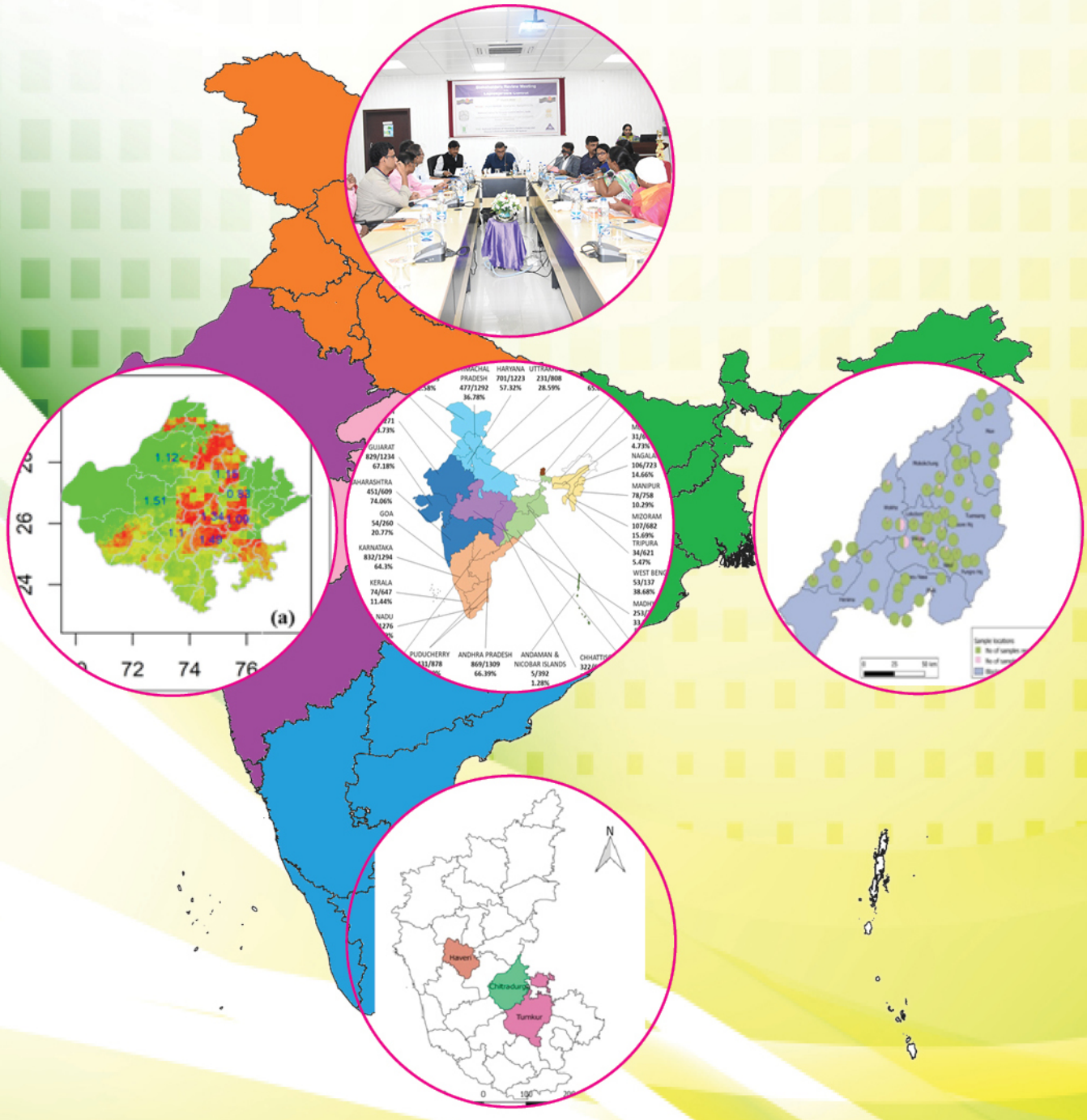
ANNUAL REPORT 2020



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

(ISO 9001 : 2015 Certified)

