains share high similarity with strains of Pakistan than the South Indian strain. Notably, a high divergence of SNPs between the HS causing circulating virulent strains of India and current HS vaccine strain P52 suggested an imminent need for a relook into HS vaccination strategy for livestock in India.
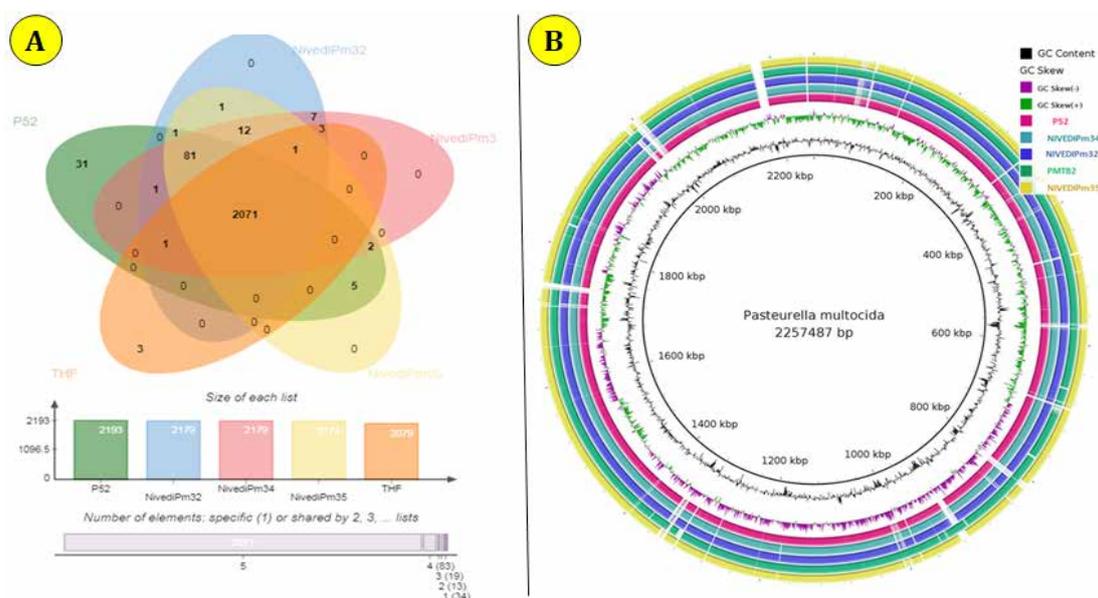
Fig. 4 : Panel A: Venn diagrams showing orthologous clusters shared by NIVEDIPm strains 32, 34, 35 and 2 other *P. multocida* strains; Panel B: Comparative circular genome visualization of *P. multocida* NIVEDIPm strains 32, 34, 35, P52 and reference genome strain Pm70

A total of 171 clinical samples (124 nasal swabs, 40 lung samples & 7 blood samples) were collected from apparently healthy and diseased small ruminants from 7 districts of Karnataka. A total of 6 samples were positive by KMT PCR and could successfully isolate three *Pasteurella multocida* isolates. The isolates were characterized for various PCRs 23S r RNA, rpoB, capsular type, LPS type, Virulence profiling and Antibiotic resistance PCR. These isolates carried fim 4 gene, tbp A, pfhA, Pm HAS but did not carry tox A, Nan H, Nan B, HgbA. These isolates were negative for Macrolide resistance genes. Multi locus sequencing type (MLST) PCR for a few representative isolates was carried out targeting different genes like AroA, G6PD, ADK, DEOd, gdh, mdh and pgi and found to be positive. Sequencing analysis of the genes was done using MEGA X software using the Maximum Likelihood method. Phylogenetic tree analysis of KMT gene of representative *P. multocida* isolates was carried out and found to be clustering together as Cluster B (**Fig. 5**). Apart from these, 10 *Mannheimia* isolates were also isolated from the samples.
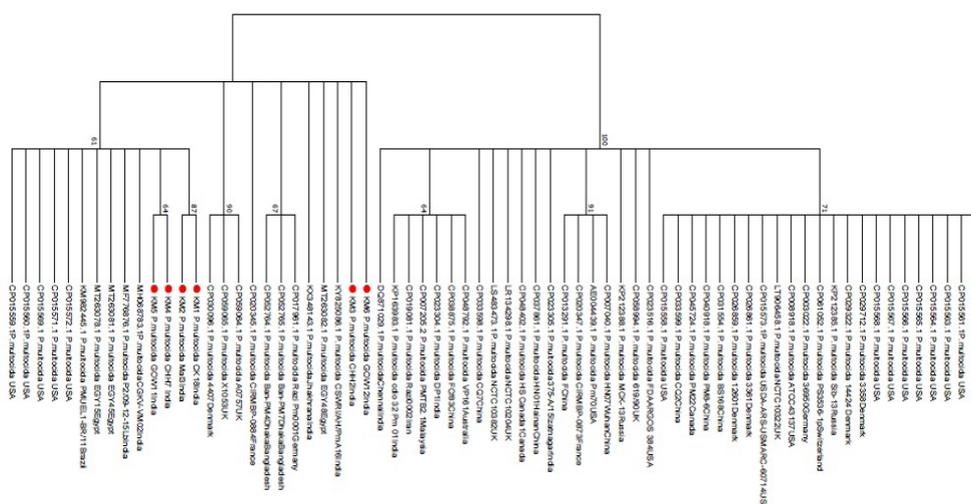
Fig. 5: Sequence analysis of KMT gene

(ii) Brucellosis

A total of 2921 bovine serum samples [Chandigarh (n=197), Karnataka (n=1532), Delhi (n=399), Mizoram (n=395), Sikkim (n=216) and Dadra and Nagar Haveli (n=182)] were received from 6 states for brucellosis S19 post-vaccination sero-monitoring. The highest seroconversion was recorded in Chandigarh (99.49%) followed by Karnataka (96.67%), Delhi (89.47%), Mizoram (88.86), Sikkim (88.43%) and Dadra and Nagar Haveli (80.77 %). Monthly data on brucellosis vaccination was collected from Information Network for Animal Productivity & Health- INAPH website to correlate with sero-monitoring during September-December, 2021. Overall, vaccinations carried out were 23,72,171 benefiting 16,51,447 farmers under NADCP program with West Bengal (7,08,186) showing the highest vaccination coverage among eight states (Gujarat, Haryana, Karnataka, Manipur, Odisha, Punjab, Telangana and West Bengal) and four UT's (Chandigarh, Dadar and Nagar Haveli & Daman and Diu, Delhi, and Ladakh).

The survey schedules and sera were collected from 15 sheep flocks from Kolar district, Karnataka and sera were subjected to screening of smooth *Brucella* spp. and *B. ovis* antibodies by ELISA. Analysis revealed that the percent positivity due to smooth *Brucella* spp. is 2.25 % and *B.ovis* is 2.8 % in Kolar district, Karnataka. Five percent of ewes have been aborted during the year, and interestingly neither of the aborted ewes nor rams have shown antibodies either for smooth *Brucella* spp. or for *B.ovis*. On comparison to other districts such as Tumkur, Chitradurga, Haveri of Karnataka under this study, sero prevalence of *Brucella* spp. antibodies were least in Kolar district. Using 16S metagenomic analysis of sheep vaginal and preputial swabs from aborted flocks in Karnataka, the presence of DNA of *Brucella* spp./*Ochrobactrum* spp., *Leptospira* spp., *Mycoplasma* spp., *Anaplasma* spp., *Chlamydia* spp., *Yersinia* spp., etc., could be identified. Thus, in the future, metagenomics may play a vital role in the molecular diagnosis of pathogens.

B. Viral Disease Epidemiology

(i) Infectious Bovine Rhinotracheitis (IBR)

Serosurveillance and virus isolation of Bovine alphaherpesvirus-1 (BoHV-1), a causative agent of Infectious Bovine Rhinotracheitis (IBR) from the samples collected from different states of India were undertaken. A total of 394 bovine serum samples from Andhra Pradesh, Karnataka, Odisha, Punjab and Uttar Pradesh were tested for the presence of IBR antibody using the NIVEDI's Avidin-Biotin ELISA kit, which revealed an overall prevalence of 43.40% (171/394) with highest positivity of 58% (58/100) in Punjab, and lowest 27% (27/100) in Andhra Pradesh and Karnataka. Odisha and Uttar Pradesh had 50 % (28/56), and 43% (55/127) positivity, respectively. The cumulative seropositivity of IBR in India from the year 1995 to 2021 is 34.51% (33568/ 97255). A blood sample of Murrah buffalo from Theerthahalli, Karnataka was screened for IBR and MCF using specific primers gB293 and 556&775 and found negative for both IBR and MCF.

(ii) Lumpy skin disease (LSD)

A survey tool was developed to record the epidemiological parameters during the outbreak investigation of LSD. The LSD outbreaks were recorded in all age groups irrespective of breed and sex. During outbreaks investigation, the lesions were more in numbers in the case of indigenous breeds compared to crossbreeds. Whereas, the size and/or severity of gross lesions were more in crossbred animals compared to indigenous breeds. Further, A total of 118 clinical cattle samples were screened by P32 gene-based in-house PCR developed for the detection of capri poxviruses and 87 samples were found positive. The LSD virus was confirmed by isolation in MDBK cell line and sequencing of full-length P32 gene and RPO30 genes. A total of 6 LSDV isolates have been successfully recovered and confirmed and are under different levels of passages. The LSD virus was confirmed by isolation and sequencing and phylogenetic analysis.

(iii) Bluetongue

The suspected bluetongue outbreaks in 45 villages within eight districts of Karnataka and Andhra Pradesh were attended and in all, epidemiological data from 112 sheep flocks and 4 goat flocks were collected through Epicollect 5. The majority of visited flocks consisted of 100-150 sheep, however, ownership of smaller flocks was more consistently seen in Raichur and Chikkaballapura. Most farmers kept goats for their daily milk needs, while 30 owned cattle and only 15 owned buffaloes. Among these flocks, nearly 56% of owners depend on locally available land for grazing, while the remaining were migratory. Nearly 17% of owners practiced seasonal inter-district migration, while 7% practiced interstate migration and the remaining flocks (19%) depended on short-distance migration within the district.

It was found that sheep (70%) within the two years of age were mostly affected indicating that the affected group probably had no previous exposure. Infection within the age group of six months which comprised 20% of the affected population is also a point of concern. The masking of typical bluetongue-clinical signs due to secondary bacterial and mycoplasmal infection was a major feature during this year. For example, most of the lame animals were severely affected by foot rot. The median flock morbidity rate was 20%, while the median flock mortality rate was 55.7%. Very high mortality rates were recorded in Ananthapuram, Bagalkot and Chitradurga districts. Analysis of the data showed clustering of BT outbreaks both in geographic space and time indicating that there were at least three independent incursions (July, September, mid-November-December, 2021) of the disease in these two states. Regarding the previous occurrence of the outbreak, 68 flock owners answered that they had seen the outbreak the previous year also, while 28 said they had faced a similar situation some five years ago, another five owners said they had seen the disease in 2019 and the remaining 11 told they did not remember when they had a previous outbreak. Geographical incursion pattern of bluetongue in 2021 **(Fig. 6)**.
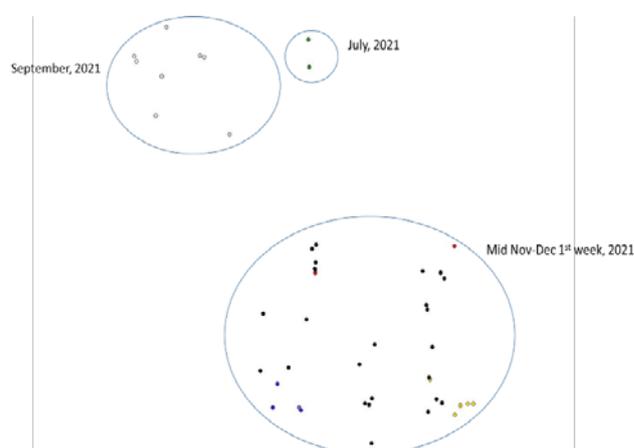
Fig. 6: Geographical incursion pattern of bluetongue in 2021-22

Flock-wise vaccination details showed that about 51% of the flocks were unvaccinated, while 19% received the vaccination with the onset of disease. The remaining other flocks, which received the first dose of vaccination never had booster doses. Interestingly, within villages also vaccination patterns and timings varied among the flocks. All the 241 clinical samples collected during the year were subjected to virus isolation in cell culture. Following four rounds of blind passes in cell culture, 52 isolates were recovered so far and serotyping is in progress. All the earlier recovered viruses (n=9) were positive for BTV genome in group-specific nested PCR and belonged to serotypes 1, 5, 12 and 16. From 56 clinical samples received from Raichur between 2020 and 2021, 27 virus isolates could be recovered in cell culture and serotyping results indicated the presence of serotypes 1, 4,12,16,23 and 24.

(iv) Sheep and Goat pox

On investigation of the eight-goat pox and 17 sheep pox outbreaks from different parts of Karnataka, female animals were more affected than males with 1-2 years old animals have mostly affected (42% and 64%) followed by below one year and least affected were above 2-year-old animals. Further, out of 68 clinical suspected goat pox samples, 64 samples were found positive, whereas, in the case of sheep pox, out of 105 samples, 95 samples were found positive for Capri poxviruses through specific amplification of partial P32 gene. Gross and microscopic examination of the pox lesions were examined and hyperplasia of type II pneumocytes and bronchiolar epithelium and presence of intracytoplasmic inclusions were characteristic in lungs. The P32 gene-based PCR showed positivity in the lungs, liver, kidney, intestine, and heart along with scab and biopsy samples indicating the systemic spread of the virus. Sequencing and phylogenetic analysis confirmed the presence of sheep pox and goat poxviruses. The strains were host specific and were closely related to other sheep and goat pox virus isolates from earlier reported outbreaks in India.

(v) Classical Swine Fever (CSF)

A total of 3085 pig serum samples received from 26 different states were screened for CSF virus antibodies using CSFV Ab Check kit, of which 1071 samples were found positive (34.71%). Further, a total of 71 pig (tissue & blood) samples received from Odisha (n=6), Maharashtra (n=5), Arunachal Pradesh (n=41) Karnataka (n=19) states were screened for CSFV infection by RT- PCR using 5' UTR out of which 2 samples one each from Maharashtra and Karnataka were found positive. The positive pig tonsil sample from Hassan, Karnataka was successfully recovered in PK15 cells (CSFV isolate No:11118/21).

(vi) Porcine Respiratory Disease Complex

A total of 28 tonsil samples were collected from three villages of Bengaluru rural district and processed for detection of selected persistent viruses *viz.,* CSFV, PRRSV, PCV2. The samples were also processed for tonsillar mononuclear cells (TMC). TMCs were stained for detection of CD4-FITC, CD8-APC and CD25-PE immuno-markers. The PCR-based screening revealed all the samples as negative for PRRSV, CSFV and PCV2 viruses. The genetic characterization of positive samples of PCV2 obtained during 2020 by gene sequencing and phylogenetic analysis revealed PCV2d genotype.

(vii) Japanese encephalitis

The host tissue-specific cell-mediated immune response in JE seropositive pigs was evaluated. The tonsil of the soft palate was collected from cases along with blood samples from each suspected animal (n=3) which were transported to the laboratory in cold conditions. In the laboratory, the pig tonsil tissues were dissected to remove the tissue aggregates from the tonsil tissue. The tonsil tissue was processed following standard protocol for isolating tonsillar mononuclear cells (TMCs) by density gradient centrifugation using histopaque-1077. The cell counting determined the cell number which ranged from 5-15 million cells. Further, a known number of cells were used for Immunophenotyping. The immunophenotyping of TMC for CD4 and CD8 counts were carried out. The specific cell populations were differentiated and gated in comparison with unstained control cells. Appropriate gating was done to exclude debris and other artifacts. The number of events was recorded for each of the markers. The CD4+ count was higher (20%) in the JEV positive samples as compared to that of the JEV negative control (2.1%). The CD8+ count was also higher (3.33%) in JEV positive samples as compared to that of the JEV negative control (0.92%). The results demonstrated that CD4 and CD8 counts varied between JEV positive and negative samples (**Fig. 7**).
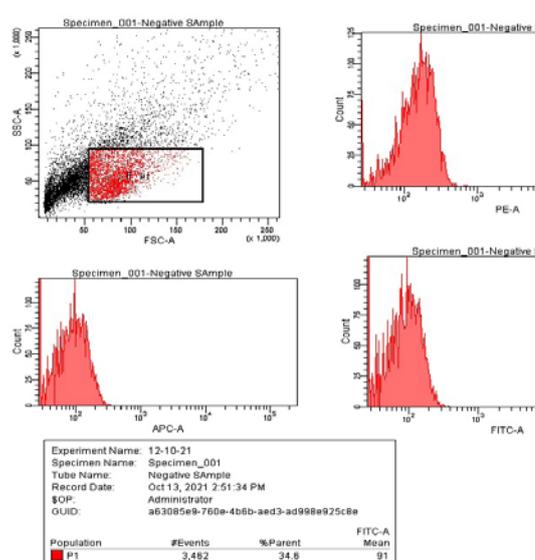
A
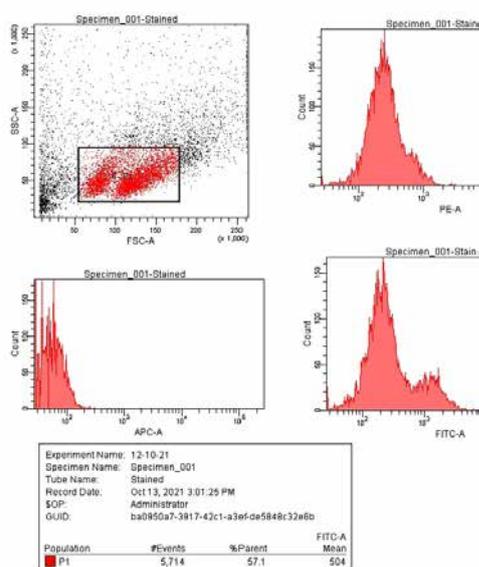
B

Fig. 7: Immunophenotyping of stained TMCs (A) against an unstained negative control (B)

C. Parasitic Disease Epidemiology

(i) Trypanosomosis

A total of 1382 bovine serum samples (Andhra Pradesh-255, Haryana-565, from Punjab-171, Assam-207 and Chhattisgarh-182) were screened by recombinant VSG antigen-based indirect ELISA, of which 587 (42.47 %) were found positive for the presence of antibodies against *Trypanosoma evansi*. Further, samples from Assam showed a high seroprevalence of 51.19 % followed by Punjab (49.12 %), Andhra Pradesh (45.09 %), Haryana (39.29%), and Chhattisgarh (32.41 %). Among buffaloes, Haryana showed 40.22 % seropositivity followed by Chhattisgarh (32.41 %), Punjab (30.61%) and Andhra Pradesh (27.38 %). Among cattle, Andhra Pradesh showed the highest seroprevalence (73.46 %) followed by Punjab (73.29 %), Assam (52.21 %) and Haryana (33.33 %). The analysis of minicircle of kinetoplast of *T.evansi* (Leopard isolate) sequence of *T. evansi* revealed 81.4 to 89.9 % similarity with other *T.evansi* isolates whereas the sequence of *Trypanosome* Alternate Oxidase (TAO) gene of *T. evansi* leopard isolate showed 99.7 to 99.9 % sequence similarity with other isolates of *T. evansi*.

(ii) Fasciolosis

Understanding the transmission foci of fasciolosis by snail surveillance is a crucial step in the effective management of the disease. A total of 285 *Radix* sp. [*Lymnaea* snails (*Radix* sp.) acts as an intermediate host for the *Fasciola gigantica*] were collected from four districts of Karnataka (Bengaluru rural, Tumkur, Kolar and Mandya) beside a total of 60 *Radix* sp. snails received from Kerala, Bihar and Madhya Pradesh. The snails were morphologically characterized and further, the genetic characterization based on Cytochrome Oxidase 1 gene and phylogenetic analysis revealed that the snails from Bareilly, Karnataka (Devarahosahalli and Madhur) and Bhopal is forming a separate clade with *Radix rufescens* and is not grouping with *R. auricularia*. Even though it is well established that *F. gignatica* infection in India is transmitted by *R. auricularia*, the present study revealed the involvement of *Radix rufescens* as the intermediate host for *F. gigantica*.

Further, out of 858 bovine sera (Odisha (n=144), West Bengal (n-117), Karnataka (n=300), Madhya Pradesh (n=148) and Chhattisgarh (n-149)) screened by ELISA using cathepsin B recombinant antigen, 362 samples (42.19%) showed the presence of antibody against *Fasciola gigantica*. The seroprevalence observed among cattle and buffalo was 38.91% and 51.08%, respectively. Among the states, the seroprevalence was highest in Madhya Pradesh (81.75%) followed by Chhattisgarh (65.77%), Odisha (47.22%), West Bengal (31.62%) and Karnataka (12.66%). Furthermore, during the reported period tick survey and sample collection were undertaken in 158 villages in 32 districts of Tamil Nadu by using a stratified sampling technique.