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Annual Report 2020

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

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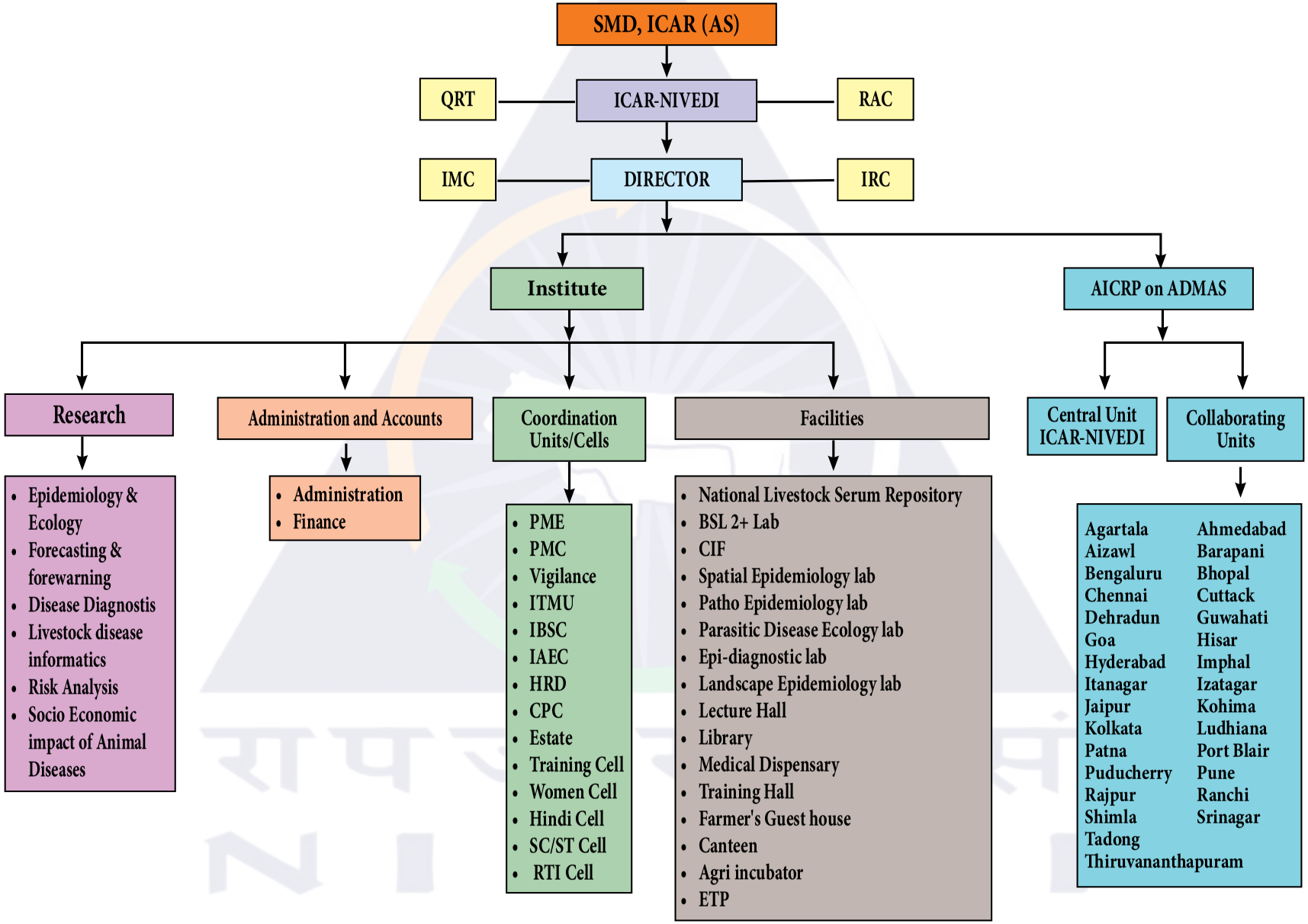
(B. R. Shome)
Director (A)

ORGANOGRAM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Administration and Accounts
Coordination Units/Cells
Facilities
Central Unit ICAR-NIVEDI
Collaborating Units
• Epidemiology & Ecology
• Forecasting & forewarning
• Disease Diagnostis
• Livestock disease informatics
• Risk Analysis
• Socio Economic impact of Animal Diseases
• Administration
• Finance
• PME
• PMC
• Vigilance
• ITMU
• IBSC
• IAEC
• HRD
• CPC
• Estate
• Training Cell
• Women Cell
• Hindi Cell
• SC/ST Cell
• RTI Cell
• National Livestock Serum Repository
• BSL 2+ Lab
• CIF
• Spatial Epidemiology lab
• Patho Epidemiology lab
• Parasitic Disease Ecology lab
• Epi-diagnostic lab
• Landscape Epidemiology lab
• Lecture Hall
• Library
• Medical Dispensary
• Training Hall
• Farmer's Guest house
• Canteen
• Agri incubator
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Aizawl
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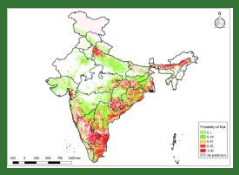
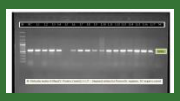
NATIONAL INSTITUTE OF VETERINARY EPIDEMIOLOGY AND DISEASE INFORMATICS

MAJOR RESEARCH AREAS

Epidemiology and Ecology

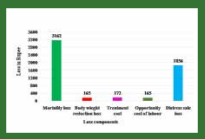



Epi-diagnostics and Disease Surveillance



Disease Informatics


Animal Health Economics




Capacity Building


EXECUTIVE SUMMARY

Epidemiology of a disease has played an important role in the present context of COVID-19 pandemic and has paved the way for prevention and control of a disease. Epidemiology has assisted in eradication of rinderpest and various other animal diseases including those of human. Considering the need of such discipline in the study of livestock disease including zoonoses, ICAR-National Institute of Veterinary Epidemiology was established and is a unique institute in the country catering to the needs of livestock disease management in the country.

The institute is conducting research on epidemiology of livestock diseases including zoonoses in the context of one health and planetary health. The surveillance kits for different animal diseases by this institute are cost effective and popular in the country. ICAR-NIVEDI is a pioneer institute working on forecasting and forewarning of animal diseases. The institute has provided estimates of economic losses due to animal diseases to the policymakers.

The salient findings of the research projects in this annual report for the period January to December, 2020 are mentioned in brief. Artificial intelligence system enabled, National Animal Disease Referral Expert system v2 is the cynosure of all activities which is forecasting 13 livestock diseases two months in advance utilising disease outbreak data, weather parameters.

With regard to Anthrax, it was found that the risk of anthrax is high in areas of mean elevation of 885.15 m and the risk of outbreaks is low in elevation above 967.911 m and below 755.47m for Karnataka. Hence, the surveillance should be targeted in high-risk areas. From the survey, it was found that the villagers felt secured and comfortable to ventilate health status in local language. One sample was found positive for anthrax in Odisha.

Currently two projects are running viz., first "Indian Network for Fisheries and Animal Antimicrobial Resistance (ICAR-INFAAR)" second "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." and third project entitled "Countrywide surveillance for Anthrax in livestock and Mastitis in Cattle for protecting and improving health globally: Building and strengthening public health impact, systems, capacity (Mastitis Component – CDC)" has recently been completed in September 2020. All the three projects are focusing on surveillance of AMR bacteria from livestock and foods of animal origin from Karnataka and North-East India. WGS based surveillance is currently being used in an Indo-UK collaborative project to address the menace of AMR through One-Health approach in India.

Under Brucellosis control programme, post vaccinated cattle (Adult) sera samples from an organized farm of Haryana tested for vaccinal antibodies by cELISA showed 65.05% positivity. The seroprevalence was recorded as 6.37%, 7.18%, 5.93% and 15.04% in cattle, goat, pig and animal handlers, respectively. The fluorescent polarization assay was standardized to be used as a differentiating test from Brucella infected animals. Overall 6.84% apparent prevalence of B. suis was recorded in Nagaland with highest sero-prevalence of 52.83% was recorded in one district.