D. Disease Investigation and Diagnostic Services

Institute disease investigation team comprising scientific experts in various disciplines visited/ attended different outbreaks including natural calamities on request from various stakeholders as and when required. After investigation of the disease outbreaks, diagnosis and epidemiology appropriate suggestions had been advised for the prevention and control of the disease. Outbreaks and disease investigation/diagnostic services were provided as per the need of the state animal husbandry departments. Diagnostic services for PPR, BT, CSF, LSD, Brucellosis, Leptospirosis, and JE in animals/Livestock and humans to various organisations, and animal husbandry departments of state disease diagnosis laboratories in different states of India as per their request as and when

samples were submitted to ICAR-NIVEDI. A total of 13 ELISA kits (four IBR AB ELISA kits and eight *Brucella* Protein G ELISA kit and one *Brucella* Sheep and Goats ELISA kit) were supplied on a payment basis to different diagnostic laboratories in India.

As a part of surveillance of Zoonotic diseases under NCDC, GoI project, diagnosis service was provided for Leptospirosis, Brucellosis, Japanese encephalitis, and Cysticercosis across the country (**Table. 4**).

Table 4. The details of the samples submitted and screened for the zoonotic diseases and provided the diagnosis

Name of zoonotic disease	Type of test performed	Species	Number of samples screened	Number of samples positive	State/Location/ Area from where samples received
Leptospirosis	MAT/IgM ELISA	Human	325	90	Gujarat, Uttar Pradesh, Odisha, Telangana
		Bovine	398	117	
		Dog	232	50	
		Goat/ Sheep	417	180	
Brucellosis	RBPT/ELISA	Goat/ Sheep	136	21	Karnataka
Cysticercosis	ELISA	Pig	95	5	Karnataka
Japanese encephalitis	RT-PCR	Pig	5	0	Karnataka
		Total	**1608**	**463**	

E. Disease Diagnostics

NIVEDI is working on the development of novel and effective diagnostic tools especially to monitor the epidemiology of disease for use in the field and regional laboratories to support clinical suspicion of disease as well as for population survey, in addition, to the investigation of disease outbreaks, generation of scientific confirmation reports, monitoring and surveillance of the livestock diseases in the country

(i) Brucellosis

cELISA for livestock

Five monoclonal antibodies against *B. abortus* S99 were produced and characterized in ADMaC phase-I project, of which, one *Brucella*-specific monoclonal antibody- 2B3 with DIVA capability was selected for standardization of cELISA. In the checkerboard titration, smooth LPS *Brucella* antigen, serum, MAb and anti-mouse HRP conjugate were used at a dilution of 1:320, 1:20, 1:200 and 1:8000, respectively. The analytical sensitivity was determined up to 1:80 dilution of serum and analytical specificity was 100% when tested with 22 cross-reactive Gram-negative bacterial hyperimmune serum. The cut-off of 30 PI was set for the detection of brucellosis. The sera from 555 calves (Punjab (n=197), Dadar Nagar & Haveli (n=182) and Andhra Pradesh (n=176)) vaccinated with *Brucella* S19 vaccine were tested for vaccinal

antibodies and results showed the DIVA potential of cELISA indicating 96.39% of total samples as vaccinated, 2.88% of samples declared as positive and 0.72% as suspected for brucellosis.

Lateral flow assay (LFA)

In DBT-ADMaC-II project, LFA for the detection of anti-*Brucella* antibodies in multiple livestock species was standardized. The satisfactory results were obtained with the neat serum of 10 µl, 100 ng of antigen, 40 µm protein A/G gold colloidal conjugate, 0.6 mm sample pad, nitrocellulose membrane pore size of 10 µm and conjugate release matrix pad PT-R5. The Analytical Sensitivity (ASe) of the standardized LFA considering iELISA as the gold standard with serum dilutions (1:10 to 1:5120) revealed positivity till 1:640 serum dilution and with reference to analytical specificity (ASp), the hyper immune sera from 22 Gram-negative bacteria tested showed no reactivity except for *Yersinia enterocolitica*. The kits were evaluated for ASn using 150 sera from multiple livestock species *viz.*, small ruminants-sheep and goats (60), cattle (70) pig (10), vaccinated (5), non-vaccinated (5). Considering RBPT and protein G iELISA as gold standard tests, the ASe at 95% confidence level was 94% and 100% and ASp was 100% and 97.9%, respectively. The kits were validated at ICAR-NIVEDI and AAU, Assam with 20 coded sera samples that showed kappa agreement of 1.0 indicating an excellent test score for the newly developed test.

Indirect ELISA for humans

Human serum samples are regularly received at NIVEDI for screening of brucellosis and tested by conventional serological tests such as RBPT and STAT. To improvise the sensitivity and specificity of diagnostic tests, IgM and IgG-based i-ELISA for detecting *Brucella* antibodies in human sera was standardized using checkerboard titration, with optimal dilutions of 1:320, 1:80 and 1:4000 sLPS antigen, serum and conjugates, respectively. The analytical sensitivity (ASe) was up to 1:320 serum dilutions with two positive samples and analytical specificity (Asp) revealed no reactivity with hyperimmune sera against 22 cross-reactive Gram-negative bacteria. In the ROC curve, a cut-off value of ≥ 42 PP with the Se of 98% and Sp of 100% for IgM ELISA and a similar cut-off value of ≥42 PP with Se of 98% and Sp of 99.9% for IgG ELISA were arrived (**Fig. 8**).

Using the standardized protocol, 754 human sera samples from Karnataka [veterinary doctors (n = 161), artificial inseminators (n = 187)] and 406 animal handlers from Kolkata were screened using RBPT, SAT, IgM and IgG ELISA. Of these 754 samples, 16.1%, 15.3%, 12.2%, and 9.2% were positive by IgG ELISA, RBPT, IgM ELISA and SAT, respectively and 73 (9.7%) were reported as positive for brucellosis. Considering RBPT as gold standard test, the diagnostic sensitivity (DSe) and diagnostic specificity (DSp) of IgM ELISA were 91.1% and 99.2% and the DSe and DSp of IgG ELISA were 92.86% and 99.2%, respectively. Similarly, considering SAT as a gold standard test, the DSe and DSp of IgM ELISA were 92.8% and 97.4% and the DSe and DSp of IgG ELISA were 90.7% and 97.4% respectively. Overall, anti-human IgM and IgG-based iELISA are sensitive and highly specific assays for the differentiation of acute and chronic brucellosis.
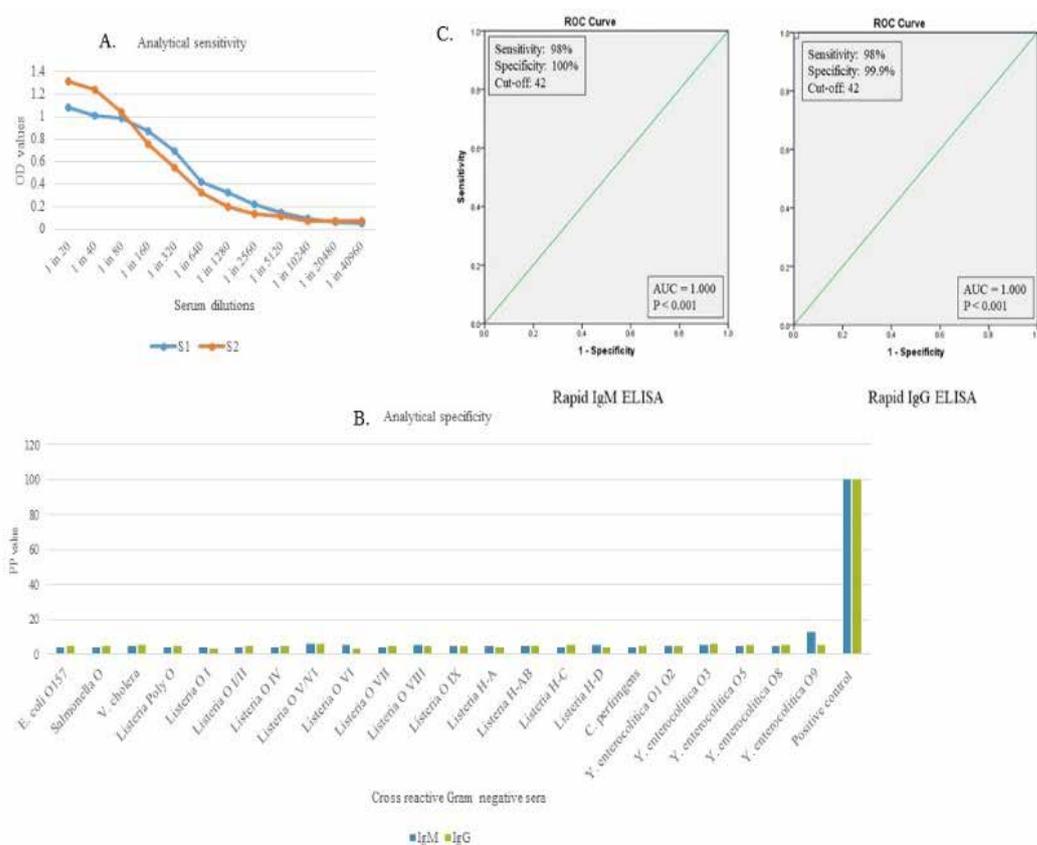
Fig.8: Determination of analytical parameters of IgM and IgG i-ELISA. A. Analytical sensitivity was estimated using two representative positive samples (S1: IgM positive sample, S2: IgG positive sample) at different dilutions. B. Analytical specificity estimated with hyper immune sera against various cross-reactive Gram-negative bacteria. C. Determination of cut-off using ROC curve analysis of IgM and IgG ELISA drawn using 50 each brucellosis positive and negative human sera.

(ii) Leptospirosis

The cloning and expression of the recombinant proteins (Lsa 44, LipL21 and 41, GroEL, ErPY-like) and fusion proteins (LSA plus OMPL, LSA plus Loa; LipL plus OmpL) of pathogenic *Leptospira* in the *E. coli* system were carried out and the proteins were characterized & confirmed by SDS-PAGE and western blot analysis. The expressed protein(s) was purified, characterized, and stored in the freeze-dried form for further use. The preparation of the Latex beads coated with this recombinant protein (s) and fusion proteins was carried out for assessing the antigenic diagnostic potential in the form of reactivity in the Latex Agglutination Test (LAT) with a standard panel of positive and negative sera. Further, for the prepared beads with LSA 44 as a diagnostic antigen, a total of 300 cattle serum samples from Telangana state were screened by LAT for evaluation.

(iii) PPR

The revival of the Bl-21 clone expressing recombinant PPRV-NPN-protein was carried out and six batches of expression were carried out. The expressed PPRV -NPN protein was purified, characterized, and stored in the freeze-dried form for further use. The hyperimmune serum was raised against the expressed purified recombinant protein in Guinea Pigs and sera were stored at -20 °C as the freeze-dried form for further use. PPR surveillance ELISA kits were developed by exploiting the polyclonal antibodies produced against expressed recombinant nucleoprotein of PPRV. All the test reagents of both the ELISA (ABrC ELISA kit and ABrAC-ELISA Kit) were prepared in the kit format and, assessed its stability for transportation at 4 °C and storage at 4 °C as well as -20 °C. Large scale screening of the serum samples (n=1437) from sheep and goats from different states (Madhya Pradesh, Odisha and Bihar) was carried out and determined the relative diagnostic efficacy (DSn= 88 %; DSP = 90%) of the PPR ABrC ELISA kit with IVRI PPR competitive ELISA kit for seromonitoring and surveillance of PPR in sheep and goats. Further, the Intra-Institute validation of both the kits PPR Ab Chek Kit / PPR Ag Chek Kit was completed through ITMU and the same for the inter Institute validation is in progress through ITMU of ICAR-NIVEDI.

(iv) Capripox virus infection

Further, in-house developed recombinant iELISA validation revealed 98% sensitivity and 96% specificity with sheep pox and 97% sensitivity and 98% specificity with goat pox.

(v) Porcine Respiratory Disease Complex

The multiplex serodiagnostic methods which are less time demanding, cost-effective and consume a very small quantity of clinical samples are the need of the hour, especially for multi-etiological disease conditions like Porcine Respiratory Disease Complex caused by the combination of viral agents majorly Porcine Circo Virus-2 (PCV2), classical swine fever virus (CSFV) and Porcine parvo virus (PPV). The current project with objectives of generating conserved immunogenic recombinant proteins of CSF, PPV2, and PCV2 and standardization of flowcytometry based multiplex microbead array for detection of antibodies against CSF, PPV2, and PCV2 was initiated. The major achievements include the standardization of functional bead conjugation with PPV recombinant protein. The optimum concentration to coat the beads was estimated to be 0.5ug of protein for every 10,000 beads.

F. National Animal Biological Repository

(i) Microbial isolates

It constitutes one of the components of natural biodiversity in addition to being the repository for candidate vaccine strain selection, epidemiological studies, and the development and validation of diagnostics. Therefore, safeguarding such treasure is everyone's responsibility. In this direction, the institute was bestowed with the responsibility of collection, recovery, maintenance and onward transmission of microbial pathogens to NCVTC. Accordingly, during the year under report, 37 isolates of bluetongue virus kept in the BT-repository of ICAR-NIVEDI were revived and freshly passaged in BHK-21 cells. Later, these infected supernatants were used for viral RNA extraction, cDNA preparation, and virus and serotype confirmation by PCR. The type confirmed isolates were lyophilized in 10 aliquots for further transmission to NCVTC. A detailed history of the isolates along with duly filled submission forms was handed over to NCVTC.

(ii) National Livestock Serum Repository

Institute has a huge repository of serum collected from randomly identified villages across India through its AICRP_ ADMAS collaborating units.

These samples, collected from apparently healthy animals, are screened for various livestock diseases and the left-over serum, after the initial screening, is stored in a livestock serum repository. Currently, the serum repository has more than one lakh sera, which are cataloged. To have easy retrieval of screening results, and metadata relating to the serum and the stored serum, MS Access-based software has been developed. The said repository acts as a storehouse for a retrospective screening of livestock diseases and also for diagnostic assay development and validation.

ICAR-NIVEDI has been mandated with animal disease monitoring and surveillance and the livestock serum samples collected through AICRP_ADMAS units (n=31) are screened for infectious diseases such as brucellosis (in sheep, goat, cattle, buffalo and pigs, humans), infectious bovine rhinotracheitis (cattle), classical swine fever (pigs), peste des petits ruminants (goats/cattle), and bluetongue (sheep/goat), porcine reproductive and respiratory syndrome (pigs) etc. The data generated about the status of livestock diseases in the country has enabled policymakers to initiate nationwide control programme on livestock diseases such as brucellosis, FMD, PPR and CSF. The details of the serum samples collected during 2017-18 & 2018-19 were updated along with the status of the serum against relevant diseases, OD/percent positivity/percent inhibition values in the serum bank database. Optical density (OD) values for bluetongue (n=25072 records), CCHF (n=24,743 records), percent inhibition values for PPR (n=24,499 records) were added to the records of sheep & goat serum samples which were collected during 2017-18. Similarly, OD values of PRRS were added to 5987 pig serum records. In addition, geographic coordinate (lat long) values for 1527 villages, from which the above serum samples were collected, were extracted from internet sources and added to the 25567 small ruminant & 6197 pig serum records. After adding the OD/percent positivity/percent inhibition values, the serum samples were short-listed to make disease and species-wise strong positive and strong negative serum panels. These serum samples (**Table 5**) were aliquoted in 250 µl quantity and lyophilized and stored for any future use.

Table 5: Serum panel available at serum repository of ICAR-NIVEDI

Name of the disease	No. of positive sera			No. of negative sera		
	Sheep	Goats	Pigs	Sheep	Goats	Pigs
Bluetongue	141(8)	60 (7)	-	214 (17)	207 (23)	-
Crimean-Congo Haemorrhagic Fever	44(8)	14 (4)	-	9 (4)	32 (9)	-
Peste des petits ruminants (PPR)	17 (1)	27 (3)	-	22 (1)	41 (3)	-
Porcine reproductive and respiratory syndrome (PRRS)	-	-	70 (4)	-	-	95 (19)
Total	202	101	70	245	280	95

The No. in bracket indicates the number of states from which the sera were obtained

3. ONE HEALTH

A. Zoonoses

(i) Brucellosis

A total of 1479 serum samples from large ruminants (n=982) and small ruminants (n=497) from 7 organized farms received from six states were tested for brucellosis by RBPT as a preliminary test followed by iELISA. In the large ruminants, seroprevalence recorded was 61% (61/100), 54.55% (6/11), 18.75% (3/16), 8.89% (4/45), 7.33% (32/437) and 2.42% (9/373) in Uttar Pradesh, Maharashtra, Telangana, Chhattisgarh, West Bengal and Karnataka, states, respectively. Similarly, brucellosis seroprevalence in a small ruminant flock from Karnataka showed 11.67% (58/497). The results were provided to the stakeholders along with advisory for the control of the disease in livestock to reduce economic loss and public health hazards.

(ii) Leptospirosis

A total of 490 purposive random serum samples from cattle (n=386) and Goats (n=104) from Andaman and Nicobar Islands, India were tested from January to March 2021, using MAT with a panel of 20 references *Leptospira* serovars. The overall leptospirosis seroprevalence of 17.6 % (86/490) with 17.6 % in cattle and 17.3 % in goats was observed. The frequency distribution of predominant anti-leptospiral antibodies representative serogroups was Icterohaemorrhagiae (45.3%), Hardjo (15.1%), Grippotyphosa (10.5%), Pomona (9.3%), Tarassovi (9.3%), etc. The present study provides evidence of the emerging prevalence of Tarassovi, Djasmin, Shermani, and intermediate serovar Hurstbridge serogroup anti-leptospiral antibodies in livestock in the South Andaman.

ICAR-NIVEDI has also been identified as a key institution in the Southern region working in the field of zoonotic diseases by NCDC, GoI and involved in Capacity Building, Surveillance & Diagnosis of zoonotic diseases and serving as regional coordinator for the Karnataka, Kerala, and Lakshadweep. Institute is maintaining 29 reference *Leptospira* serovars cultures in semisolid and liquid EMJH medium for the seroepidemiological study of Leptospirosis. A total of 1372 serum samples (Bovine 398; Human 325; Dog 232; Goat/Sheep 417) from Gujarat, Uttar Pradesh, Karnataka, Odisha, Telangana were tested by MAT at ≥1:100 dilution using the panel of 20 to 28 pathogenic reference serovars for seroprevalence of *Leptospira* serogroup specific antibodies, of which 437 (Human-90; Bovine -117; Dog-50; Sheep/goat - 180) serum samples were showed positive reactivity against different *Leptospira* serovars with a percentage positivity of 32%.

(iii) Japanese encephalitis

A conventional RT-PCR targeting the envelope gene and NS3 gene of JEV was standardized, beside a conventional RT-PCR for detecting Panflavivirus targeting the NS5 gene of flavivirus was standardized. RNA extracted from JEV vaccine strain SA 14-14-2 was used as a positive control template for standardization of the aforementioned RT-PCR assays. Further, C6/36 and Porcine Stable Kidney cell lines have been procured from NCCS, Pune and are being propagated in the laboratory for virus isolation. A sampling plan has been derived using two-stage cluster sampling (n=448)

for sero-surveillance of JE in pigs in the southern part of Karnataka. To collect the data regarding the pigs, demography and farm details, a questionnaire has also been developed. Further, to identify the human JE prevalence in Karnataka state, the human JE cases data from 2010 to 2020 was obtained from National Vector Borne Disease Control Program (NVBDCP) unit, Department of Health and Family Welfare, Government of Karnataka and analysed for spatial and temporal distribution of human JE cases.

(iv) Toxoplasmosis and Coxiellosis

Epidemiological analysis on the prevalence of *Toxoplasma gondii,* along with coexisting antibodies against abortifacient zoonotic pathogens *viz. Coxiella burnetii* and *Leptospira* spp. in dairy cattle with reproductive disorders was carried out using cattle sera (n=246) collected from the dairy farms (n=35) situated in different locations in India. The overall seropositivity of 11.38 % (28/ 246) in dairy cattle with the presence of antibodies in reproductive disorders with seropositivity in 15 dairy farms was observed, as invariability of at least one suspected animal in each farm was found to be positive. Moreover, on analysis of screened sera for *Coxiella burnetii* antibodies by PrioCHECK™ Ruminant Q Fever AB Plate ELISA Kit, and for *Leptospira* antibodies by microscopic agglutination test, 49.78 % and 77.64% samples were found positive, respectively.