A total of 807 pig serum samples received from different states i.e., Arunachal Pradesh, Chhattisgarh, Goa, Kerala, Maharashtra, Mizoram, Odisha, Rajasthan were tested for the presence of CSFV antibodies and found 266 Positive for CSFV, showing the prevalence of (32.96%) using CSF Ab check kit. A total of 11553 pig sera samples were screened spanning 11 years revealed 38.16% seropositivity. The Indirect ELISA kit (CSF Ab Check) developed by the institute for detection of antibodies against CSFV in Pigs was released by the Hon'ble Shri Narendra Singh Tomar, Union Minister of Agriculture and Farmers Welfare on 16th July 2020

More projects were awarded in the field of Cysticercosis, Fasciolosis. The indirect ELISA employing r cathB5 was developed by the institute that showed 95.8% sensitivity, 90.6% specificity with a Cohen's kappa value of 0.861.

Prevalence of genes of *Pasteurella multocida* were; *nanH* (90%), *oomph* (71%), *pfhA* (63%), *plpB* (80%), *hsf-1* (12%), *hsf-2* (37%), *pmHAS* (78%), *toxA* (78%), *hgbA* (37%), *hgbB* (81%), *tbpA* (78%) and *fimA* (98%), among isolates. Molecular characterisations of the isolates pf *P. multocida* from sheep and goat were done by Antibiotic resistance genes PCR for quinolones and tetracycline and six found positive.

During period, a total of 911 bovine serum samples received from six states/UT *viz*, Andaman and Nicobar (n=418), Karnataka (n=175), Kerala (n=100), Madhya

Pradesh (n=100), Odisha (n=100) and Telangana (n=18) were tested for the presence of IBR antibodies using the ICAR-NIVEDI's Avidin-Biotin ELISA kit. It was found that out of 911 sera, 266 samples were found to be positive for IBR antibodies with overall seropositivity rate of 29.20%. Further, in the country between the years 1995-96 and 2020-21, a total of 96,861 bovine serum samples were screened for IRB antibodies of which 33,397 sera were found positive with an overall national prevalence of 34.47%.

A qPCR protocol was developed and standardized for screening the pig samples for Japanese encephalitis using M gene primers with PCR product size of 134. Projects on respiratory viral persistence in pigs, development and validation of novel multiplex serodiagnostic for diagnosis of porcine respiratory disease complex have provided a new insight into the research.

Evaluation of multi-antigenic proteins and fusion recombinant proteins of Leptospira as a diagnostic antigen in immunoassay LAT/ELISA is in progress. Recombinant Antigen based Diagnostics for Bovine and Human Leptospirosis was developed.

A population assay/test was developed for detection of antibodies against PPR. High coverage mass vaccination is required to eliminate the PPR virus. The state-wise PPR seroprevalence/immunity status in India has been discussed.

Validation of population assay developed with ORF 117 with serum samples revealed 98% sensitivity and 96% specificity with sheep pox and 97% sensitivity and 98% specificity with goat pox.

A total of 2460 serum samples and 1722 blood samples have been analysed for the presence of antibodies against *T. evansi* in different animal species of three NE States of India comprising Assam, Mizoram and Tripura. Serology employing ELISA/CATT revealed 26.96, 25.71, 25; and 19.54;–percent positive whereas PCR revealed 9.82, 12.85, 3.12, 4 and 5.29 positive in cattle, buffalo, goat, pig and dog respectively from the study area. Different projects on zoonotic diseases have provided useful information which can pave the way for formulating control programmes.

ICAR-NIVEDI maintains a National Livestock Serum Repository (NLSR) and presently, it contains more than 1,00,000 catalogued serum samples of various livestock species, collected since the year 2011and is being utilised by various organizations. Agri business incubators funded by ICAR and RKVY is catering to the needs of start-ups and its work is applauded by the council.

National Animal Disease Referral Expert System v2 (NADRES-v2) database is a weather-based forewarning system enabled with artificial intelligence and machine learning intelligence tools developed by ICAR- NIVEDI that forecasts 13 economically important livestock diseases two months in advance to provide the stakeholders sufficient time for awareness and preparedness to act further. The information in the form of a monthly bulletin supplied all the state animal husbandry departments is highly appreciated. Sampling plans for collection of biological samples from bovines, sheep, goat and pigs was provided to DAHD, GoI, New Delhi under National Animal Disease Control Programme (NADCP). ICAR-NIVEDI is a major partner in animal disease control programmes planned by the DAHD, GoI, New Delhi and is supporting the schemes at all India level.