(v) Animal Coronaviruses

A cross-sectional study design for surveillance of Porcine coronaviruses (Transmissible Gastroenteritis Virus (TGEV), Porcine Respiratory Coronavirus (PRCV), and Porcine Epidemic Diarrhoea Virus) in Karnataka and Assam were developed. The sample size was estimated for Karnataka with a sample number of 486 by covering 54 villages with the assumed factors of Cluster sensitivity: 0.9, Design level prevalence: 0.3, Cluster Level prevalence: 0.03. Based on the sampling design, the sampling is initiated in Karnataka, and a total of 96 samples were collected (58 nasal samples and 38 fecal samples). All the samples were subjected to screening of TGEV and PRCV, and the results were negative. To date, 350 pig serum samples were also collected and stored. Out of which 178 serum samples were screened for antibodies using commercial ELISA (SVANOVIR® TGEV/PRCV-Ab ELISA Kit); 28 samples were positive for TGEV and one was positive

for PRCV. The Questionnaire titled "Identification of Host and Environmental Risk Factors of Porcine Coronaviruses" was prepared using Epi Info Software to identify the risk factors.

(vi) Ecological drivers for the emergence of Zoonoses

The Crimean Congo Haemorrhagic Fever, Anthrax and Avian influenza are the prioritized diseases to identify and quantify the ecological drivers for the emergence of important zoonotic diseases in India. For CCHF, the data on the spatial distribution of different species of *Hyalomma* ticks in India were collected from published literature and maps were prepared. It was found that *H. marginatum* species is most abundant in India and a large proportion of them was concentrated in the northern states of Punjab, Himachal Pradesh and Haryana. There is a presence of different tick species in the state of Gujarat where the first case of CCHF in India was reported in 2011. Further, risk factors for the occurrence of CCHF were enlisted and work is in progress to quantify the risk factors. For Anthrax, past outbreaks in the Chikkballapura district of Karnataka were visualized with a contour map with river streams (**Fig. 9**). The contour map shows the distribution of anthrax outbreaks from high altitude to low lying areas with few outbreaks at high elevation compared to more outbreaks at low elevation. Further studies are required to collect the samples during the outbreaks to identify the source of infection. Initiated the work on Avian influenza with the collation of past outbreaks and other risk factors. The geo-locations of bird sanctuaries in India were obtained and a map was prepared.
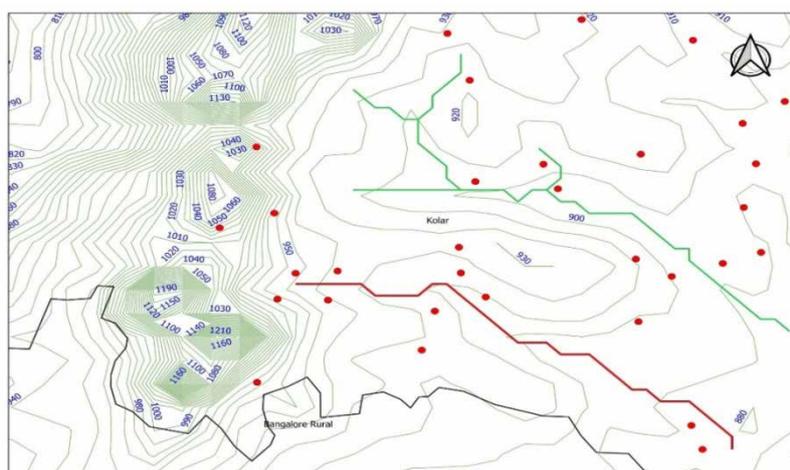
Fig. 9: Contour map showing the occurrence of anthrax outbreaks and elevation values (meters). The red dots are the location of anthrax outbreaks in Chikkballapura and lines (red and green) are the river streams flowing in that area.

B.   Antimicrobial Resistance

One eighty samples (cow milk 81; buffalo milk 15; sheep/goat rectal swabs 29; pig rectal swabs 19; poultry cloacal swabs 36) and 72 animal handlers' swabs (36 each of hand and nasal swabs) were collected from 12 villages belonging to four taluks of Chikkaballapura district. Duplex PCR identified 164 *Staphylococcus* isolates [89 from cow/buffalo milk (54.26%) and 75 from animal handlers (45.73%)] and 18 *mec*A positive (10.97%) isolates. Multiplex PCR identified 15 *mec*A positive isolates *viz*., eleven *S. epidermidis* (4- cow milk, 4- hand swab, 3- nasal swab), three *S. haemolyticus* (2-cow milk, 1- hand swab) and one *S. chromogenes* (hand swab). Three *mec*A positive isolates were identified by partial 16S rRNA sequencing as one each of *S. gallinarum*, *S. pasteuri* and *S. saprophyticus* from hand swab, cow and buffalo milk, respectively. The *mec*A positive *S. epidermidis* detected from cow milk and animal handlers of Haleperesandra and Dibburu villages are alarming (**Table 6**). Methicillin resistance among animal handlers was 10.33% (10/75) which was higher compared to animals *i.e.*, 8.98% (8/89). Kirby

Bauer disc diffusion assay among animals and animal handlers showed maximum resistance to penicillin at 50% and 76% respectively. All staph isolates were sensitive to vancomycin by broth microdilution method. *E. coli* multiplex PCR identified 144 (57.14%) isolates as *E. coli,* of which, 113 were from animals (62.77%) and 31 from animal handlers (43%). Kirby Bauer disc diffusion assay among animals and animal handlers showed maximum resistance to cefotaxime

(46%) and amoxyclavulinic acid (61.29%) respectively. All *E. coli* isolates were sensitive to colistin by the broth microdilution method. The confirmatory disc diffusion test identified 31 *E. coli* isolates as ESBL producers (21.52%), 6 as AmpC producers (4.16%) and 6 other isolates as both ESBL and AmpC (4.16%) producers. The highest prevalence was found in the poultry sector (34.8%; 15/43) showing the poultry sector as the major cause of concern.

Table 6: Details of *mec*A positive isolates

Taluk	Villages	Isolate ID	Source	*mec*A positive Staph
Sidlaghatta	Abludu	HS1	Animal handler hand swab	*S. gallinarum*
		HS3	Animal handler hand swab	*S. epidermidis*
	Devaramalluru	IN 169	Cow milk	*S. epidermidis*
Gauribidanur	Bandarlahalli	IN 16 C1	Cow milk	*S. haemolyticus*
		IN 20 C2	Cow milk	*S. pasteuri*
	Kudumalakunte	HS 13	Animal handler hand swab	*S. haemolyticus*
		NS 13	Animal handler nasal swab	*S. epidermidis*
Chintamani	Alapalli	IN 37 C2	Buffalo milk	*S. saprophyticus*
Chikkaballapur	Dibburu	IN 52	Cow milk	*S. epidermidis*
		HS 10 C2	Animal handler hand swab	*S. epidermidis*
		HS 12	Animal handler hand swab	*S. chromogenes*
		NS 12	Animal handler nasal swab	*S. epidermidis*
	Peresandra	IN 77	Cow milk	*S. epidermidis*
	Haleperesandra	IN 155 C1	Cow milk	*S. haemolyticus*
		IN 157	Cow milk	*S. epidermidis*
		HS 31 C2	Animal handler hand swab	*S. epidermidis*
		HS 32	Animal handler hand swab	*S. epidermidis*
		NS 32 C2	Animal handler nasal swab	*S. epidermidis*

In conclusion*, S. epidermidis* harboring ***mec*A gene** both in cattle and the animal handler of the **same household** in the village of Haleperesandra of Chikkaballapur taluk probably suggesting that horizontal mode of transmission from animals to humans or vice versa. **S. epidermidis** harbours ***mec*A gene** both in cattle and the animal handler of **different households** but belonging to the same village of Dibburu of Chikkaballapur taluk. Thus, appropriate animal husbandry practices must strictly be implemented in the dairy herds to prevent the spread of resistance and reduce the disease burden associated with these resistant pathogens.

The bacterial isolates processed during 2020-21 revealed resistance trends with a putative hotspot at the Garchuk site, Guwahati. Genomic study of 55 archived

S. aureus isolates from various institutes (ICAR-NIVEDI, Bengaluru; ICAR-CIFT, Cochin, ICAR-IVRI, Bareilly, ICAR-RCNEH, Barapani, GMCH, Guwahati and IIT-Delhi) isolated from various **clinical** samples {cattle (milk, nasal, extra mammary site and wound samples) and nasal samples from goat, pig, sheep and poultry}, were screened for the detection of methicillin resistance and other factors responsible for the development of AMR. Whole-genome size of 55 *S. aureus* isolates ranged from 2.61 mb (**NIVEDI**) to 3.02 mb (**NIVEDI**). Out of 55 isolates, 25 isolates harbored PBP2a gene (294bp). The MLST analysis resulted in 17 sequence types with the dominant ST being ST772 of Bengal Bay clone (GMCH =6, CIFT=7) followed by ST672 (GMCH =4 & IVRI =4) and livestock specific six ST1687 from NIVEDI. Similarly, 23 *spa* types with

the most prevalent *spa* types being t345 (GMCH=8) and t17242 (NIVEDI=6). Samples belonging to ST772 and ST672 need to be studied in detail as they were found to be more prevalent in India across the sectors (**Table 7** and **Fig. 10**). Preliminary genome-wide analysis suggests water/ environment as a reservoir of highly virulent STs which may transfer to humans through aquaculture and from the environment.

The data generated from across the sectors (animal, human and environment) for *S. aureus* from India is the first of its kind addressing AMR in the One Health context. The social science survey conducted in 2021 at three study sites at Guwahati indicated that 75% of veterinarians administer/treat with antibiotics such as Ceftriaxone, Enrofloxacin, Penicillin, Amoxicillin and Streptomycin.

Table 7: MLST based analysis of *S. aureus*

Properties	Animals	Foods of animal origin	Aquaculture	Environment	Humans	Common STs
MLST	ST3881, ST22	ST22, ST789, ST72, ST672, ST2219, ST2459, ST1687	ST772	ST772	ST1, ST6, ST12, ST772, ST672, ST1482, ST1004	ST772 (among aquaculture, environment and humans & ST672 (among food of animal origin and humans
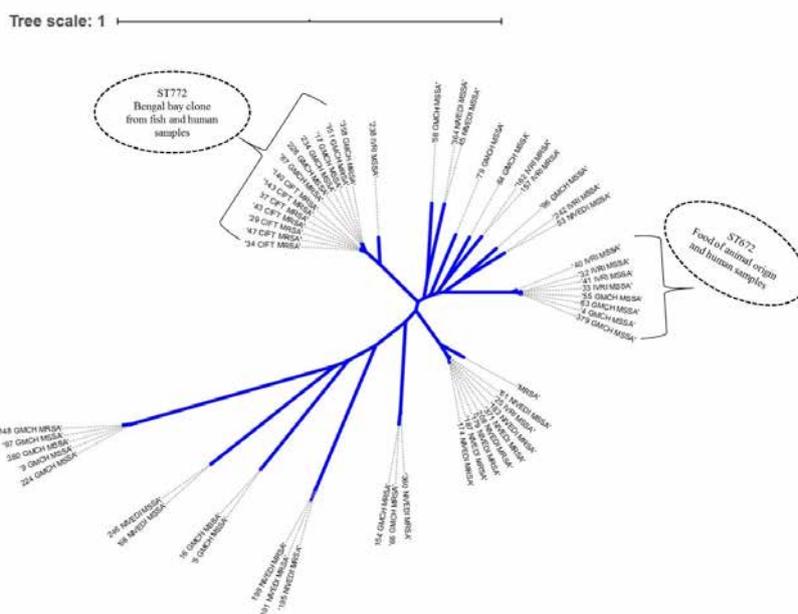
Fig. 10: SNP-based parallelogram of 55 *S. aureus* genomes. *S. aureus* ST772 and ST672 were found associated with samples from hospitals (humans), fisheries and foods of animal origin

4. ANIMAL DISEASE SOCIO-ECONOMICS

The estimation of economic losses due to livestock diseases help in the prioritization of control options and helps in allocating scarce resources efficiently.

A. Assessment and Economic Impact

(i) Economic loss due to sheep and goat pox

The study envisaged to assess the economic loss due to sheep and goat pox in Rajasthan state. Ajmer, Bikaner and Jodhpur districts were surveyed in 2021 by a multi-stage random sampling procedure. A total of 362 flocks were surveyed. The collected data was analyzed using deterministic models. The pooled

results showed that the disease incidence, CFR, recovery and distress sale in Rajasthan state in sheep was 1.0%, 32.6%, 37.5% and 29.9%, respectively. The estimated mortality loss was Rs. 6278 and Rs. 12250 per animal in <1-year and >1-year old animals, respectively. Some of the constraints faced by the farmers in adopting sheep and goat pox vaccination were the non-availability of vaccination at local places; vaccination place is too far and unaware of the need for vaccination against sheep and goat pox.

(ii) Disease Burden Quantification in Small Ruminants

A cross-sectional survey was undertaken in three districts viz., Kalahandi, Mayurbhanj and Balangir of Odisha to quantify the disease burden in small ruminants. Using the deterministic model disease loss per farm was calculated. The survey results revealed that the major diseases observed in sheep and goats in the survey districts were Enterotoxaemia (ET), Sheep and goat pox, PPR and FMD. The estimated loss ranged between Rs. 2600 to Rs.28000/per farm and Rs 1200 to 32000/farm for PPR and ET, respectively. To minimize the farm level disease losses 'mass vaccination drive' against the important diseases in sheep and goats needs to be undertaken. Further, the deworming impact on weight gain was assessed using the *quasi-experimental techniques* in real field situations. The results revealed that the weight of the dewormed animals had increased by 9.2% to 14.7% compared to the control animals.

(iii) Impact of PPR in sheep and goats

The ILRI project intends to quantify the economic impact of three major diseases in livestock in India *viz.*, PPR, HS and Brucellosis using a value chain approach. The survey was undertaken in Andhra Pradesh (Ananthapur and Prakasham districts) and Karnataka (Bellary and Mandya districts) to assess the impact of PPR. The disease incidence, CFR, recovery and distress sale was 3.2%, 83.6%, 15.2% and 1.2%, respectively in Andhra Pradesh and it was 3.5%, 65.2%, 30.4% and 4.4%, respectively in Karnataka. Besides per farm and animal loss assessment, the PPR spread module in sheep and goats using Stella Architect was developed for Karnataka and Andhra Pradesh and the validation is in progress. Further, the herd and market dynamic modules were also developed to assess the comprehensive impact of PPR among various value chain actors.

(iv) Impact of Bluetongue in Sheep

An attempt was made to assess the economic losses arising due to BTV at the farm/flock level and to study the factors influencing the losses. Conducted a primary survey and data were collected from Chitradurga, Bellary, and Koppal districts of Karnataka and Anantapura, Kurnool, and Guntur districts of Andhrapradesh to know the incidence, attacks and deaths and economic loss due to BTV outbreaks.

(v) KAP studies

During the reported period, the social science team conducted a brief survey with identified stakeholders (poultry and piggery farms, pharmacists, meat shops, and markets in and around the project sites in Guwahati, Assam) to collect qualitative and quantitative data on the Knowledge, Attitude and Practices on antibiotics and AMR. The team considered the meat shops are the key drivers in AMR, hence, data on the type of meat processed, source of purchase, hygiene practices, knowledge on antibiotics use in animals and waste disposing methods of the meat shops were documented. The team also interviewed the poultry, piggery and fish markets (near to sites) to document their antibiotics usage in the farms.

B. Outreach and Extension

(i) Assessment of adoption of biosecurity practices

The interview schedule was developed with respect to FMD, Mastitis and HS diseases by including components such as general animal health management measures being adopted in the farm, farm characteristics, knowledge on symptoms and treatment strategies, awareness about disinfectants, risk factors, farmers' innovation proneness and constraints in adoption of biosecurity management practices to prevent diseases occurrences in the farm. During September 2021, a pilot survey was conducted in the Tumkuru and Ramanagara districts of Karnataka, and questionnaires were modified as per the local situation. Along with studying biosecurity management measures, a separate questionnaire on Social Network Analysis (SNA) was developed to study the impact of Blue Tongue Virus (BTV) on trade, knowledge dissemination, and disease communication among the sheep growers of Karnataka and Andhra Pradesh.

(ii) Development Action Plan for Scheduled Castes (DAPSC)

In March 2021 under DAPSC, 15 training programmes including animal health camps were conducted. A total of 853 farmers from Tumkuru, Chitradurga, and Chikabalapura districts of Karnataka belonging to scheduled caste have participated. The subjects covered were improved production technologies for cereals and pulses, mushroom cultivation, nutritional security, soil and water conservation, oil seeds production technologies and horticultural technologies.

On 21st March 2021, ICAR-NIVEDI organized goat and feed distribution programme along with study desk bench, and water filter distribution to the village school, Pemmadevarahalli. The programme was graced by the Director, ICAR-NIVEDI, and other district-level animal husbandry and agricultural department functionaries. During October and November, 2021 for the upliftment of scheduled caste people rural poultry farms were promoted by selecting the most economically backward people of Bilekalpalya of Koratagere taluk and Suthahalli village of Doddabalapur taluk, and Vaddarapalya of Kolar taluk. About 4000 Kalinga Brown 6 weeks old vaccinated chicks were distributed to 425 families.

(iii) Mera Gaon Mera Gaurav (My Village My Pride)

This scheme was launched on July 25, 2015, by the Hon'ble Prime Minister of India. At ICAR-NIVEDI this scheme is being implemented through all scientists in 5 teams adapting 25 villages belonging to Bengaluru rural district. Accordingly, on 18.12.2021 a meeting was organized in the MGMG adapted village Shivkote and created awareness of communicable diseases and safe disposal of bio-degradable and non-bio-degradable wastes. In the awareness camp, ICAR-NIVEDI staff distributed face masks and handwashes for farmers and to the general public. The awareness camp was organized with help of local panchayat members.

The staff of ICAR-NIVEDI visited the Gantiganahalli MGMG village, under a special swachhta campaign on 13th October 2021. The staff of state health departments Dr. Halima (AYUSH Hospital), Dr. Viswanath (Vet. Hospital) participated in the Swachhata activities undertaken in and around hospital areas. The team undertook a cleanliness drive along with livestock farmers in the Veterinary and AYUSH hospitals compound.

(iv) Swachha Bharat Abhiyan (SBA)

A detailed programme of the Swachha Bharat Abhiyan 2021 at ICAR-NIVEDI was planned and executed from January to December 2021. From 2nd to 31st October 2021, under Special *Swachhta* Campaign, week wise action plan was drawn as per the instructions from Council. In this context, various scientists' teams with week-wise activities have been constituted and allotted to different MGMG villages adopted by the ICAR-NIVEDI. All the team members actively participated and devoted their time to campaigns. In four week, nine campaigns were organized and the total number of participants was 630, the number of files weeded out were 45, and disposal of scrap was 100 quintals and as a result, the

space freed was 370 (Sq. Ft.) and revenue generated out of this activity was Rs.40000/-.In addition to this, from 16th to 31st December 2021, a fortnightly *Swachhta Pakhwada* plan was drawn by keeping in view of the mission mode programs of the Government of India which includes Digital India, COVID-19 Appropriate Behaviours, Swasth Bharat, waste water management and rain water harvesting, Atmanirbhar Bharat (waste-to-wealth), doubling farmer's income, and women empowerment. The activities led to the participation of staff, students, and invitees (officers, progressive farmers, common public, etc.) to fulfill the goals of Swachh Bharat Abhiyan. Mask and pamphlet distribution were also taken up during these events. Besides within the campus, selected outside places of Ramagondanahalli and adjoining areas were cleaned by all the members of the team with slogans about the "*Swachh Bharat - Ek Kadam Swachhta Ki Ore*", "*Clean Village-Healthy Village*". Apprised each household about the proper disposal of waste material including their segregation. The overall impact of the above programmes resulted in general hygiene maintenance, beautification and making the campus a safe place to work and house a safe place to live.

(v) Awareness Programme

Under the broad umbrella India@75 celebration, ICAR-NIVEDI observed "World Rabies Day" in collaboration with the National Center for Disease Control (NCDC), Delhi under the National One Health Programme for Prevention and Control of Zoonoses (NCDC-NOHPPCZ).. The activities included a webinar, a week-long anti-rabies Vaccination drive at the Veterinary clinical complex, Yelahanka (for 100 dogs and cats) and an outreach awareness program (for pet owners and students of Nagarjuna Pre University College, Ananthapura, Bengaluru urban district) on 28th September 2021, to create awareness on Rabies transmission, proper wound toilet, the importance of timely and complete post-exposure prophylaxis, the importance of responsible pet ownership and dog vaccinations.

Further, on the occasion of World Zoonoses Day, on 6th July 2021, a webinar was conducted to create awareness on the prevention and control of zoonotic diseases among different stakeholders. As a part of an outreach activity, Awareness Program on Zoonotic Diseases was undertaken to school children at Marasandra village, Doddaballapura taluk, Bengaluru rural district and sensitized 102 farmers on Zoonotic Diseases at Bilekalpalya village, Gubbi taluk, Tumkur district of Karnataka.