Outreach programmes like Mera Gaon Mera Gaurav, Swachh Bharat Abhiyan, DAPSC are being implemented by the institute successfully.

ICAR-NIVEDI *.....an unique institute*

ICAR-NIVEDI began its journey as AICRP on ADMAS in 1987, upgraded to PD- ADMAS in 2000 and finally in the year 2013 it was rechristened as ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (ICAR-NIVEDI). The coordinating units of AICRP-ADMAS continued to grow from four coordinating unitsduring1987to31 at present. ICAR-NIVEDI is a pioneering institute working with the mandate of R&D in the field of veterinary epidemiology and disease informatics. Its role is significant in developing disease models, risk analysis, animal disease forecasting &forewarning; need based diagnostics and economic impact of livestock diseases. The institute has developed various technologies and patented few products which are being utilized by different stakeholders in the country. The role of this institute in the eradication of Rinderpest from India and development of National Animal Disease Referral Expert System (NADRES), an interactive software for animal disease forecasting, are noteworthy. The institute has been conducting plethora of training programmes on epidemiology, economic impact, sampling frame, GIS and RS and disease diagnosis that benefits national and international stakeholders. The efforts of ICAR- NIVEDI have been appreciated and recognized by various organizations by conferring international and national awards and fellowships.

ICAR-NIVEDI plays a significant role by delivering many innovative solutions and services in the form of improved animal disease forecasting and forewarning models, diagnostic techniques, economic estimates of animal diseases and its control. The institute works with the following vision, mission, focus and mandates:

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.

Mission

- Capacity building in frontier areas of Veterinary Epidemiology, dynamics of animal diseases including zoonoses and animal health care intelligence.

Focus

- Improving disease monitoring and surveillance through development of pen side diagnostics
- Risk assessment for 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 modelling/forecasting
- Understanding economic impacts of animal diseases and the management strategies
- Promoting innovations and improving human resource capacity

Mandate of ICAR-NIVEDI

- Epidemiology, informatics and economics of animal disease including zoonoses.
- Surveillance, forecasting and forewarning for management of animal diseases including zoonoses.
- Repository and capacity development.

Mandate of AICRP on ADMAS

- Strengthening of National Livestock Serum Repository
- Effective updating of NADRES with active disease data, climatic and non-climatic risk factors
- Surveillance of diseases/pathogens of companion, lab and wild animals
- Analysis on economic losses due to animal diseases and the control measures adopted for their management
- Sero-monitoring of animal diseases based on sample frame
- Investigation of endemic, emerging and reemerging animal disease outbreaks using innovative technologies

Research Projects

6. Anthrax

6a. Identification of Ecological risk factors for occurrence of Anthrax in India

The main objectives of the project were to develop risk map for occurrence of anthrax in endemic states of India, identify temporal factors responsible for occurrence of anthrax and identification of village level risk factors. During the period under report, role of elevation in occurrence of anthrax outbreaks was further evaluated. It was found that the risk of anthrax is high in areas of mean elevation of 885.15 m and the risk of outbreaks is low in elevation above 967.911 m and below 755.47m for Karnataka. Hence, the surveillance should be targeted in high-risk areas (Chanda *et al.*, 2020a).

6b. Countrywide surveillance for Anthrax in livestock and Mastitis in Cattle for protecting and improving health globally: Building and strengthening public health impact, systems, capacity

In the anthrax component, steps were taken to create awareness about Anthrax, to carry out outbreak investigations, to screen suspected clinical samples and capacity building programme to diagnose anthrax. Accordingly, create awareness among the villagers of Koraput district, about the prevention and control of anthrax in livestock and humans, field support staff were deployed to conduct door to door survey. Information with respect to anthrax such as vaccination status, history of illness or death in livestock and human were gathered. From the survey, it is found that the villagers felt secured and comfortable to ventilate health status in local language. It is heartening to note that eight hundred two villagers from 83 villages were covered during the study period whose livestock population is close to 10,000.