Further, the awareness programme on Zoonotic Diseases for farmers was organized on 21st March 2021 at Pemmadevarahalli village, Koratagere Taluk, Tumkur District, Karnataka state.

5. CAPACITY BUILDING

A. Entrepreneurship

Agri-Business Incubator- NIVEDI's Agri-business Incubation Centre for Animal Husbandry and Veterinary Sciences (NaaViC), is a unique institution for Startups on animal health with significant strength and strong network across India. This will pave the way for revenue generation for ICAR and also support current Govt of India programme like Atmanirbhar Bharat, Vocal for Local, wealth creation, employment generation, skill development of potential entrepreneurs, start-up and stand-up India.

The centre is involved in various entrepreneurship promotional activities like webinar series **(Table 8)**, ideation and boot camps, etc. R-ABI Implementation Committee (RIC) meeting for the first cohort, was held to monitor the progress made by startups and recommended for release of 2nd tranche of Grant-in-aid. RIC meeting for second cohort applicants was held with MANAGE Hyderabad and a total of 16 startups pitched their ideas and of which 7 startups (Seed stage: 2, Pre-seed stage: 5) got selected to receive a total outlay of 80 lakhs as Grant-in-aid from the ministry.

A total of 175 applications (NEO-98; NEST-77) were screened in third cohort proposals, and after selection 28 entrepreneurs were trained in agripreneurship program organised from 11th Jan to 2nd Feb 2021. Of 16 applications pitched in the final RIC meeting, a total of 10 startups were recommended for receiving a total of 1.1 crore grant-in-aid. The fourth cohort call was launched on 13.05.2021, and a total of 365 applications were received under NEO (209) and NEST (156) programme.

The first RIC meeting for the 4th cohort was held on 26-27th July 2021, which recommended a total of 26 entrepreneurs for a two-month-long virtual training programme (15th Sept to 15th Nov 2021). The second RIC meeting for the 4th cohort was conducted, which recommended 12 proposals for the RIC meeting. Further, the fifth cohort call for proposal was launched in Sept 2021, and a total of 253 applications were received under NEO (119) and NEST (135) programme. A total of 30 applicants were recommended for training. Additionally, NaaViC also organized virtual six-week DST-sponsored Technology–based Entrepreneurship Development Programme (TEDP) and trained 35 young entrepreneurs. NaaViC promoted Agri India Hackathon-2021 for four months from Nov 2020 to Feb-2021 and over 9000 applications from across India participated. Two startups incubated at NaaViC, namely M/s Jeevabharu Bioinnovation Pvt Ltd and M/s. Froots Technologies Pvt Ltd won the Agri India Hackathon -2021 challenge award. Glimpses of

entrepreneurial promotional activities conducted by Team NaaViC are shown below.

Further, on a path to excellence and sustainability of NaaViC, several noteworthy roadmap suggestions were provided by experts during the first ABI-Advisory Committee meeting. In addition to ongoing activities, ABI launched two new flagship programs. The 'NOVICE' program runs throughout the year and it is specially designed for entrepreneurs, Start-ups, and Ideapreneurs having innovative ideas and who are willing to avail physical/ virtual incubation facilities at NaaViC. The 'NEXUS' program is membership access

to the NaaViC online mentoring platform, which will allow the ideapreneurship and entrepreneurs to interact with our mentors & resource persons.

NaaViC continued its efforts to sow such seeds of innovation in the minds of several young entrepreneurs through a series of national webinars (10) namely, 'EMPOWER' in collaboration with Karnataka Science and Technology Academy (KSTA), Govt of Karnataka and reached more than 12000 budding entrepreneurs nationally. Further, 'ARISE' webinar (5) series was organized in collaboration with the National Institute of MSME, Hyderabad to support & enrich the knowledge of startups towards entrepreneurial ecosystem and opportunities, in which about 2000 startups/entrepreneurs participated. To commemorate the 75th year of Independence, NaaViC promoted 'Azadi Ka Amrit Mahotsav webinar/lecture series', reaching more than 1000 participants.

Additionally, NaaViC actively took part in promoting the National level KRITAGYA Hackathon on 'Precision and Economical Animal Farming' launched by NAHEP & Animal Science division of ICAR throughout states through various communication means, and 4 incubates of NaaViC were selected for the final round in highly competitive selection process. NaaViC also organized more than 40 boot camps to create awareness about entrepreneurial opportunities in Agri and allied sectors by visiting various Incubation Centers and colleges. The team also facilitated the signing of several MoUs (>5) with leading organizations and R&D institutes for entrepreneurship development. NaaVic also promoted entrepreneurship through various platforms of social media reaching more than 30000 plus participants across India.

Table 8: Details of training and webinars organised by NaaViC

Sl. No.	Name of Seminar /Workshop /Training	Venue	Duration (Days)	Date
1	Two months Agripreneurship training program AOP and SAIP (3rd Cohort)	ICAR-NIVEDI (Virtual)	60	25.01.2021-25.03.2021
2	Workshop on 'Veterinary entrepreneurship orientation program'	ICAR-NIVEDI (Virtual)	1	25.03.2021
3	Webinar on 'Phytobiotics and their pharmacology'	ICAR-NIVEDI (Virtual)	1	11.08.2021
4	Webinar on 'Animal coronavirus and their pandemic potential'	ICAR- NIVEDI (Virtual)	1	02.09.2021
5	Agripreneurship training program AOP and SAIP (4th Cohort)	ICAR-NIVEDI (Virtual)	60	15.09.2021-15.11.2021

6	Webinar on 'Application of ICTs in livestock management'	ICAR-NIVEDI (Virtual)	1	15.09.2021
7	Sensitization program on 'Entrepreneurship opportunities in agricultural and allied sciences through the application of information technology'	ICAR-NIVEDI (Virtual)	1	24.09.2021
8	Webinar on 'How RKVY-AFTAR can be your fortune turner'	NaaVic, ICAR-NIVEDI (Virtual)	1	08.10.2021
9	Lecture on emotional intelligence stress management & soft skill development for entrepreneurs	ICAR- NIVEDI	1	02.11.2021
10	Webinar on 'Bankable project report'	ICAR- NIVEDI (Virtual)	1	03.12.2021
11	Webinar on 'Government schemes and institutional support for agri-entrepreneur'	ICAR-NIVEDI (Virtual)	1	10.12.2021

B. Human Resource Development

Institute has established collaborative linkages with various international and national organizations/ Institutions including NGOs for research and development activities, training, outreach activities etc. The institute has conducted need-based training programmes for scientists/ academicians/ field Veterinarians etc., working at various levels and trained on modern laboratory techniques, epidemiological investigations, NADRES software, EpiInfo software, epidemiological analysis, forecasting of livestock diseases, GIS data analysis, diagnostics, research methodologies, the economic impact of diseases, sensitization programme on disease control, etc., These trainings were imparted to veterinary officers in the departments of animal husbandry, field veterinarians, Assistant professors from SAU's, students from various disciplines of life sciences on the above-said areas **(Table 9 and Table 10)**.

Table 9: Training/Webinar/Workshop/Meeting/Outreach/awareness programme Organized

Sl. No.	Name of Webinar/Workshop /Trainings	Venue	Duration (Days)	Date
1	Orientation programme on tick survey and sample collection for field veterinarians of Tamil Nadu state	ICAR-NIVEDI, Bengaluru	1	06.01.2021
2	Sensitization e-workshop on important zoonotic diseases in Karnataka state under NCDC Inter sectoral coordination for prevention and control of zoonotic diseases	ICAR-NIVEDI (Virtual)	1	10.02.2021
3	Skill development in scientific animal husbandry practices and input distribution under SCSP	ICAR-KVK, Konehalli, Tipatur	1	09.03.2021
4	Role of kitchen garden in achieving nutritional security	Department of Agriculture Training Centre (DATC), Tumkur	1	16.03.2021
5	Meeting of state level zoonosis committee in Kerala under NCDC Inter-sectoral coordination for prevention and control of zoonotic diseases	ICAR-NIVEDI (Virtual)	1	17.03.2021
6	Organic farming for doubling farmers income	Department of Agriculture Training Centre (DATC), Tumkur	1	17.03.2021
7	Bee farming (Apiculture) for increasing farmers income	Department of Agriculture Training Centre (DATC), Tumkur	1	18.03.2021
8	Training on livestock production technologies, agriculture and allied activities	ICAR-KVK, Hirehalli, Tumkur	1	18.03.2021

Sl. No.	Name of Webinar/Workshop /Trainings	Venue	Duration (Days)	Date
9	Integrated farming system (IFS) for sustainable income	Department of Agriculture Training Center (DATC), Tumkur	1	20.03.2021
10	Awareness programme on zoonotic diseases under OPZD	Pemmadevarahalli, Tumukuru	1	21.03.2021
11	Modern scientific animal husbandry practices	Sheep Breeding Training Centre, Khudapura Farm, Chitradurga	1	23.03.2021
12	Training on livestock production technologies, agriculture and allied activities	ICAR-KVK, Hirehalli, Tumkur	1	24.03.2021
13	Training on livestock production technologies, agriculture and allied activities	ICAR-KVK, Hirehalli, Tumkur	1	25.03.2021
14	Creating awareness on Agriculture, Horticulture and Animal Husbandry development programmes to farming community	Department of Agriculture Training Centre (DATC), Tumkur	1	25.03.2021
15	Animal health camp and modern animal husbandry practices	Dyavaranahalli, Challakere, Chitradurga	1	25.03.2021
16	Animal health camp and input distribution	Pulaganahalli and Alipur colony, Chikkaballapur	1	26.03.2021
17	Animal health camp and programme on modern animal husbandry practices	Rajeevanagara, Channammanagatihalli, Chitradurga district	1	26.03.2021
18	Zero budget natural farming: minimum cost and maximum profit	Department of Agriculture Training Centre (DATC) Tumkur	1	26.03.2021
19	Awareness programme on clean hygienic health practices and zoonotic diseases to school children	Govt. School, Nayakanahatti, Chitradurga	1	27.03.2021
20	Krigging in Python	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	30.04.2021
21	Codon usage bias analysis	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	01.05.2021
22	Measuring Compositional HM of GC content from coding regions by KLD approach	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	03.05.2021
23	Estimating of indices from Landsat 8 real image datasets	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	06.05.2021
24	Basics of QGIS	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	10.05.2021
25	Introduction to python & markov chain model	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	11.05.2021
26	Molecular clock and demographic tree models	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	13.05.2021
27	All India COVID confirmed cases R0 calculation	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	14.05.2021
28	Epitope prediction	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	19.05.2021
29	Estimation of LST using Landsat8 real Image datasets	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	21.05.2021
30	Time series analysis using ARIMA	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	22.05.2021
31	KDL approach to establish core-length of the codon	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	25.05.2021

Sl. No.	Name of Webinar/Workshop /Trainings	Venue	Duration (Days)	Date
32	Estimation of indices from Landsat8 real image datasets-2	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	27.05.2021
33	Meta-analysis	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	31.05.2021
34	Deep learning	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	01.06.2021
35	Process of generating risk map	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	03.06.2021
36	Calculating R0 values for COVID 19 Cases	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	12.06.2021
37	Awareness program on zoonotic diseases on the occasion of World Zoonoses Day 2021	Chikkadoddavadi, Tumkur	1	07.07.2021
38	Struggle and achievements of women's right to equality and their right to property	ICAR-NIVEDI (Virtual)	1	14.08.2021
39	Webinar on position of women in post independent era with particular reference to right to property	ICAR-NIVEDI (Virtual)	1	18.08.2021
40	Food and nutrition for farmers	ICAR-NIVEDI (Virtual)	1	26.08.2021
41	Mental health challenges faced by farming communities	ICAR-NIVEDI (Virtual)	1	28.08.2021
42	Krigging	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	30.08.2021
43	Basic microbiological culture techniques and molecular procedures	ICAR-NIVEDI	30	01.09.2021-30.09.2021
44	Introduction to LINUX-CLI (Command Line Interface)	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	01.09.2021
45	LINUX advance commands	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	02.09.2021
46	Training on brucellosis control program implementation modalities under NADCP	Chickkaballapur District, Karnataka	1	02.09.2021
47	Introduction to python	Spatial Epidemiology Laboratory, ICAR-NIVEDI	1	06.09.2021
48	Lecture on the application of ICT's in livestock management	ICAR-NIVEDI (Virtual)	1	15.09.2021
49	Veterinary diagnostics-fitness of purpose and validation strategies	ICAR-NIVEDI (Virtual)	1	21.09.2021
50	Training on brucellosis control program implementation modalities under NADCP	KVK, Hadonahally, Doddaballapur	1	24.09.2021
51	Webinar on Rabies in animals: diagnosis , surveillance and control - a priority	ICAR-NIVEDI (Virtual)	1	28.09.2021
52	Awareness lecture on rabies for college students	Nagarjuna PU college, Bengaluru	1	28.09.2021
53	Webinar on 'FMD control in India: pros and cons'	ICAR-NIVEDI (Virtual)	1	18.10.2021
54	Vigilance Awareness Week-2021	ICAR- NIVEDI	7	26.10.2021-01.11.2021
55	Sensitization lecture on 'Importance of cleanliness and major zoonotic diseases'	Government Lower Primary School, Marasandra, Bengaluru Rural	1	29.10.2021
56	Lecture on 'Biosecurity practices to prevent infectious disease in pig farm'	Veterinary College, Hasan	1	10.11.2021

Sl. No.	Name of Webinar/Workshop /Trainings	Venue	Duration (Days)	Date
57	World antimicrobial awareness week 2021	ICAR-NIVEDI	7	18.11.2021-24.11.2021
58	Legal awareness program on sexual harassment of women at work place POSH Act, 2013	ICAR-NIVEDI	1	23.11.2021
59	28th Annual Scientist's meet of AICRP on Animal Disease Monitoring and surveillance	ICAR-NIVEDI (Virtual)	1	24.11.2021
60	Creation of micro Enterprise	ICAR-NIVEDI	1	27.11.2021
61	Agricultural technologies for conversion of waste to wealth	ICAR-NIVEDI (Virtual)	1	22.12.2021
62	Interactive meeting on economics of brucellosis	Department of Animal Husbandry and Veterinary Services, Tumkur	1	22.12.2021
	Training programme on doubling of farmers income through poultry rearing and chick distribution programme under DAPSC	Vaddarapalya, Kolar	1	28.12.2021

Table 10: Training / Summer/ Winter Schools / Seminars/ Conferences/ Symposia/ Workshops/ KrishiMela/ Fairs/ Programmes participated

Sl. No.	Name of Seminar / Workshop /Training	Organised by	Date	Attended by
1	Online review meeting of officers of ICAR and DARE by Secretary, DARE & DG, ICAR	ICAR, New Delhi	01.01.2021	All scientist
2	Time series data analysis	ICAR-NAARM, Hyderabad	04.01.2021-09.01.2021	Dr. G. Govindaraj
3	Generic online training on cyber security	ICAR, New Delhi (Virtual)	05.01.2021	Dr. P. Krishnamoorthy
4	Standardization of different techniques for checking the antibiotic residues in milk samples –Quality analysis	KMF, Bengaluru	05.01.2021-06.01.2021	Dr. B. R. Shome
5	Enhancing work and health efficiency for employees	ICAR-NIVEDI, Bengaluru	08.01.2021	Dr. P. Krishnamoorthy
6	One health workshop on 'Tripartite regional workshop on diagnosis, surveillance and control of rabies'	Veterinary College, KVAF SU, Hebbal, Bengaluru and NCDC Delhi (Virtual)	12.01.2021	Dr. V. Balamurugan
7	Technical seminar & entrepreneurship orientation for veterinary doctors	ICAR-KVK, Shivamogga, Karnataka	12.01.2021-13.01.2021	Dr. S. B. Shivachandra Dr. R. Yogisharadhya
8	Morphological identification of ticks at genus and species level	Madras Veterinary College, Chennai	18.01.2021-22.01.2021	Dr. P. Krishnamoorthy
9	Generic online training in cyber security	Ministry of electronics and Information Technology (MeitY), Government of India	21.01.2021	Dr. M. Nagalingam
10	COVID-19 pandemic: Concerns and perspectives	Indian Virological Society (Virtual)	23.01.2021	Dr. D. Hemadri
11	Scientist interaction meeting with DDG (Animal Sciences)	ICAR-NIVEDI, Bengaluru	25.01.2021	All the scientists

Sl. No.	Name of Seminar / Workshop /Training	Organised by	Date	Attended by
12	International symposium & workshop on 'One Health in India : Research informing biosafety, preparedness & response'	ICMR, New Delhi	12.02.2021	Dr. R. Sridevi Dr. V. Balamurugan
13	Workshop on 'Prevention & control of acute encephalitis syndrome / Japanese encephalitis'	Department of Health Services, Govt. of Karnataka, Arogya Soudha, Bengaluru	17.02.2021	Dr. Jagadish Hiremath Dr. Chethan Kumar H.B
14	Webinar on 'Agriculture research through knowledge discovery'	EBSCO, New Delhi (Virtual)	23.02.2021	Dr. P. Krishnamoorthy
15	Alternative therapies to mitigate microbial resistance	ICAR-IVRI and NABARD	23.02.2021-24.02.2021	Dr. V. Balamurugan Dr. R. Sridevi
16	One health meeting on strategy for elimination of human anthrax from an endemic district of Odisha	RMRC, Bhubaneswar	23.02.2021	Dr. D. Hemadri
17	WHONET training	INFAAR network	23.02.2021	Dr. B. R. Shome
18	Early warning system for disease management in small ruminants	J&K	23.03.2021	Dr. K.P. Suresh
19	Peste des petits ruminants (PPR) - Sharing the India experience in control and major achievements	OIE and DAHD, GOI	09.04.2021	Dr. V. Balamurugan
20	International webinar on 'Diagnostic parasitology of animal parasitic diseases'	Madras Veterinary College, TANUVAS, Chennai	23.04.2021	Dr. Siju S. Jacob
21	PPR global research and expertise network (PPR-GREN) thermotolerant vaccine meeting	OIE, France (Virtual)	23.04.2021	Dr. V. Balamurugan
22	International webinar on 'One health approach during pandemics'	Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry	24.04.2021	Dr. R. Sridevi
23	Meat frauds and authenticity: Recent analytical approaches	FSSAI and Thermo Fischer Scientific (Virtual)	26.04.2021	Dr. Chethan Kumar H.B
24	Basics of IPR management	ICAR-NIVEDI, Bengaluru	30.04.2021	Dr. V. Balamurugan
25	European leptospirosis meeting	European leptospirosis society	06.05.2021	Dr. V. Balamurugan
26	International e-Symposium on "One health concept: opportunities and perspectives in present scenario"	Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab	28.05.2021-29.05.2021	Dr. Chethan Kumar H.B

Sl. No.	Name of Seminar / Workshop /Training	Organised by	Date	Attended by
27	One health initiative on prevention and control of emerging and re-emerging zoonotic diseases	Millenium India Education Foundation New Delhi, Vardhman Mahavir Medical College & Safdarjung Hospital, New Delhi, Seth G S Medical college & KEM hospital Mumbai and Heart care foundation of India (Virtual)	06.07.2021	Dr. M. Nagalingam
28	Preventing future zoonotic pandemics –interventions at the wildlife-livestock-human interface	ICAR- NRC on Equines, Hissar (Virtual)	06.07.2021	Dr. D. Hemadri Dr. R. Sridevi
29	KRISHI portal updates and new features	ICAR-IASRI, New Delhi (Virtual)	17.07.2021	Dr. P. Krishnamoorthy
30	International Symposium on 'Harnessing the potentials of genome editing tools to augment the productivity and health of farm animals'	ICAR-NDRI, Karnal	19.07.2021-20.07.2021	Dr. R. Sridevi Dr. Siju S. Jacob
31	Agricultural knowledge management in the networked digital environment	Professor Jayashankar Telengana SAU, Hyderabad (Virtual)	28.07.2021	Dr. Siju S. Jacob
32	OIE webinar on progress and challenges in brucellosis control in the Asia pacific region	OIE Asia Pacific (Virtual)	29.07.2021	Dr. D. Hemadri
33	Disease forecasting: an advanced holistic approach for disease control and prevention	College of Veterinary Science & Animal Husbandry, Rewa, Jabalpur, MP	11.08.2021	Dr. K.P. Suresh Dr. Siju Susan Jacob
34	Climate resilient animal husbandry	ICAR-CRIDA and MANAGE, Hyderabad (Virtual)	18.08.2021-21.08.2021	Dr. P. Krishnamoorthy
35	FAO-EQAS laboratory assessment program (3 Cycles)	ICAR – NIVEDI, Bengaluru	28.08.2021 22.11.2021 27.12.2021	Dr. B. R. Shome
36	Mastering the craft of academic writing: a systematic approach	Research Marketing APAC, WILEY (Virtual)	31.08.2021	Dr. R. Sridevi
37	Wiley webinar on 'Winning the game of publishing research papers, raising your profile and extending the impact of publications'	Research Marketing APAC,WILEY	07.09.2021	Dr. R. Sridevi
38	Webinar on 'One health paradigm: challenges and opportunities for preparedness against emerging and exotic diseases in India'	ICAR-NIHSAD, Bhopal (Virtual)	08.09.2021	Dr. P. Krishnamoorthy
39	Meeting of national stakeholder consultation on draft national human wildlife conflict: strategy and action plan & guidelines	Hotel Taj, Bengaluru	18.09.2021	Dr. Md Mudassar Chanda Dr. Chethan Kumar H.B

Sl. No.	Name of Seminar / Workshop /Training	Organised by	Date	Attended by
40	Applications of bioinformatics in agricultural research and education	ICAR-NAARM, Hyderabad (Virtual)	20.09.2021-24.09.2021	Dr. P. Krishnamoorthy Dr. Siju S. Jacob
41	Veterinary diagnostics - fitness of purpose and validation strategies	ADMaC core Lab, Guwahati (Virtual)	21.09.2021	Dr. Rajeswari Shome Dr. D. Hemadri Dr. M. Nagalingum
42	Artificial intelligence for livestock dis ease forewarning and NADRES	KVASU campus, Kerala	21.09.2021	Dr. K.P. Suresh
43	Modern epidemiological tools in disease investigation and their application	Central Agricultural University, Aizawl, Mizoram	23.09.2021	Dr. K.P. Suresh
44	Strategic meeting on protecting human health through one health approach (one health initiative)	ICAR-ILRI (Virtual)	24.09.2021	Dr. Rajeswari Shome
45	International e-conference on 'An integrated approach to prevent rabies in animals and humans: the best possible one health strategy'	Madras Veterinary College, Chennai (Virtual)	28.09.2021-29.09.2021	Dr. P. Krishnamoorthy
46	Online training programme on data analysis in social sciences research	ICAR-NAARM, Hyderabad	04.10.2021-08.10.2021	Dr. R. Sridevi
47	Training programme on 'Statistical techniques for data analysis in agriculture'	ICAR-IASRI, New Delhi (Virtual)	04.10.2021-13.10.2021	Dr. Siju Susan Jacob
48	4th Zonal conference of IAVP central zone	College of Veterinary Sciences & AH, Rewa, Madhya Pradesh (Virtual)	05.10.2021-06.10.2021	Dr. P. Krishnamoorthy
49	International conference on infections and immunity	Department of Zoology, Daulat Ram College, University of Delhi (Virtual)	08.10.2021-10.10.2021	Dr. K.P. Suresh
50	Training on 'Implementation and use of agricultural research management system (ARMS)'	IASRI , New Delhi (Virtual)	11.10.2021	Dr. V. Balamurugan Dr. P. Krishnamoorthy
51	Launching of One Health program of DBT (International mini-symposium on Foundation of One Health)	NIAB, Hyderabad (Virtual)	13.10.2021	Dr. D. Hemadri
52	National webinar on important animal diseases and their control	ICAR-RCER, Patna (Virtual)	23.10.2021	Dr. P. Krishnamoorthy
53	A webinar on 'Use of laboratory animals in biomedical research: role of CPCSEA'	ICAR-NDRI, Karnal (Virtual)	29.10.2021	Dr. R. Sridevi
54	Scientists interaction meeting with ILRI Regional representative, South Asia	ICAR-NIVEDI, Bengaluru	30.10.2021	All the Scientists
55	Antimicrobial resistance: A hidden pandemic which needs preparedness in India	Virtual	03.11.2021	Dr. V. Balamurugan
56	OIE PPR reference laboratories network – first workshop	FAO/OIE, Rome, Italy (Virtual)	08.11.2021-09.11.2021	Dr. V. Balamurugan
57	Novel paradigms in biotechnology- bio engineering interface from concepts to reality (NPBBI-2021)	SIST with IAAM and CUSM (Virtual)	10.11.2021-12.11.2021	Dr. M. Nagalingam

Sl. No.	Name of Seminar / Workshop /Training	Organised by	Date	Attended by
58	National stakeholder workshop on 'National action plan on antimicrobial resistance (Livestock sector)'	FAO and DAHD, New Delhi	23.11.2021	Dr. N. Shivasharanappa
59	Webinar on 'Ethics of publication'	Elsevier India, New Delhi (Virtual)	23.11.2021	Dr. P. Krishnamoorthy
60	Training programme on 'Proteomics data analysis'	ICAR-IASRI (Virtual)	24.11.2021-26.11.2021	Dr. R. Sridevi
61	Fourth PPR vaccine producers workshop	FAO/OIE, Rome, Italy (Virtual)	24.11.2021-26.11.2021	Dr. V. Balamurugan
62	UAS, Bengaluru science week program	UAS-B, GKVK, Bengaluru (Virtual)	28.11.2021	Dr. S. B. Shivachandra
63	Fourth PPR GREN meeting	FAO/OIE, Rome, Italy (Virtual)	06.12.2021-08.12.2021	Dr. V. Balamurugan
64	Implementation and use of ARMS	IASRI, New Delhi (Virtual)	09.12.2021	Dr. P. Krishnamoorthy Dr. R.Sridevi
65	Annual Review meet of NCVTC	ICAR-NCVTC (Virtual)	10.12.2021	Dr. D. Hemadri
66	Management of technology and innovation	Institute of Public Enterprise, Osmania University Campus, Hyderabad	13.12.2021-17.12.2021	Dr. M. Nagalingam
67	MDP on leadership development	ICAR-NAARM, Hyderabad (Virtual)	13.12.2021-24.12.2021	Dr. D.Hemadri Dr. K.P.Suresh Dr. S.S. Patil Dr. V. Balamurugan
68	30th National Congress of veterinary parasitology	College of Veterinary and Animal Sciences, Parbhani	14.12.2021 16.12.2021	Dr. P. Krishnamoorthy
69	International proficiency testing for antimicrobial susceptibility testing (PTAST- 2021)	Chulalongkom University, Bangkok (Virtual)	15.12.2021	Dr. B. R. Shome
70	Training programme on 'SNP mining, GWAS'	ICAR-IASRI, New Delhi (Virtual)	16.12.2021-21.12.2021	Dr. R. Sridevi
71	International pathology conference on 'Advances in veterinary pathology for diagnosis and control of emerging and re-emerging diseases of livestock, wild animals and poultry'	Indian Association of Veterinary Pathologists (IAVP) and RAJUVAS, Bikaner (Virtual)	17.12.2021-19.12.2021	Dr. P. Krishnamoorthy Dr. G. B. M. Reddy Dr. Shivasharanappa N
72	International webinar and memorial orations of Indian society of veterinary pharmacology and toxicology (ISVPT) 2021	Veterinary college and Research Institute, Namakkal	21.12.2021	Dr. M. Nagalingam

C. Post Graduate Teaching and Research

The Institute has established memorandum of understanding (MoU) with various Universities/ Organizations of mutual interest in the area of R & D activities, including post-graduate research, exchange of faculties for training, research, and study as per the guidelines of ICAR. Institute provided exposure, and training and facilitated the project/dissertation work of post-graduate students in the field of animal health

The following institutes/ Universities were in MoU with ICAR-NIVEDI during 2021:

1.   National Institute of Animal Biotechnology

(NIAB), Hyderabad, Telangana

2. The University of Trans-Disciplinary Health Sciences and Technology (TDU), Bengaluru, Karnataka

3. Jain University, Bengaluru, Karnataka

4. Chhattisgarh Kamdhenu Vishwavidyalaya (CGKV), Durg, Chhattisgarh

5. REVA University, Bengaluru, Karnataka

6. Maharani Lakshmi Ammani College for Women, Bengaluru, Karnataka

7. Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST)-Kashmir

8. College of Veterinary Sciences & Animal Husbandry, OUAT, Bhubaneswar, Odisha

9. Department of Biosciences and Bioengineering, IIT, Guwahati, Assam

10. Directorate of Medical & Health Services, Silvassa, Dadra & Nagar Haveli

Three students (Mr. Sanketh Kumar; Mr. Harish and Ms.Gagana. P) from REVA University for M.Sc. project work/dissertation (M.Sc. Biotechnology) for a duration of 3 months joined ICAR- NIVEDI from January 2021 to March 2021 and they were allotted and worked under the supervision of NIVEDI scientists Dr. Chethan Kumar, Dr. Jagdish Hiremath, and Dr. G.B.Manjunatha Reddy, respectively.

6. National Animal Disease Epidemiology Network (NADEN)

The progress report of these internal network activities includes the NADRES and National Livestock Serum repository-related activities, which are described in detail in the respective sessions.

The 29th Annual Review Meet of AICRP on Animal Disease Monitoring and Surveillance (ADMAS) was organized as a virtual meet by ICAR-NIVEDI on 24th November 2021. The meeting was inaugurated by Dr. B. N. Tripathi, Deputy Director General (AS), ICAR, Krishi Bhavan, New Delhi. The other luminaries who attended the meeting were Dr. Praveen Malik, Animal Husbandry Commissioner, DAHD, GOI, Shri. Upamanyu Basu, Joint Secretary (LH), DAHD, GOI, Dr. Ashok Kumar, ADG (AH), ICAR, Krishi Bhavan, New Delhi, Dr. B. R. Shome, Director (Acting), ICAR-NIVEDI and Dr. Jyothi Misri, Principal Scientist,

ICAR, Krishi Bhavan, New Delhi. Dr. M. Rajasekhar, Founder Director, ICAR-NIVEDI was an expert at the above meeting. In addition, the scientists of ICAR-NIVEDI and principal investigators of 31 centres of AICRP on ADMAS attended the virtual meet. The progress made by each unit for 2019-20 was reviewed in the meeting. Dr. Divakar Hemadri, Nodal Officer, AICRP on ADMAS presented Action Taken Report for the year 2019-20 and the progress of the central coordinating unit and also the comprehensive progress report of all the AICRP centres. All the thirty-one centres were represented in the meeting and each one presented its centre's progress report. The work performed by the centre was appreciated by the house and the experts provided general recommendations along with centre-wise recommendations where ever required.

29th Annual Review Meet of AICRP on ADMAS on 24.11.2021

7. Research Projects

Sl. No.	Project Title	Institute Project Code	ICAR Project ID	Principal Investigator	Co-Principal Investigators
	I. ANIMAL DISEASE INFORMATICS				
1	National Animal Disease Referral Expert System- NAD-RES (Service Project)	ANSCNIVEDISIL 201100100020	IXX08329	Dr. K. P. Suresh	Dr. D Hemadri Dr. S.S. Patil Dr. P. Krishnamoorthy Dr. Siju. S. Jacob
2	Development of an expert system for cattle diseases diagnosis: A participatory approach	ANSCNIVEDISIL 201700500083	IXX13141	Dr. P. Krishnamoorthy	Dr. K.P. Suresh Dr. G. Govindaraj
3	National Surveillance Program for Aquatic Animal Diseases	ANSCNIVEDICOP 201300900052	OXX02581 (NSPAAD)	Dr. K. P. Suresh	Dr. P. Krishnamoorthy (w.e.f. 03.8.2020)
4	National Initiative on Climate Resilient Agriculture (NICRA)	ANSCNIVEDICOP 201500100064	OXX03915 ICAR-network	Dr K. P. Suresh	Dr. P. Krishnamoorthy Dr. Siju. S. Jacob
5	Upgradation and Implementation of knowledge-based system (KBS) in NER of India an extended activity of advanced animal disease diagnosis and management consortium (AD-MaC) under ADMaC: Phase II Validation and translation of the vaccines as well as diagnostic technologies developed in Phase I of ADMac	ANSCNIVEDICOP 202100700121	OXX5043 (DBT-ADMac Phase II)	Dr. K. P. Suresh	Dr. S.S. Patil Dr. D. Hemadri Dr. G. Narayanan
6	Sampling plan generation for carrying out sero-surveillance and sero-monitoring and data analytics for FMD and Brucellosis.	ANSCNIVEDISOL 202100400118	OXX5044 (DAHD- NA-DCP)	Dr K. P. Suresh	Dr. S S Patil Dr. D. Hemadri
7	Establishment of a consortium for one Health to address Zoonotic and Transboundary diseases in India, Including the Northeast Region. (Development of Artificial Intelligence enabled early warning system for zoonotic and Transboundary Diseases in India including NER)	ANSCNIVEDICOP 202100800122	OXX5046 (DBT)	Dr. K. P. Suresh	Dr. S.S. Patil Dr. D. Hemadri Dr. V. Balamurugan
8	Molecular platform for epidemiology, disease mapping and development of diagnostics for economically important diseases of duck	ANSCNIVEDICOP 201800400094	OXX04444 (DBT-Twinning)	Dr. S. S. Patil	Dr.K. P. Suresh Dr.P.P. Sengupta

Sl. No.	Project Title	Institute Project Code	ICAR Project ID	Principal Investigator	Co-Principal Investigators
			II. ANIMAL DISEASE EPIDEMIOLOGY		
9	Epidemiology of Haemorrhagic Septicaemia (HS) in India	ANSCNIVEDISIL 201500300066	IXX12176	Dr. S.B. Shivachandra	Dr. M. M. Chanda Dr. Jagadish Hiremath Dr. P. Krishnamoorthy Dr. R. Yogisharadhya Dr. A. Prajapathi (w.e.f. 7th August, 2020)
10	Understanding the carrier status of small Ruminants (Sheep and Goats) in endemic areas with respect to *Pasteurella multocida*	ANSCNIVEDISIL 201800600096	IXX14748	Dr. R. Sridevi	Dr. M. Nagalingam Dr. P. Krishnamoorthy Dr. G. B. Manjunatha Reddy Dr. R.Yogisharadhya Dr. A. Prajapathi (w.e.f. November, 2021)
11	Sero-epidemiology of Brucellosis (Service Project)	ANSCNIVEDISIL 201300200045	IXX10708	Dr. Rajeswari Shome	Dr. B.R. Shome Dr. M. Nagalingam
12	Surveillance of ovine brucellosis with reference to *Brucella ovis*	ANSCNIVEDICIP 201800500095	IXX14750	Dr. M. Nagalingam	Dr. R. Shome Dr. V. Balamurugan Dr. G. B. Manjunatha Reddy Dr. R. Sridevi
13	Sero-monitoring of Brucellosis control programme under National Animal Disease Control Programme for control of FMD and Brucellosis (NADCP)- ELISA kit supply and capacity building.	ANSCNIVEDISOL 202100300117	OXX05184 (DAHD, GoI)	Dr. Rajeswari Shome	Dr. M. Nagalingam
14	Validation and field testing of DIVA test developed in ADMaC phase – I project for surveillance of brucellosis in North Eastern region of India under ADMaC : Phase II Validation and translation of the vaccines as well as diagnostic technologies developed in Phase I of ADMac.	ANSCNIVEDICOP 202100600120	OXX5043 (DBT-ADMac Phase II)	Dr. Rajeswari Shome	Dr. M. Nagalingam
15	Development of recombinant multi-antigenic and fusion proteins based immune diagnostics for the surveillance of Leptospirosis	ANSCNIVEDISIL 202000200105	IXX15283	Dr. V. Balamurugan	Dr. M. Nagalingam
16	Seroepidemiology of Infectious Bovine Rhinotracheitis (IBR) in India (Service Project)	ANSCNIVEDISIL 201200800032	IXX10709	Dr. S.S. Patil	Dr. D Hemadri

Sl. No.	Project Title	Institute Project Code	ICAR Project ID	Principal Investigator	Co-Principal Investigators
17	Understanding nucleotide sequence variation and dynamics of serotype distribution in the epidemiology of bluetongue in Karnataka	ANSCNIVEDISIL 202000600109	IXX15749	Dr. D. Hemadri	Dr. M M Chanda Dr. G. B. Manjunatha Reddy Dr Jagadish Hiremath
18	Evaluation of in-house population assay for surveillance of peste des petits ruminants (PPR)	ANSCNIVEDISIL 202000300106	IXX15339	Dr. V. Balamurugan	----
19	Monitoring and Surveillance of Sheep pox and Goat pox Diseases	ANSCNIVEDISIL 201700200080	IXX13244	Dr. Manjunatha Reddy GB	Dr. V. Balamurugan Dr.Satish B Shivachandra Dr. M. Nagalingam Dr. R. Yogishradhya
20	Immuno-epidemiological characterization of respiratory viral persistence in pigs	ANSCNIVEDISIL 201900100100	IXX15306	Dr. Jagadish Hiremath	Dr. M. M. Chanda Dr. G. B. Manjunatha Reddy Dr. S. S. Patil Dr. D. Hemadri
21	Standardization of serological and molecular tests and surveillance of Japanese encephalitis virus infection in pigs in Southern part of Karnataka state	ANSCNIVEDISIL 202000900112	IXX15748	Dr. Chethan kumar H.B	Dr Jagadish Hiremath Dr. G. B. Manjunatha Reddy
22	Immuno- epidemiological characterization of pigs as an amplifying host of Japanese Encephalitis	ANSCNIVEDISOL 201800700097	OXX04490 (DST_SERB)	Dr. Jagadish Hiremath	Dr. G. B. Manjunatha Reddy Dr. M M Chanda Dr. S S Patil Dr. S. B. Shivachandra
23	Study on sero-surveillance of surra in bovines	ANSCNIVEDISIL 202100100115	IXX15747	Dr. P.P. Sengupta	Dr. S.S. Jacob
24	Epidemiological surveillance of transmission foci of fasciolosis	ANSCNIVEDISIL 201700400082	IXX13196	Dr. Siju Susan Jacob	Dr. P. P. Sengupta Dr. Yogishradhya Dr. A. Prajapathi
25	Precision diagnostic approach for fasciolosis in cattle and buffaloe	ANSCNIVEDISOP 201700900087	OXX04084 (ICAR- (CRP-V&D)	Dr. P P Sengupta	Dr. Siju. S. Jacob Dr. R. Yogishradhy
26	Development of Diagnostic Test for detection of classical swine fever virus.	ANSCNIVEDISOP 201701000088	OXX04086 (ICAR- (CRP-V&D)	Dr. S S Patil	Dr. K. P. Suresh Dr. Jagdish Hiremath
27	Development and validation of novel multiplex serodiagnostic for diagnosis of porcine respiratory disease complex.	ANSCNIVEDISOP 201701100089	OXX04085 (ICAR- (CRP-V&D)	Dr. Jagadish H	Dr. D. Hemadri Dr. S. S. Patil
28	ICAR-NIVEDI Network Center of National Center for Veterinary Type Cultures- under Veterinary Microbe Component	ANSCNIVEDICOP 202101100125	OXX5047 (ICAR)	Dr. D. Hemadri	Dr. Manjunatha Reddy G.B. Dr. M. Nagalingam

Sl. No.	Project Title	Institute Project Code	ICAR Project ID	Principal Investigator	Co-Principal Investigators
29	Maintenance and updating of Livestock serum repository-NLSR (Service Project)	ANSCNIVEDISIL 201100300022	IXX08279	Dr. D. Hemadri	Dr. K. P. Suresh Dr. S.S. Patil
30	Epidemiology of Lumpy Skin Disease in cattle and Buffaloes	ANSCNIVEDISIL 202100900123	IXX16530	Dr. Manjunatha Reddy GB	Dr. N. Shivasharanappa Dr. D. Hemadri Dr. H.B. Chethan Kumar Dr. R. Yogisharadaya
31	Patho-Epidemiology of Respiratory Diseases in Small Ruminants in India	ANSCNIVEDISIL 202101000124	IXX16570	Dr. N. Shivasharanappa	Dr. Manjunatha Reddy G.B. Dr. S.S. Patil Dr. R. Sridevi
	III. ONE HEALTH				
32	Quantifying ecological drivers for emerging zoonotic diseases in India	ANSCNIVEDISIL 202100200116	IXX16924	Dr. M. M. Chanda	Dr. S.B. Shivachandra Dr. Yogisharadaya R. Dr. Awadesh Prajapathi
33	Indian network for fisheries and animal antimicrobial resistance (INFAAR) (Surveillance of AMR in animal species – under INFAAR Network initiated by ICAR)	ANSCNIVEDICIP 201800900099	IXX14760	Dr. B. R. Shome	Dr. R. Shome Dr. P. Krishnamoorthy Dr. N. Shivasharanappa (w.e.f. 30-12-2021)
34	Outreach Programme on Zoonotic diseases (OPZD)	ANSCNIVEDISOP 200900500017	OXX0223 ICAR-Network	Dr V Balamurugan	Dr. P.P. Sengupta Dr. R. Sridevi Dr. G. Govindaraj
35	Does antimicrobial resistance (AMR) in livestock contribute to AMR in people in NE India? An interdisciplinary study investigating antibiotic use, drivers of AMR, and transmission dynamics	ANSCNIVEDICOP 201800800098	OXX04457 (Indo-UK)	Dr. B. R. Shome	Dr G Govindaraj Dr. P Krishnamoorthy Dr.M Nagalingam, Dr.V Balamurugan Dr.R Shome, Dr.R Sridevi Dr. R Yogisharadhya
36	National One health program for prevention and control of zoonotic diseases (NOHPPCZ) Intersectoral Coordination for prevention and control of zoonotic diseases	ANSCNIVEDICOL 201900400103	OXX004785 (NCDC-GoI)	Dr. B.R Shome (Regional Coordinator) Dr V Balamurugan (Nodal Officer/Project coordinator)	Dr. Chethan Kumar HB, Dr. Nagalingam M Dr. Siju Susan Jacob Dr. Jagadish Hiremath Dr.M.M Chanda Dr.K.P. Suresh Dr.D. Hemadri Dr. G.B. Manjunatha Reddy
37	Epidemiology and antiviral therapeutic development- Optimal Sampling strategies for detecting animal COVs and risk analysis and surveillance for porcine respiratory and enteric coronaviruses	ANSCNIVEDISOL 202100500119	OXX5045 (NASF)	Dr. K. P. Suresh	Dr Jagadish Hiremath