During the period, anthrax outbreak investigations in Rupuguda village of Boipariguda block of Koraput district of Odisha and the disease was confirmed. Under the capacity building objective, advanced training on molecular diagnosis of anthrax conducted at Centre for Wildlife Health, OUAT, Bhubaneswar from 4-6 March, 2020.

Processing of clinical materials suspected of anthrax was also done during the period and clinical samples from Odisha (n=29), Jharkhand (n=6) and Gujarat (n=5) were processed and concerned departments were provided with confirmatory diagnosis. In all, 1 out 41 samples was found positive for anthrax (Hemadri *et al.*, 2020a).

7. Antimicrobial Resistance

7a. Indian Network for Fisheries and Animal Antimicrobial Resistance(INFAAR)

A total of 236 samples were collected from various animal species (cow milk-105, buffalo milk-23, Poultry cloacal swabs-45, sheep rectal swab-61 and pig rectal swabs-2), of 16 villages across four taluks in Chikkaballapur District, Karnataka during 2019. The phenotypically confirmed ESBL/AmpC *E.coli* isolates (n=15) were further screened for ESBL (TEM, SHV, OXA and CTX-M genes), AmpC (ACC, FOX, MOX, DHA, EBC, CIT) and carbapenem (NDM) genes. Ten genotypically resistant *E.coli*isolates were detected of which 50% of them were from poultry. Out of two pig samples, one isolate harboured NDM and AmpC gene (Table 1).

Table 1: Genotypic characterization of the isolates from samples obtained in various animal species

S.No	Isolates	Source	Genotypic	Village
1	IN 1	Cow	ESBL (tem, shv)	Thumukalahalli
2	IN 10	Poultry	ESBL(tem)	Thumukalahalli
3	IN 41	Poultry	ESBL (shv)	Manchanaballe
4	IN 54	Poultry	ESBL (ctxm-1)	Gundalagurki
5	IN 59	Pig	ndm, Amp C (dha)	Gundalagurki
6	IN 102	Sheep	ESBL (ctxm-1)	Kendalahalli
7	IN 118	Cow	ESBL (ctxm-1)	Gattamaranahalli
8	IN 124	Cow	Amp C (ebc)	Gattamaranahalli
9	IN 141	Poultry	ESBL (tem), Amp C (dha)	Nagamangala
10	IN 185	Poultry	ESBL (tem, shv)	Mudigere

Survey was taken for second year sampling to find out if all animal species were available in respective villages. Second year sampling was done from Abludu village of Shidlaghatta taluk. A total of 15 samples were collected (cow milk-4, buffalo milk-4, poultry cloacal swabs-3, pig rectal swabs-2 and goat/sheep rectal swabs-2) of which 8 samples viz., cow milk-4 and buffalo milk-4 were processed only for isolation and identification of *Staphylococcus* species while all 15 samples were processed for isolation and identification of *E.coli.* Molecular identification by PCR detected 10 isolates as *Staphylococcus* species. Multiplex PCR identified all the 10 *Staphylococcus* species as MRCoNS with *S.chromogenes* as the most leading species. However, mmethicillin resistant determinant (*mec*A/ *mec* C gene) were not detected from this village. Anti biogram profile showed four isolates (cow-2, buffalo-2) were resistant to penicillin, while two isolates (one each from cow and buffalo milk) were resistant to cefoxitin. *E. coli* specific multiplex PCR detected 6 isolates as *E.coli* (poultry cloacal swabs-2, pig rectal swabs-2 and goat/sheep rectal swabs-2). Confirmatory disc diffusion test revealed out of 6 *E. coli* isolates two from poultry and one from sheep as ESBL producers (Shome BR *et al.,* 2020a).

7b. Surveillance and Molecular analysis of MRSA, MR-CoNS, VRE, ESBL and Carbapenemase producing Gram-Negative bacteria in farm animals, the animal handlers and livestock products in NE India

Achievements:

- Prepared and Submitted the Phase II proposal for the next 3 years work plan under "DBT-Advanced Animal Disease Diagnosis and Management Consortium".
- With the pending data of ADMaC two manuscripts have been submitted to the respective journals.
- A Review paper on "ESBL In Gram Negative bacteria" is under process.
- Pending work was carried out for publications.
- Planned and made the protocol for the next stage of the project.