Sl. No.	Project Title	Institute Project Code	ICAR Project ID	Principal Investigator	Co-Principal Investigators
6 IV. ANIMAL DISEASE SOCIO-ECONOMICS
38	Estimation of economic loss of sheep and goat pox in endemic states of India	ANSCNIVEDISIL 201700600084	IXX13346	Dr. G. Govin-daraj	Dr. G. B. Manjunatha Reddy Dr. V. Balamurugan Dr. P. Krishnamoorthy Dr. R. Yogisharadhya Dr. G. Narayanan (w.e.f. 5.10.2020) Dr. Sathish Gowda (w.e.f. 5.10.2020)
39	Economic impact of Blue-tongue Virus (BTV) in sheep	ANSCNIVEDISIL 202000500108	IXX15816	Dr. Sathish Gowda	Dr. D. Hemadri Dr. G. Govindaraj Dr. G. Narayanan
40	Assessment of economic impact of priority animal diseases and their control in India	ANSCNIVEDICOP 201900200101	OXX04635 (ICAR-ILRI)	Dr. G. Govin-daraj	Dr. V. Balamurugan Dr. R. Shome Dr. M. Nagalingam Dr. P. Krishnamoorthy
41	Disease burden quantification in small ruminants and impact of adopting preventive interventions on rural livestock farmers in Odisha	ANSCNIVEDISOL 201900300102	OXX04779 (DST)	Dr. G. Govin-daraj	Dr M Nagalingam, Dr V Balamurugan Dr Siju Suasan Jacob Dr. Gopal Charan Bal (AICRP-ADMAS, Cuttack, Odisha)
42	Assessment of adoption of biosecurity practices for prevention of major infectious diseases of ruminants in Southern India	ANSCNIVEDISIL 202000400107	IXX15814	Dr. G. Narayanan	Dr. G. Govindaraj Dr. M. Nagalingam Dr. Sathish Gowda
6 V. CAPACITY BUILDING
43	Socio-economic upliftment of the Scheduled caste livestock farmers and farm women in rural area through improved livestock production technologies	ANSCNIVEDISIL 202000700110	IXX15815	Dr. G. Narayanan	Dr. Sathish Gowda Dr. R. Sridevi Dr. M. Nagalingam Dr.H.B.Chethan Kumar Dr. R.Yogisharadaya
44	R-Agri-Business incubator (ABI)-RKVY-RAFTAAR funded MoAFW, GOI	ANSCNIVEDISOL 201900500113	OXX04668	Dr. S.B. Shivachandra	Dr.G.B. Manjunatha Reddy Dr. R. Yogisharadhya Dr.M.M. Chanda (w.e.f. 20.4.2021) Dr. Awadhesh Prajapati (w.e.f.20.4.2021)
45	ICAR- Agri-Business incubator (ABI)- ICAR funded NAIF-IP-and TM Division, ICAR, GOI	ANSCNIVEDISOL 202001000114	IXX16527	Dr. S.B. Shivachandra	Dr.G.B. Manjunatha Reddy Dr. R. Yogisharadhya Dr.M.M. Chanda, (w.e.f. 20.4.2021) Dr. Awadhesh Prajapati (w.e.f. 20.4.2021)

8. Facilities at ICAR-NIVEDI

A. Biosafety Laboratory Facility

ICAR-NIVEDI has state of art containment facility which is a biosafety level 2++ category. It supports the major research activities of the institute. Being a unique facility in the country, annually number of people visit the laboratory for various purposes. The biosafety unit of the institute is instrumental in the operation and maintenance of the laboratory. The expertise gained in the area of laboratory operation and maintenance, laboratory biosafety, and biosecurity practices over the years has also been offered in the form of advice, exposure visits to the laboratory, technical inputs, budgeting, etc. The quarterly, six-monthly and annual maintenance works with HVAC, BMS, ETP, RO, and Chiller were carried out as per the recommended schedules. During the reporting year periodic maintenance like fumigation, sanitization of biosafety cabinets, filter cleaning, etc, were also carried out. All the supporting staff were trained to use PPE and to perform the sanitization works inside the laboratory and also the office premises as part of COVID-19 pandemic preparedness and also handling the COVID-19 positive environment.

B. Training Facility

ICAR-NIVEDI has a Training Hall with the capacity of 100 persons at a time where the training cum awareness programmes is being conducted. The training hall is equipped with Overhead Projector, projector screen, 2 TVs and podium and audio-visual aids, etc., The training hall is located in Training cum Farmers' Hostel -Guesthouse with boarding and lodging facilities, canteen and dining facilities. Apart from this, the institute has a committee room with a capacity of 40 persons at a time and is furnished with audio-visual aids, an interactive touch screen with Wi-Fi facility, individual mike facility on the table which enables to conduct national-level meetings, offline and online training programmes. Additionally, there is a separate lecture Hall in the administrative block with a capacity of 60 persons at a time with necessary audio-visual aids. Further, the institute has a Spatial Epidemiology and GIS Lab facility, Disease informatics and Bio-informatics Lab facilities where the trainees are trained in the open-source software of Bio-informatics and GIS and other mapping tools.

9. Technologies

Patents Granted

✦ Recombinant VSG and monoclonal antibody-based competitive inhibition enzyme-linked immunosorbent assay for the detection of antibodies against *Trypanosoma evansi*. (Patent Number: 361741; Date of filing: 25.01.2015; Date of grant: 18.03.2021; Inventors- Dr. Pinaki Prasad Sengupta, Dr. Ligi Milesh, Dr. Vinayagamurthy Balamurugan and Dr. Habibur Rahman).

✦ Monoclonal antibody-based double antibody sandwich ELISA for the detection of *Trypanosoma evansi* antigen in animals. (Patent Number: 369790; Date of filing: 20.06.2015; Date of grant: 21.06.2021, Inventors- Dr. Pinaki Prasad Sengupta, Dr. Ligi Milesh and Dr. Habibur Rahman).

Intra-institute validation of technologies developed at ICAR-NIVEDI

✦ Intra-institute validation performed for the technology "PPR-ABrAC ELISA" intended for the detection of PPRV antigen in clinical specimens.

✦ Intra-institute validation performed for the

technology "PPR-ABrC ELISA" intended for the detection of PPRV antibodies in the serum samples.

✦ Intra-institute validation performed for the technology "Lateral Flow Assay (LFA) Kit for brucellosis" for detection of *Brucella* antibodies in the serum samples.

10. Publications

A. Research Publications

1. ICAR-NIVEDI Publications

1. Alamuri A, Vinod Kumar K, Varghese B, Palkhade R, Mahadeviah SN, Chaudhari S, Roy P and Balamurugan V. (2021). Evaluation of recombinant leptospiral surface antigen (Lsa27) lipoprotein for serodiagnosis of human leptospirosis by latex agglutination test. Indian Journal of Medical Microbiology, 39(2): 212-217. http://krishi.icar.gov.in/jspui/handle/123456789/71554.

2. Archana Abhijith, Sejian V, Wilfred Ruban, Krishnan G, Bagath M, Prathap Pragna, Manjunatha Reddy GB and Bhatta R. (2021). Summer season induced heat stress associated changes on meat production and quality characteristics, myostatin and HSP70 gene expression patterns in indigenous goat. Small Ruminant Research, 203: 106490. doi: https://doi.org/10.1016/j.smallrumres.2021.106490. http://krishi.icar.gov.in/jspui/handle/123456789/71525.

3. Balamurugan V, Alamuri A, Kumar KV, Govindaraj G and Roy P. (2021). Prevalence of *Coxiella burnetii* antibodies in dairy cattle associated with abortions and reproductive disorders. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences, 91: 353–359. http://krishi.icar.gov.in/jspui/handle/123456789/71553.

4. Balamurugan V, Alamuri A, Kumar KV, Varghese B, Govindaraj G, Hemadri D and Roy P. (2021). Prevalence of anti-leptospiral antibodies and frequency distribution of *Leptospira* serovars in small ruminants in enzootic South Peninsular India. Veterinary World, 14: 2023-2030. http://krishi.icar.gov.in/jspui/handle/123456789/71614.

5. Balamurugan V, Kumar KV, Dheeraj R, Kurli R, Suresh KP, Govindaraj GN, Shome BR and Roy P. (2021). Temporal and spatial epidemiological analysis of Peste Des Petits Ruminants outbreaks from the past 25 years in sheep and goats and its control in India. Viruses, 13(3): 480-480. http://krishi.icar.gov.in/jspui/handle/123456789/71552.

6. Balamurugan V, Thirumalesh SRA, Alamuri A, SowjanyaKumari S, Vinod Kumar K, Linshamol L, Bharath V, Nagalingam M and Roy P. (2021). Evaluation of the diagnostic potential of recombinant leptospiral OMP A-like protein (Loa22) and transmembrane (OmpL37) protein in latex agglutination test for serodiagnosis of leptospirosis in animals. Letters in Applied Microbiology, 72(6): 730-740. http://krishi.icar.gov.in/jspui/handle/123456789/71551.

7. Balamurugan V, Varghese B, Sowjanya Kumari S, Vinod Kumar K, Muthuchelvan D, Nagalingam M and Roy P. (2021). Avidin-Biotin recombinant antigen capture ELISA for the detection of peste des petits ruminants virus in the clinical specimens of sheep and goats. Journal of Virological Methods, 291: 114103. http://krishi.icar.gov.in/jspui/handle/123456789/71550.

8. Balamurugan V, Varghese B, Sowjanya Kumari S, Vinod Kumar K, Muthuchelvan D, Nagalingam M, Hemadri D, Roy P and Shome BR. (2021). Avidin-Biotin recombinant nucleoprotein competitive ELISA for the detection of peste des petits ruminants virus antibodies in sheep and goats. Journal of Virological Methods, 295: 114213. http://krishi.icar.gov.in/jspui/handle/123456789/71549.

9. Beelagi MS, Indrabalan UB, Patil SS, Suresh KP, Kollur SP, Prasad A, Srinivasa C and Shivamallu C. (2021). Insight of codon usage bias and evolutionary rate among the genes C,

E, prM and NS5 of the Kyasanur forest disease virus. International Journal of Research in Pharmaceutical Sciences, 12(3): 2028-2046. http://krishi.icar.gov.in/jspui/handle/123456789/71602.

10. Beelagi MS, Kumar SS, Indrabalan UB, Patil SS, Prasad A, Suresh KP, Kollur SP, Jayappa VS, Kakkalameli SB, Srinivasa C and Venkataravana PA. (2021). Synonymous codon usage pattern among the S, M, and L segments in crimean-congo hemorrhagic fever virus. Bioinformation, 17(4): 479-491. http://krishi.icar.gov.in/jspui/handle/123456789/71527.

11. Bora DP, Venkatesan G, Arya S, Pariat AO, Amit Kumar, Sabnam Ingtipi, Puja Mech, Manjunatha Reddy GB, Panda SP, Barman NN and Balamurugan V. (2021). Molecular evidence and sequence analysis of goatpox virus isolates from Assam, India: An emerging viral disease of goats. Proceedings of the National Academy of Sciences, India, Section B: Biological Sciences, 91: 607-614. DOI: https://doi.org/10.1007/s40011-021-01256-9. http://krishi.icar.gov.in/jspui/handle/123456789/71523.

12. Bylaiah S, Shedole S, Suresh KP, Gowda L, Patil SS, Indrabalan UB and Shivamallu C. (2021). Relative analysis of codon usage and nucleotide bias between anthrax toxin genes subsist inpxo1 plasmid of *Bacillus anthracis*. Annals of the Romanian Society for Cell Biology, 25: 5758-5774. http://krishi.icar.gov.in/jspui/handle/123456789/71599.

13. Chandu AGS, Sengupta PP, Jacob SS, Borthakur SK, Patra G and Roy P. (2021). Mining the pervasiveness of surra in different animal species of Northeastern states of India: Assam, Mizoram and Tripura. Journal of Parasitic Diseases, 45: 330–335. http://krishi.icar.gov.in/jspui/handle/123456789/71593.

14. Chandu AGS, Sengupta PP, Jacob SS, Suresh KP, Borthakur SK, Patra G and Roy P. (2021). Seroprevalence of *Trypanosoma evansi* in cattle and analysis of associated climatic risk factors in Mizoram, India. Journal of Parasitic Diseases, 45(1): 244–251. http://krishi.icar.gov.in/jspui/handle/123456789/71592

15. Chethan Kumar HB, Hiremath J, Yogisharadhya R, Balamurugan V, Siju SJ, Manjunatha Reddy GB, Suresh KP, Shome R, Nagalingam M, Sridevi

R, Patil SS, Prajapati A, Govindaraj G, Sengupta PP, Hemadri D, Krishnamoorthy P, Misri J, Kumar A, Tripathi BN and Shome BR. (2021). Animal disease surveillance: Its importance and present status in India. Indian Journal of Medical Research, 153(3): 299-310. http://krishi.icar.gov.in/jspui/handle/123456789/46688.

16. Govindaraj G, Ganeshkumar B, Krishnamohan A, Hegde R, Nandakumar S, Prabhakaran K, Wadhwan VM, Kakker N, Lokhande T, Sharma K, Kanani A, Limaye A, Natchimuthu K, Ananth PN, Arup Kumar De, Khan TA, Misri J, Dash BB, Pattnaik B and Rahman H. (2021). Foot and Mouth Disease (FMD) incidence in cattle and buffaloes and its associated farm-level economic costs in endemic India. Preventive Veterinary Medicine, 190: 105318. DOI: https://doi.org/10.1016/j.prevetmed.2021.105318. http://krishi.icar.gov.in/jspui/handle/123456789/71548.

17. Indrabalan UB, Suresh KP, Shivamallu C and Patil SS. (2021). An extensive evaluation of codon usage pattern and bias of structural proteins p30, p54 and, p72 of the African swine fever virus (ASFV). Virus Disease. 32(4): 810-822. http://krishi.icar.gov.in/jspui/handle/123456789/71601.

18. Jacob SS, Sengupta PP, Chandu AGS, Shamshad S, Yogisharadhya R, Sudhagar S and Ramesh P. (2021). Existence of genetic lineages within Asian genotype of *Taenia solium*-Genetic characterization based on mitochondrial and ribosomal DNA markers. Transboundary and Emerging Diseases, 1-10. DOI: 10.1111/tbed.14227. http://krishi.icar.gov.in/jspui/handle/123456789/50787.

19. Krishnamoorthy P, Akshata LG, Jacob SS, Suresh KP and Roy P. (2021). Theileriosis prevalence status in cattle and buffaloes in India established by systematic review and meta-analysis. Indian Journal of Animal Sciences, 91(4): 269-279. http://krishi.icar.gov.in/jspui/handle/123456789/60975.

20. Krishnamoorthy P, Goudar AL, Suresh KP and Roy P. (2021). Global and countrywide prevalence of subclinical and clinical mastitis in dairy cattle and buffaloes by systematic review and meta-analysis. Research in Veterinary Science, 136: 561-586. http://krishi.icar.gov.in/jspui/handle/123456789/46629.

21. Krishnamoorthy P, Sudhagar S, Akshata LG, Siju SJ and Suresh KP. (2021). Molecular survey and

phylogenetic analysis of tick-borne pathogens in ticks infesting cattle from two South Indian states. Veterinary Parasitology: Regional Studies and Reports, 25: 100595. http://krishi.icar.gov.in/jspui/handle/123456789/47135.

22. Krishnamoorthy P, Suresh KP, Jayamma KS, Shome BR, Patil SS and Amachawadi RG. (2021). An understanding of the global status of major bacterial pathogens of milk concerning bovine mastitis: A systematic review and meta-analysis (Scientometrics). Pathogens, 10(5): 1-31. http://krishi.icar.gov.in/jspui/handle/123456789/46987.

23. Krithiga N, Triveni K, Mangadevi N, Chaitra Y, Nagalingm M, Swati S, Somy S, Shome BR, Obli RVK, Habibur R and Shome R. (2021). Sero-prevalence and risk factors for brucellosis in organized small ruminant flocks of Karnataka in Southern Province of India. Veterinary World, 14: 2855-2862. http://krishi.icar.gov.in/jspui/handle/123456789/71556.

24. Mohanty NN, Hemadri D, Munivenkatarayappa A, Shetty N, Subramanyam V, Biswas SK, Chanda MM and Shivachandra SB. (2021). Development of recombinant NS1-NS3 antigen based indirect ELISA for detection of bluetongue antibodies in sheep. Journal of Immunological Methods, 490: 112959. DOI: 10.1016/j.jim.2021.112959. Epub 2021 Jan 4. PMID: 33412173. http://krishi.icar.gov.in/jspui/handle/123456789/71573.

25. Nagalingam M, Basheer TJ, Balamurugan V, Shome R, Kumari SS, Reddy GBM, Shome BR, Rahman H, Roy P, Kingston JJ and Gandham RK. (2021). Comparative evaluation of the immunodominant proteins of *Brucella abortus* for the diagnosis of cattle brucellosis. Veterinary World, 14(3): 803-812. http://krishi.icar.gov.in/jspui/handle/123456789/71576.

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2. Collaborative Research Publications

1. Aasdev A, Pawar SD, Mishra A, Dubey CK, Patil SS, Gogoi SM, Bora DP, Barman NN and Raut AA. (2021). First complete genome characterization of duck plague virus from India. Virus Disease, 32(4): 789-796. DOI: 10.1007/s13337-021-00748-6. http://krishi.icar.gov.in/jspui/handle/123456789/71580.

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Nicobar Islands, India. Exploratory Animal and Medical Research, 11(1): 110-114. http://krishi.icar.gov.in/jspui/handle/123456789/71579.

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30. Sumithra TG, Chaturvedi VK, Gupta PK, Bincy J, Jacob SS, Sunita SC, Reshma KJ, Patel CL and Rai AK. (2021). A novel bicistronic DNA vaccine with enhanced protective immune response against *Bacillus anthracis* through DNA prime-protein boost vaccination approach. Microbial Pathogenesis, 158: 105104, DOI: 10.1016/j.micpath.2021. http://krishi.icar.gov.in/jspui/handle/123456789/71570.

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33. Venkatesh Paramesh, Chakurkar EB, Bhagat T, Sreekanth GB, Chetan Kumar HB, Rajkumar

S, Gokuldas PP, Mahajan GR, Manohara KK and Ravisankar N. (2021). Impact of integrated farming system on residue recycling, nutrient budgeting and soil health. Indian Journal of Agricultural Sciences, 91(1): 44-48. http://krishi.icar.gov.in/jspui/handle/123456789/49409.

34. Raut AA, Aasdev A, Mishra A, Dutta, B, Bharali A, Konwar N, Dubey CK, Chingtham S, Pawar SD, Raghuvanshi R, Sakhrie A, Sen A, Patil SS, Singh VP and Barman NN. (2021). Detection of coinfection of a divergent subgroup of genotype I Japanese encephalitis virus in multiple classical swine fever virus outbreaks in pigs of Assam, India. Transboundary and Emerging Diseases, 68(4): 2622-2627. DOI: 10.1111/tbed.13903. http://krishi.icar.gov.in/jspui/handle/123456789/71575.

35. Saminathan M, Singh KP, Madhulina Maity, Sobharani V, Manjunatha Reddy GB, Dhama K, Malik YS, Ramakrishn MA and Jyoti M and Gupata VK. (2021). Pathological and immunological characterization of bluetongue virus serotype 1 infection in type I interferons blocked immunocompetent adult mice. Journal of Advanced Research, 31: 137-153. https://doi.org/10.1016/j.jare.2021.01.007. http://krishi.icar.gov.in/jspui/handle/123456789/71524.

B. Abstracts Presentation in conferences/ symposia/workshops/seminars/ other fora

1. ICAR-NIVEDI Abstracts

1. Beelagi MS, Indrabalan UB, Patil SS, Suresh KP, Kollur SP, Prasad A, Srinivasa C and Shivamallu C. (2021). Insight of codon usage bias and Evolutionary rate among the genes C, E, prM and NS5 of the Kyasanur forest disease virus. In XV Agricultural Science Congress & SC Expo, held at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 13-16th November, 2021.

2. Bhavya AP, Suresh KP, Akshata Nayak, Mohan Kumar GS, Patil SS and Bibek RS. (2021). Seroprevalence of sheep pox and goat pox virus in Asia and African continent: A systematic review and meta-analysis (Scientometrics). In XV Agricultural Science Congress & ASC Expo, held at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 13-16th November, 2021.

3. Chanda MM. (2021). Delivered lecture on "Developing long term preventive strategies to keep Zoonotic diseases at a distance from becoming pandemic/endemic". In 7th National Digital Conference on Scientific updates on Emerging viral zoonotic diseases including nCOVID19 prevention in India and drivers influencing mutations, organized by Millenium India Education Foundation on 27th January, 2021.

4. Chanda MM. (2021). Delivered theory counselling session on "Agroterrorism" in post graduate certificate in medical management of CBRNE disasters programme of IGNOU, New Delhi on 5th February, 2021.

5. Chandu AGS, Sengupta PP and Jacob SS. (2021). Genotyping of selected metabolic and housekeeping genes of *Trypanosoma evansi*. In the compendium of 30th National Congress on Veterinary Parasitology held at College of Veterinary and Animal Sciences, Parbhani, during 14-16th December. Pp. 124.

6. Hiremath J (2021). Epidemiology of emerging coronavirus in human & understanding the role of animals. International Webinar on Zoonosis, Jointly organized by Centre for Diagnosis, Surveillance & Response of Zoonotic Diseases (CDSRZ), Post Graduate Institute of Veterinary Education and Research (PGIVER) and Rajasthan University of Veterinary and Animal Sciences (RAJUVAS), Bikaner on 6th July 2021.

7. Hiremath J (2021). Epidemiology of emerging coronavirus in human & animals. On the eve of centenary year celebrations of T N Medical College & Nair Hospital, Mumbai, Maharashtra, on 8th August 2021.

8. Indrabalan UB, Suresh KP, Patil SS, Beelagi MS, Sharma P, Shivamallu C, Pappana M and Amachavadi R. (2021). Reverse vaccinology based in silico analysis of epitope prediction in cya, lef and pag genes from *Bacillus anthracis* against anthrax infected species: An Immunoinformatics Approach. In International Conference on Infections and Immunity organized by Department of Zoology, Daulat Ram College, the University of Delhi during 8-10th October, 2021.

9. Indrabalan UB, Suresh KP, Shivamallu C and Patil

SS. (2021). An extensive evaluation of codon usage pattern and bias of structural proteins p30, p54 and, p72 of the African swine fever virus (ASFV). In XV Agricultural Science Congress & ASC Expo, held at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 13-16th November, 2021.

10. Krishnamoorthy P, Dharshan HV, Siju SJ and Suresh KP. (2021). Risk mapping and epidemiological analysis of cattle ticks in Karnataka and Kerala states in India. In: 30th National congress of Veterinary Parasitology and National Symposium on "Fundamentals of Integrated Parasite management and its relevance in One health" held at College of Veterinary and Animal Sciences, Parbhani, Maharashtra during 14-16th December, 2021. Pp. 194.

11. Krishnamoorthy P, Dheeraj R, Dharshan HV and Suresh KP. (2021). Development of Cattle diseases diagnosis expert system (CaDDES) for the diagnosis of cattle diseases. In Online 38th Annual conference of IAVP and International Symposium on "Advances in veterinary pathology for diagnosis and control of emerging and re-emerging diseases of livestock, wild animals and poultry" organized by College of Veterinary and Animal Science, Bikaner, Rajasthan during 17-19th December, 2021.

12. Krishnamoorthy P, Karthika N, Sangeetha TR, Suresh KP, Sridevi R and Shome BR. (2021). Foot and Mouth disease prevalence in cattle and buffaloes in India determined by systematic review and meta-analysis. In Online 38th Annual conference of IAVP and International Symposium on "Advances in veterinary pathology for diagnosis and control of emerging and re-emerging diseases of livestock, wild animals and poultry" organized by College of Veterinary and Animal Science, Bikaner, Rajasthan during 17-19th December, 2021.

13. Krishnamoorthy P, Sangeetha TR, Karthika N, Shashidhar VB and Suresh KP. (2021). Epidemiological analysis of cattle ticks in Dharwad and Haveri districts in Karnataka. In 30th National congress of Veterinary Parasitology and National Symposium on "Fundamentals of Integrated Parasite management and its relevance

in One health" held at College of Veterinary and Animal Sciences, Parbhani, Maharashtra during 14-16th December, 2021, Pp. 97-98.

14. Mithra SD, Saurab S, Aishwaraya S, Rohit S, Shome R and Shome BR. (2021). Isolation and Identification of a lytic bacteriophages against New Delhi Metallo beta lactamase (NDM) producing Carbapenem resistant *Escherichia coli* isolates. In International e-Symposium on "One Health Concept: Opportunities and Perspectives in Present Scenario" and XVII Annual Conference of IAVPHS organized by Centre for One Health, GADVASU, Ludhiana, Punjab during 28-29th May, 2021.

15. Naganayak MM, Suresh KP, Patil SS, Indrabalan UB, Beelagi MS, Krishnamoorthy P and Jacob SS. (2021). A new information framework for evaluating the codon usage metrics, evolutionary models and phylogeographic reconstruction of Tomato yellow leaf curl virus (TYLCV) in different regions of Asian countries. In XV Agricultural Science Congress & ASC Expo, held at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 13-16th November, 2021.

16. Nayak A, Suresh KP, Bhavya AP, Hiremath J, Patil SS, Majumdar S, Barman NN and Shome BR. (2021). Prevalence of Japanese encephalitis (JE) virus in Asian continent: A systematic review and meta-analysis. In XV Agricultural Science Congress & ASC Expo, held at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 13-16th November, 2021.

17. Nimita V, Rituparna T, Feroze G, Shome R and Shome BR. (2021). Methicillin resistant coagulase negative staphylococci (MRCoNS): A pilot study at interface between cattle and animal handlers. In the International e-Symposium on One Health Concept: Opportunities and perspectives in present scenario and XVII Annual Conference of Indian Association of Veterinary Public Health Specialists (IAVPHS) organized by Centre for One Health, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, Punjab during 28-29th May, 2021.

18. Prajapati A, Mohanty NN, Yogisharadhya R, Chanda MM and Shivachandra SB. (2021). Evaluation of sero-diagnostic potential of

recombinant NanH protein of *Pasteurella multocida* B:2 in mouse model. In XV Agricultural Science Congress & ASC Expo-2021, held at Banaras Hindu University (BHU), Varanasi, Uttar Pradesh (UP), India during 13-16th November, 2021.

19. Rituparna T, Nimita V, Shome R and Shome BR. (2021). Molecular characterization, antimicrobial resistance profile and a systematic surveillance approach to address the problem of extended spectrum beta lactamase, AmpC beta lactamase and metallo-beta-lactamase producing *E. coli* from livestock and poultry in North eastern India. In the International e-Symposium on One Health Concept: Opportunities and Perspectives in Present Scenario and XVII Annual Conference of Indian Association of Veterinary Public Health Specialists (IAVPHS) organized by Centre for One Health, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, Punjab during 28-29th May, 2021.

20. Sengupta PP and Jacob SS. (2021). Current status of trypanosomosis in India. In 11 days online training program entitled "Novel approaches for controlling parasitic diseases with special reference to integrated parasite management", organized by Department of Veterinary Parasitology, College of Veterinary Science and Animal Husbandry, NDVSU, Mhow (M.P.) during 20th September to 1st October 2021.

21. Sharma P, Suresh KP, Patil SS, Indrabalan UB, Hemadri D, Guha A, Raghavendra G and Amachawadi. (2021). Equating Triplet Codon Block Shannon Entropy (TCBShE) to Napier Constant (e): Pentaclado-genic Quantitative survey among 1118 species across 14.45 million transcripts. In 20th International Conferences on Bioinformatics held at Kunming, Yunnan, China during 6-8th November, 2021.

22. Sharma P, Suresh KP, Patil SS, Shivamallu C, Indrabalan UB, Hemadri D, Raghavendra G and Amachawadi. (2021). Brucellosis vaccine design-directed epitope prediction for HLAA*0201 allele. In International Conference on Infections and Immunity organized by Department of Zoology, Daulat Ram College, University of Delhi during 8-10th October, 2021.

23. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Jacob SS, Mohankumar GS, Sushma B, Jyoti Misri and Shome BR. (2021). Forewarning system powered by artificial intelligence for livestock disease management in India with special reference to National Animal Disease Referral Expert System v2(NADRES v2). In XV Agricultural Science Congress & ASC Expo, held at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 13-16th November, 2021.

24. Tewari R, Venugopal N, Shome R and Shome BR. (2021). Molecular characterization, antimicrobial resistance profile and a systematic surveillance approach to address the problem of extended spectrum beta lactamase, AmpC beta lactamase and metallo beta lactamase producing *E. coli* from livestock and poultry in North eastern India. Poster presented in the International e-Symposium on "One Health Concept: Opportunities and perspectives in present scenario" and XVII IAVPHS organized by Centre for One Health, GADVASU, Ludhiana, Punjab during 28-29th May, 2021.

25. Umaya Suganthi R, Malik PK and Manjunatha Reddy GB. (2021). Determination of intestinal transepithelial electrical measurements and intestinal integrity in broilers: An Indian Perspective RBBT-9. In e-conference organized by SVBBI during 24-25th March, 2021.

26. Veena R and Chanda MM. (2021). Spatial risk factors influencing on the occurrence of foot and mouth disease outbreaks in Karnataka. In international meeting on emerging diseases and surveillance held virtually during 4-6th November, 2021.

27. Venugopal N, Tewari R, Ganaie F, Shome R and Shome BR. (2021). Methicillin resistant coagulase negative staphylococci (MRCoNS): A pilot study at interface between cattle and animal handlers. Poster presented in the International e-Symposium on "One Health Concept: Opportunities and Perspectives in Present Scenario" and XVII Annual Conference of IAVPHS organized by Centre for One Health, GADVASU, Ludhiana, Punjab during 28-29th May, 2021.

2. Collaborative Abstracts

1. Chethan Kumar HB, Chandisha DS, Rajkumar S, Shivasharanappa N, Susitha R, Udharwar SV and Chakurkar EB. (2021). Copro-prevalence of *Cryptosporidium* in pigs of selected districts in West coast of India: A preliminary study. In 17th Annual conference of Indian Association of Veterinary Public Health Specialists organized by Centre for One Health, College of Veterinary Science, GADVASU, Ludhiana during 28-29th May, 2021. Pp. 160.

2. Garima S, Florence M, Deka RP, Shome R, Bandopadhay S, Shome BR, Kumar N, Grace D, Dey TK and Johanna Lindahl JF. (2021). Managing the spread of antimicrobial resistance through awareness creation and community sensitization. In Virtual Research Conference Agriculture, Nutrition and Health (ANH 2021) during 29th June to 1st July, 2021.

3. Krishnamoorthy P, Gowda NKS, Pal DT and Shome BR. (2021). Effect of boron supplementation in white leghorn layer birds fed with calcium inadequate diet on humoral immunity and histopathology. In online 4th Zonal (central) conference of IAVP 2021 on "Livestock diseases and their impact on sustainable production" organized by College of Veterinary Science and Animal Husbandry, Rewa, Madhya Pradesh during 5-6th October, 2021.

4. Murugesan D, Shome R, Ojha R, Mendem SK, Mohandoss N, Chanda M, Govindaraj GN, Rajangam S, Paramanandham K, Revanaiah Y, Gowda PK, Kumar N, Pappanna P and Shome BR. (2021). In international e-Symposium on 'One Health Concept: Opportunities and Perspectives in Present Scenario' & XVII Annual Conference of Indian Association of Veterinary Public Health Specialists (IAVPHS), organized by Centre for One Health, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana (Punjab) during 28-29th May, 2021

5. Veena M, Puttalakshmamma GC, Sengupta PP, Ananda KJ, Siju SJ, Isloor SK, Krishnamoorthy P and Dhanalakshmi H. (2021). Gene expression analysis of P-glycoproteins in ivermectin resistance *Haemonchus contortus* larvae of sheep using real time PCR. In 30th National congress of Veterinary Parasitology and National Symposium on "Fundamentals of Integrated Parasite management and its relevance in One health" organized by College of Veterinary and Animal Sciences, Parbhani, Maharashtra during 14-16th December, 2021. Pp: 143.

C. Books and Book chapters

Books

1. Kollur SP, Jain AS, Vaidya G, Poojitha B, Ankegowda VM, Sayed A, Bhakali AH, Srinivasa C, Patil SS and Shivamallu C. (2021). Drug repurposing approach for non-small cell lung cancer targeting MAPK signaling pathway. Edition: First, Eliva Press, Republic of Moldova, Europe. Pp 1-45

2. Patil SS, Suresh KP and Roy P. (2021). Pig Disease and Management. Edition: First, Today and Tomorrow's Printers and Publishers, New Delhi. Pp. 1-350

Book Chapters

1. Bylaiah S, Shedole S, Suresh KP, Gowda L, Patil SS and Indrabalan UB. (2021). Analysis of codon usage bias in Cya, Lef, and Pag genes exists in px01 plasmid of *Bacillus Anthracis*. In: ICT Analysis and Applications. Lecture Notes in Networks and Systems (Ed. Fong S, Dey N. and Joshi A), vol 314. Springer, Singapore. https://doi.org/10.1007/978-981-16-5655-2_1. pp.

2. Chanda MM, Hiremath J, Archana M, Kundave VR, Balakirshnan N and Patil SS. (2021). Japanese encephalitis. In: Pig diseases and management. (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's Printers and Publishers, New Delhi. pp. 167-179.

3. Chethan Kumar HB, Shivasharanappa N, Susitha Rajkumar and Chakurkar EB. (2021). Salmonellosis in pigs. In: Pig diseases and management (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's Printers and Publishers, New Delhi. pp 55-66.

4. Hiremath J, Chanda MM, Bhavana GB and Patil SS. (2021). Porcine Reproductive and Respiratory Syndrome. In: Pig diseases and management (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's Printers and Publishers, New Delhi. pp. 217-228.

5. Mangadevi N, Manjunatha Reddy GB and Patil

SS. (2021). Porcine parvovirus. In: Pig diseases and management (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's Printers and Publishers, New Delhi. pp. 209-215.

6. Manjunatha Reddy GB and Patil SS. (2021). Necropsy procedures in pig. In: Pig diseases and management (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's Printers and Publishers, New Delhi. pp. 319-329.

7. Manjunatha Reddy GB, Lavanya KV, Sumana K, Prajapati A, Yogisharadhya R, Sajjanar B and Patil SS. (2021). Swine pox. In: Pig diseases and management (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's Printers and Publishers, New Delhi. pp. 259-264.

8. Patil SS, Suresh KP, Shivaraj DB, Hiremath J, Chanda MM, Manjunatha Reddy GB and Prajapati A. (2021). Classical swine fever. In: Pig diseases and management. (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's Printers and Publishers, New Delhi. pp. 143-155.

9. Prajapati A, Manjunatha Reddy GB, Yogisharadhya R and Patil SS. (2021). Actinobacillosis in pigs. In: Pig diseases and management (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's

Printers and Publishers, New Delhi. pp. 1-13.

10. Shome R. (2021). Swine brucellosis. In: Pig diseases and management. (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's Printers and Publishers, New Delhi, pp. 75-96.

11. Sridevi R and Jacob SS. (2021). Non progressive atrophic rhinitis (NPAR) in Pigs. In: Pig diseases and management (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's Printers and Publishers, New Delhi. pp. 39-54.

12. Srinivasa C, Shivamallu C, Santhosh Kumar SR, Sushma P, Kollur SP, Patel SJ, Patil SS, Suhas R, Egbuna C and Tung BT. (2021). Medicinal potentials of phytochemicals as a source of drugs for the treatment of onchocerciasis (river blindness). In: Neglected Tropical Diseases and Phytochemicals in Drug Discovery (Ed. Chukwuebuka Egbuna, Muhammad Akram, and Jonathan Chinenye Ifemeje). First Edition, John Wiley & Sons, USA. pp. 283-295.

13. Vinutha S and Patil SS. (2021). Torque Teno Sus Virus in Pigs. In: Pig diseases and management (Ed. S.S. Patil, K.P. Suresh and Parimal Roy). Today & Tomorrow's Printers and Publishers, New Delhi. pp. 273-281.

C. Technical Bulletins/ Manuals/ Booklets/Leaflets

Particular	Title	Authors	Pages/Reference
Bulletin	Livestock disease forewarning monthly bulletin	Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P and Siju SJ.	January 2021 to March 2021 http://krishi.icar.gov.in/jspui/handle/123456789/45213. http://krishi.icar.gov.in/jspui/handle/123456789/45303. http://krishi.icar.gov.in/jspui/handle/123456789/46190.
Bulletin	Livestock disease forewarning monthly bulletin	Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ and Shome BR.	April 2021-December-2021 http://krishi.icar.gov.in/jspui/handle/123456789/46514. http://krishi.icar.gov.in/jspui/handle/123456789/47044. http://krishi.icar.gov.in/jspui/handle/123456789/47230. http://krishi.icar.gov.in/jspui/handle/123456789/49591. http://krishi.icar.gov.in/jspui/handle/123456789/57236. http://krishi.icar.gov.in/jspui/handle/123456789/61971. http://krishi.icar.gov.in/jspui/handle/123456789/65532. http://krishi.icar.gov.in/jspui/handle/123456789/67534. http://krishi.icar.gov.in/jspui/handle/123456789/68326.
Manual	Sampling plan for serosurveillance for FMD in India under National Animal Disease Control Programme	Suresh KP, Hemadri D, Patil SS, Saravanan S, Mohapatra JK and Singh RP	ICAR-NIVEDI, Bengaluru
Manual	Sampling plan for seromonitoring for FMD in India under National Animal Disease Control Programme	Suresh, KP, Hemadri D, Patil SS, Saravanan S, Mohapatra JK and Singh RP.	ICAR-NIVEDI, Bengaluru

Leaflet	Japanese encephalitis: Things you should Know (English).	Chethan Kumar HB, Jagadish Hiremath, Manjunatha Reddy GB, Yogisharadhya R and Balamurugan V	NIVEDI/Tech.Bull./2020-21/06
Leaflet	Japanese encephalitis (Kannada).	Chethan Kumar HB, Jagadish Hiremath, Manjunatha Reddy GB, Yogisharadhya R and Balamurugan V.	NIVEDI/ Tech. Bull./2020-21/07
Leaflet	Leptospirosis (Rat fever).	Chethan Kumar HB, Prajapati A, Balamurugan V, Vinod Kumar and Nagalingam M. (2021).	NIVEDI/ Tech. Bull./2020-21/5
Leaflet	Be (a)ware of parthenium.	Nagalingam M, Janofer U, Jacob SS, Sridevi R, Narayanan G, Sathish Gowda CS, Manjunatha Reddy GB, Chetan Kumar HB and Yogisharadhya R.	ICAR-NIVEDI/Tech.Bull./2021-22/01

11. Awards/Recognition

- Dr. Sathish B. Shivachandra, *Principal Scientist*, acted as '*Invited International Expert*' for updating a Disease Technical card on *Haemorrhagic septicaemia* (HS) and Chapter-3.4.10 on *Haemorrhagic septicaemia* (HS) (*Pasteurella multocida* serotypes 6:b and 6:e), to be included in the '*Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, Eight Edition (2021),* published by OIE, Paris, France.

- Dr. Krishnamoorthy P, *Senior Scientist,* awarded DeFacto Member and Diplomate of Indian College of Laboratory Animal Medicine (ICLAM) by ICLAM under the Laboratory Animal Scientists Association (LASA) of India for the contributions made in the field of laboratory animal science and welfare during ICLAM Technical meeting held on 17th July 2021.

- Dr. Krishnamoorthy P, *Senior Scientist,* awarded the Best Oral Presentation Award Second place in the online 4th Zonal conference (Central) of Indian Association of Veterinary Pathologists organized by College of Veterinary Science and Animal Husbandry, Rewa, Madhya Pradesh held during 5-6th October 2021.

- Dr. S.S. Patil, *Principal Scientist* awarded Indian Scientist Award-2021 by International Research Association, England, UK.

- Two startups incubated at ICAR-NIVEDI viz., M/s Jeevabharu Bioinnovation Pvt Ltd and M/s. Frootss Technologies Pvt Ltd, won the Agri India Hackathon -2021 challenge award.

- ICAR-NIVEDI was bestowed with Swachhta Pakhwada Award 2021 (First Prize) by Hon'ble Shri. Narender Singh Tomar, Union Minister for Agriculture and Farmers Welfare during Director's conference at NASC Complex, New Delhi.

12. Miscellaneous

A. Committees

Quinquennial Review Team (QRT)

Name and Designation	Position
Dr.B.B.Malik, Former VC, WBUAIS, Kolkata & Ex-Director, IVRI	Chairman
Dr. VA Srinivasan, Ex-Director, Indian Immunological, Hyderabad	Member
Dr. Lal Krishna, Ex-ADG, ICAR	Member
Dr. JR Rao, Former Head, Division of Parasitology, IVRI, Izatnagar	Member
Dr. A Chakravarty, Ex-Dir, Research, AAU, Khanaparha	Member
Dr. P Kumar, Ex-Head, Ag Economics, IARI	Member
Dr. P.P. Sengupta, Principal Scientist, ICAR- NIVEDI, Bengaluru	Member Secretary

Research Advisory Committee (RAC)

Name and Designation	Position
Dr. C. Balachandran, VC, TANUVAS, Chennai-600 051, Tamil Nadu	Chairman
Dr. B. R. Shome, Director (A)	Member
Prof. Gaya Prasad, VC, SVPUAT, Meerut- 250110, Uttar Pradesh	Member
Dr. K. Kumanan, Prof. & Head, Dept. of Bioinformatics, MVC,TANUVAS, Chennai-600 051, Tamil Nadu	Member
Dr. K. Prabhudas, Former Director, PD_ADMAS, Hyderabad- 500 016,Telangana	Member
Dr. Manoj V Murhekar, Director & Scientist G, ICMR-NIE, Chennai-600077, Tamil Nadu	Member
Dr. V.V.S. Suryanarayana, Retd. Principal Scientist, ICAR-IVRI,Visakhapatnam-530040, Andra Pradesh	Member
Dr. Manoj Raje, Chief Scientist, CSIR-IMT, Chandigarh-160 036	Member
Shri Ashok Allapur, Progressive farmer, Sindhagi,-586128, Vijayapura, Karnataka	Member
Dr. V. Balamurugan, Principal Scientist	Member Secretary

Institute Management Committee (IMC)

Name and Designation	Position
Dr. B. R. Shome, Director	Chairman
Dr. Ashok Kumar, ADG (AH), ICAR, New Delhi	Member
Dr. Aniket Sanyal, JD, IVRI, Bengaluru	Member
Dr. G. Sai Kumar, IVRI, Izatnagar	Member
Dr. TK Bhattacharya, DPR, Hyderabad	Member
Dr. NH Mohan, National Fellow, NRC Pig, Guwahati	Member
Sh. Vijaya Kumar, AF& AO	Member
Sh. Raghuraman V, AO	Member Secretary

Priority Setting, Monitoring and Evaluation Cell (PME)

Name and Designation	Position
Dr. P. P. Sengupta, Principal Scientist	Nodal officer till 10.11.2021
Dr. V. Balamurugan, Principal Scientist	Co-Nodal officer till 10.11.2021 Nodal Officer w.e.f. 11.11.2021
Dr. G. Govindaraj, Principal Scientist	Co-Nodal officer w.e.f. 11.11.2021
Dr. M. Nagalingam, Senior Scientist	Co-Nodal officer
Dr. G. Narayanan, Senior Scientist	Co-Nodal officer
Dr. Siju Susan Jacob, Scientist	Co-Nodal officer
Dr. H. B. Chethan Kumar, Scientist	Co-Nodal officer
Dr. A. Prajapati, Assistant Chief Technical Officer	Co-Nodal officer

Institute Technology Management Committee (ITMC)

Name and Designation	Position
Dr. B. R. Shome Director (A)	Chairman
Dr. Divakar Hemadri, Principal Scientist	Member
Dr. K. P. Suresh, Principal Scientist	Member
Dr. P. P. Sengupta, Principal Scientist	Member
Dr. B. P. Sreenivasa, Principal Scientist, ICAR-IVRI, Bengaluru	Member
Dr. G. Govindaraj, Principal Scientist	Member
Dr. M. Nagalingam, Senior Scientist	Member Secretary

Institutional Animal Ethics Committee (IAEC)

Name and Designation	Position
Dr. B. R. Shome, Director (A)	Biological Scientist cum Chairperson
Dr. R. K. Shakthi Devan, Syngene International Limited, Bengaluru	CPCSEA Nominee
Dr. Jagadeesh S, Professor , Department of veterinary pharmacology and toxicology, Veterinary College, Bengaluru	Link Nominee
Dr. Shivakumar, Head, Technical & Labs, Provimi Animal Nutrition India Ltd, Bengaluru	Scientist from outside the institute
Dr. R. G. Prakash, Senior Technical Officer, JNCASR, Jakkur, Bengaluru	Socially Aware Nominee
Dr. V. Balamurugan, Principal Scientist	Scientist of different discipline
Dr. Jagadish Hiremath, Senior Scientist	Scientist of different discipline
Dr. Siju Susan Jacob, Scientist	Veterinarian
Dr. P. Krishnamoorthy, Senior Scientist	Member Secretary

Institutional Biosafety Committee (IBSC)

Name and Designation	Position
Dr. B. R. Shome, Director (A)	Chairman
Dr. Suresh H Basagoudanavar, Pr. Scientist, ICAR-IVRI, Bengaluru	DBT Nominee
Dr. N. Ravi Sundaresan, Asst. Professor, Dept. of Microbiology and Cell Biology, IISc, Bengaluru	Outside Expert
Dr. Sakey Srinivas, Chief Medical Officer, ICAR-IVRI, Bengaluru	Biosafety Officer
Dr. Divakar Hemadri, Principal Scientist, ICAR-NIVEDI, Bengaluru	Internal Member
Dr. G. B. Manjunatha Reddy, Senior Scientist, ICAR-NIVEDI, Bengaluru	Internal Member
Dr. M. Nagalingam, Senior Scientist, ICAR-NIVEDI, Bengaluru	Internal Member
Dr. Jagadish Hiremath, Senior Scientist, ICAR-NIVEDI, Bengaluru	Member Secretary

Hindi Implementation Committee

Name and Designation	Position
Dr. B. R. Shome, Director (A)	Chairman
Dr. Divakar Hemadri, Principal Scientist	Co-Chairman
Dr. Rajeswari Shome, Principal Scientist	Member
Dr. Manjunatha Reddy G.B., Senior Scientist	Member
Sh. A. Vijay Kumar, AF&AO	Member
Dr. Awadhesh Prajapati, Assistant Chief Technical Officer	Member secretary

Women's cell

Name and Designation	Position
Dr. Rajeswari Shome, Principal Scientist	Chairperson
Dr. R. Sridevi, Senior Scientist	Member
Dr. G. Govindaraj, Principal Scientist	Member
Mr. V. Raghuraman, Administrative Officer	Member till 9th November, 2021
Dr. Siju Susan Jacob, Scientist	Member Secretary

B. Distinguished visitors

1. Dr. Praveen Malik, Animal Husbandry Commissioner, DAHD, GoI, New Delhi
2. Prof. (Dr.) Suresh S Honnappagol, Former Vice-Chancellor, KVAFSU, Bidar and Former Animal Husbandry Commissioner, DAHD, GoI.
3. Dr. H. Rahman, Former DDG (AS) & ILRI Representative South Asia
4. Dr. B.N. Tripathi, Deputy Director General (Animal Science), ICAR, New Delhi
5. Dr. Mahesh A.S., Joint Commissioner & Director, CPDO&TI, Hessarghatta, Bengaluru
6. Mrs. Kavitha Mishra, Managing Director, Sandal Farm, Raichur, Karnataka
7. Mrs. Suseela Santhosh, Director, Vishwa Vidyapeeth group of schools, Bengaluru
8. Dr. K. Jayanna, Dean, Faculty of Life and Allied Health Sciences, Ramaiah University of Applied Sciences
9. Dr. Janaki H.P., Assistant Director (Rtd), AH&VS, Karnataka
10. Dr. Meera Uday, Professor, National School of Business, Bengaluru
11. Dr. Monal Daptardar, Consultant Public Health, New Delhi
12. Ms. Trishala Sharma, Data Manager, NCDC, New Delhi

Sl. No	Name of the Officers & Staff	Designation
1	Dr. B.R. Shome	Director (Actg.) (RMP)
Scientific staff		
2	Dr. (Mrs.) R. Shome	Principal Scientist
3	Dr. Divakar Hemadri	Principal Scientist
4	Dr. P.P.Sengupta	Principal Scientist
5	Dr. K.P. Suresh	Principal Scientist
6	Dr.V. Balamurugan	Principal Scientist
7	Dr. Sharanagouda S Patil	Principal Scientist
8	Dr. S. B. Shivachandra	Principal Scientist
9	Dr. G. Govindaraj	Principal Scientist
10	Dr. Jagadish Hiremath	Senior Scientist
11	Dr. P. Krishnamoorthy	Senior Scientist
12	Dr. (Mrs) R. Sridevi	Senior Scientist
13	Dr. Md. Mudassar Chanda	Senior Scientist
14	Dr. Shivasharanappa N	Senior Scientist
15	Dr. M. Nagalingam	Senior Scientist
16	Dr. G. B. Manjunatha Reddy	Senior Scientist
17	Dr. Narayanan G	Senior Scientist
18	Dr. (Mrs) Siju Susan Jacob	Scientist
19	Dr. Chethan Kumar H.B	Scientist
20	Dr. Sathish Gowda C.S	Scientist
Technical Staff		
21	Dr. Yogisharadhya R	ACTO
22	Dr. Awadhesh Prajapati	ACTO
Administrative Staff		
23	Sh. Raghuraman V	AO till 9.11.2021
24	Sh. Muraleedharan P	AO w.e.f. 27.12.2021
25	Sh. A. Vijay Kumar	AF& AO
26	Sh. Narayanaswamy N	AAO till 30.6.2021
27	Sh. Santosh Kumar	AAO w.e.f. 10.08.2021
28	Mrs. Saranya A	Steno-Gr-III
29	Sh. K. Vijayaraj	Steno-Gr-III
30	Mrs. Sridevi G.C.	UDC
31	Sh. Gangadhareshwara L	LDC
Skilled Supporting Staff (SSS)		
32	Sh. M. K. Ramu	SSS
33	Sh. Hanumantharaju	SSS
34	Sh. H. S. Umesh	SSS

D. Staff Joined/ Transferred/Promoted/ Superannuated

- Dr. Shivasharanappa N, Senior Scientist (Veterinary Pathology) transferred from ICAR - Central Coastal Agricultural Research Institute, Goa and joined ICAR-NIVEDI on 11th October 2021.

- Sh. Muraleedharan P, promoted as Administrative Officer (AO) and transferred from ICAR- Indian Institute of Spices Research, Kozhikode and joined ICAR-NIVEDI on 27th December 2021.

- Sh. Santosh Kumar transferred from ICAR-Central Marine Fisheries Research Institute, Cochin and joined as Assistant Administrative Officer (AAO) (on deputation) in ICAR- NIVEDI on10th August 2021 and relieved from ICAR-NIVEDI on 7th February 2022 to join as AAO (promotion) back to ICAR-CMFRI, Cochin.

- Dr .G. Govindaraj, Senior Scientist promoted as Principal Scientist w.e.f. 1st January 2020.

- Dr. Jagadish Hiremath, Senior scientist promoted to Pay level-13A w.e.f 1st March 2020.

- Dr. P. Krishnamoorthy, Senior scientist promoted to Pay level-13A w.e.f 7th January 2021.

- Dr. R. Sridevi, Senior scientist promoted to Pay level-13A w.e.f 10th February 2021.

- Dr. M. Nagalingam, Scientist promoted as Senior Scientist w.e.f. 21st April 2019.

- Dr. G. B. Manjunatha Reddy, Scientist promoted as Senior Scientist w.e.f. 21st April 2019.

- Dr. Narayanan G, Scientist promoted as Senior Scientist w.e.f. 27th April 2020.

- Dr. Chethan Kumar H. B., Scientist promoted to Pay level -11 w.e.f. 26th July 2019

- Dr. Sathish Gowda C. S., Scientist promoted to Pay level -11 w.e.f. 1st January 2020.

- Dr. R. Yogisharadhya, STO promoted as Assistant Chief Technical Officer w.e.f. 16th December 2018.

- Dr. Awadesh Prajapati, STO promoted as Assistant Chief Technical Officer w.e.f. 1st January 2019.

- Mrs. Saranya A, Steno-Gr-III promoted as Assistant w.e.f.1st January 2022.

- Mrs. Sridevi G.C, Lower Divisional Clerk (LDC) got promoted as Upper Divisional Clerk (UDC) w.e.f 28th June 2021.

- Mr. Raghuraman, Administrative officer transferred with promotion from ICAR NIVEDI to ICAR-CMFRI, Cochin as Senior Administrative Officer on 9th November 2021.

- Shri. N. Narayanaswamy, AssistantAdministrative officer was superannuated from service on 30th June 2021.

E. BUDGET

Revised Estimate and Expenditure of ICAR- NIVEDI (2021-22) (in Lakh Rupees)

Major Heads	Plan	
	Revised Estimate	Revised Estimate
Grant for creation of capital assets (Capital)	_	_
Works	_	_
Equipment	15.00	15.00
Information Technology	13.00	13.00
Library Books and Journals	_	_
Vehicles & Vessels	_	_
Furniture & Fixture	2.00	2.00
Grant in Aid-Salaries (Revenue)	739.15	739.15
Establishment Expenses (Salaries)	_	_
Grant in Aid-General (Revenue)	450.00	450.00
Travelling Allowances	_	_
Research & Operational Expenses	_	_
Administrative Expenses	_	_
Miscellaneous Expenses	_	_
NEH	62.00	62.00
SCSP	43.00	43.00
Grand Total	**1324.15**	**1324.15**

Revenue Receipts (2021-2022) (in Lakh Rupees)

Description	Amount
License Fee	4.93
Interest earned from loans a & advances	–
Interest earned from short term deposits	5.79
Interest earned from Training	–
Income generated from sale of kits	5.38
Income generated through brucellosis diagnostic service	1.28
Miscellaneous receipts	10.92
Total	**28.30**

13. ICAR-NIVEDI Activities

Distinguished visitors

Hon'ble Dr. B.N. Tripathi, DDG (Animal Science), ICAR, New Delhi visited ICAR-NIVEDI and inaugurated the "Rainwater harvesting pond" and interacted with scientists on 25th January 2021.

Dr. Mahesh A.S., Joint Commissioner & Director, CPDO&TI, Bengaluru, visited ICAR-NIVEDI and delivered a lecture on the National Science Day (28th February, 2021).

Dr. Monal Daptardar, Consultant Public Health and Ms. Trishala Sharma, Data Manager, NCDC, New Delhi visited ICAR-NIVEDI on 25th March, 2021.

Dr. K. Jayanna, Dean, Faculty of Life and Allied Health Sciences, Ramaiah University of Applied Sciences, visited ICAR-NIVEDI during a health awareness programme on "Effective Health Management for Enhancing Work Efficiency" on 8th January, 2021.

Important Meetings

Dr B.R. Shome, Director (A), ICAR-NIVEDI met Hon'ble Dr Trilochan Mohapatra, Secretary, DARE & DG, ICAR on 20th March, 2021 at ICAR-NIANP, Bengaluru for discussion on EFC of the institute.

Virtual 13th Research Advisory Committee (RAC) meeting of ICAR-NIVEDI held on 6th March, 2021

The 17th Institutional Animal Ethics Committee (IAEC) meeting of ICAR-NIVEDI held on 30th January, 2021

Institute Technology Management Committee (ITMC) meetings of ICAR-NIVEDI held on 12th February, 10th March, 2021 and 11th November, 2021 to discuss on commercialization of technologies, patent and copyright proposals etc.,

Institute Joint Staff Council (IJSC) meeting of ICAR-NIVEDI held on 29th June, 2021

29th Annual Review Meet of AICRP on ADMAS held on 24th November 2021

Mid-Term IRC meeting of ICAR-NIVEDI held on 10th December 2021

20th IMC meeting of ICAR-NIVEDI held on 17th December 2021

Exhibition

ICAR-NIVEDI participated in the National Horticultural Fair held during 8-12th February, 2021 organized by Indian Institute of Horticultural Research, Bengaluru

Important events

The 72nd Republic Day was celebrated by ICAR-NIVEDI on 26th January, 2021

International women's day celebrated on 8th March 2021

Medical Health check-up conducted on 25th March 2021 for all the permanent staff of ICAR-NIVEDI

Shri. N. Narayanaswamy, Assistant Administrative officer was superannuated from service on 30th June, 2021.

Institute Foundation Day was celebrated on 1st July 2021

COVID-19 vaccination drive held on 1st July 2021 commemorating Institutional Foundation Day

Tree sapling plantation by the Director, ICAR-NIVEDI, Bengaluru during ICAR Foundation Day on 16th July 2021.

At ICAR-NIVEDI, 16th Parthenium awareness week (16-22 August, 2021) was observed

Honourable Prime Minister interaction with farmers-virtual telecast: Scientists farmers interaction at ICAR-NIVEDI on 28th September 2021

On the occasion of World Rabies Day 2021, ICAR-NIVEDI organized free Anti-Rabies Vaccination Camp for dogs/cats at Veterinary Clinical Complex, Yelahanka on 28th September 2021.

National Unity Day observed at ICAR-NIVEDI on 30th October 2021

Vigilance awareness week observed at ICAR-NIVEDI during 26th October to 1st November 2021

Legal Awareness program on 'Sexual Harassment of women at work place" was organized at ICAR-NIVEDI on 23rd November 2021

ICAR-NIVEDI celebrated the 72nd Anniversary of adoption of constitution of India on 26th November 2021

World Antimicrobial awareness week was organized at ICAR-NIVEDI during 18-24th November 2021

Karnataka Rajyotsava was celebrated at ICAR-NIVEDI on 30th November 2021

ICAR-NIVEDI organized National Farmers' Day on 23rd December 2021

Training programs

ICAR-NIVEDI organized "Sensitization e-workshop on important Zoonotic diseases" for Karnataka and "Meeting of state level zoonosis committee in Kerala" for Kerala states during 10th February and 17th March, 2021, respectively under Intersectoral co-ordination programme sponsored by NCDC, New Delhi

ICAR-NIVEDI organized Training Programme on Skill Development in Scientific Animal Husbandry practices and practical farm visits for the benefit of Scheduled caste farmers, in collaboration with ICAR-Krishi Vigyan Kendra, Konehalli, Tumkur on 9th March, 2021.

ICAR-NIVEDI organized awareness programme on Zoonotic Diseases under Outreach Programme on Zoonotic Diseases project at Pemmadevarahalli village, Koratagere, Tumkur, Karnataka on 21st March, 2021.

ICAR-NIVEDI and KVK, Hirehalli, Tumkur organized awareness programme on zoonotic diseases to farmers in Chikkadoddavadi, Tumkur district on the occasion of World Zoonoses Day celebration on 7th July 2021.

Under NADCP project, training on project implementation was conducted for 63 Veterinarians in Deputy Director Office, Department of Animal Husbandry and Veterinary Services, Chikkaballapur District, Karnataka on 2nd September 2021.

ICAR-NIVEDI organized awareness lecture on 'Rabies' for students of Nagarjuna PU college, Bengaluru on 28th September 2021on the occasion of World Rabies Day 2021.

Sensitization meeting/workshop on economics of brucellosis with Deputy Director (DAH & VS) and other district veterinary officers for ICAR-ILRI project "Assessment of economic impact of priority animal disease and the cost effectiveness of their control strategies in India-Brucellosis at Tumkur organized by Dr. Rajeswari Shome, Dr. G. Govindaraj and Dr. M. Nagalingam on 24th December 2021.

ICAR-NIVEDI in collaboration with Extension Education Unit of University of Agricultural Sciences, Bengaluru/ICAR-KVK-Chintamani and Department of Animal Husbandry and Veterinary Services, Kolar conducted training Program on 'Doubling Farmers Income through poultry rearing' for scheduled caste farmers at Vaddaraplya, Kolar district on 28th December 2021.

Livestock disease investigations/Field visits

Dr. K. P. Suresh, Principal Scientist and Dr. P. Krishnamoorthy, Senior Scientist visit to AICRP on ADMAS centres Vijayawada, Andhra Pradesh and Hyderabad, Telangana states on 16th and 18th February, 2021
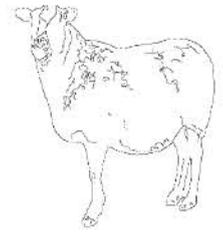

Dr. D. Hemadri and Dr. V. Balamurugan, Principal Scientists discussion with State Project Director, IDSP at Health and Family Welfare Department, Bengaluru on 23rd March, 2021.

Dr M. Nagalingam, Senior Scientist conducted investigation of ovine brucellosis at Kuruburu, Chintamani, Chikkaballapur on 30th November 2021.

Dr P. Krishnamoorthy, Senior Scientist visit to the State Level Animal Disease Diagnostic Laboratory, Tirupati on 1st December 2021.