Awards: STAR ALUMINA Award for creditable Academic and Research achievement on AMR subsequent to award of Ph.D by Jain University on 29th Feb, 2020 (Shome BR, 2020).

7c. Countrywide surveillance for Anthrax in livestock and Mastitis in Cattle for protecting and improving health globally: Building and strengthening public health impact, systems, capacity

The project focused to estimate the burden of mastitis, Knowledge Attitude and Practice (KAP) of animal handlers on antibiotic usage, strengthening surveillance system in Assam and Karnataka for detection of major mastitis pathogens from cattle and animal handlers, their antimicrobial resistance pattern, delineation of molecular epidemiology of those resistant isolates and antibiotic residues presents in milk sample. A total of 1420 (Assam- 793 and Karnataka-627) samples comprises of 1031 – milk samples, 185- AH hand swab, 177- AH nasal swab and 27 milking machine swabs were screened

Assam: From 5 study sites 8th mile, 9th mile, 10th mile,11th mile and Jorabat, 180 households were surveyed for KAP. A total 1341 milking cows were screened for sub clinical mastitis and the prevalence was found to be 54.06%. Out of six antibiotics screened for antibiotic residues, 19.14% of milk samples were contaminated for one or the other antibiotic groups. The milk samples (649), AH hand swab (76) and AH nasal swab (68) were processed and 235 *Staphylococcus spp.* were identified by genus specific PCR. High antibiotic resistance was observed against **β-lactams (76%) followed by Lincosamide (26%) and Macrolides (25%). The lowest Resistance was observed for Nitrofurans (3%).** The*mec*A gene determinant was found in 39 (16.59%) isolates of which 8.51% from milk samples, 1.27% from AH hand swab and 6.8% from AH nasal swab. The resistant isolates were identified as *S.epidermidis* (8.5%) *S.haemolyticus* (5.1%), *S.scuiri* (1.28%), *S.aureus* (0.85%), 0.42% of both *S.auricularis* and *S.saprophyticus.* Out of 173 Gram negative isolates, 35 isolates were *K. pneumoniae*, 65 isolates were *Klebsiella* sp., 12 were *E. coli and rest* 61 were other Gram-negative bacteria. The high antibiotic resistance was observed against Penicillins (88%) followed by Cephalosporins (53%) and Sulfonamides (14%).Phenotypic confirmatory test for extended-spectrum β-lactamase (ESBL)/ AmpC β-lactamase (AmpC) /Metallo-beta-lactamase (MBL) producing gram negative isolates comprised of 49%, 24% and 5% respectively.

Karnataka:A total of 211 households were KAP surveyed from four taluks Devanahalli, Doddaballapura, Nelamangala and Bangalore

north. Out of 533 milking cows screened for sub clinical mastitis, prevalence was found to be 48.03%. Six antibiotics were screened for antibiotic residue testing by Charm Rosa test, 20.78% milk samples were contaminated one or the other antibiotic groups. The milk samples (382), AH hand swab (109), AH nasal swab (109) and 27 milking machine swabs were processed and 455 (72.56%) *Staphylococcus spp*. (milk – 241, AH hand swab -98, AH nasal swab -93 and milk machine swab-27) were identified. Multiplex PCR identified *S.epidermidis* (24.83%), *S.aureus* (24.61%), *S.chromogens* (9.67%), *S.scuiri* (3.51%) and *S.haemolyticus* (1.97%). Genotypic detection revealed 52 mecA positive isolates which includes, 20 isolates from milk, 2 from milking machine swab, 14 from hand swab, 16 from nasal swab. Genotypic identification revealed 13, 02, 01 MRSA from milk, hand swab and nasal swab respectively. Seven MRCoNS from milk [2 each of *S. epidermidis* and *S. haemolyticus*, 1 each of *S. chromogenes*, *S. hominis* and *S. saprophyticus)*, two MRCoNS from milking machine swab [*S. epidermidis* (1), *Enterococcus faecalis* (1)]; 12 [*S. epidermidis* (6), *S. chromogenes* (2), *S. haemolyticus* (2), *S. sciuri* (1), *S. hominis* (1)]; 15 [*S. epidermidis* (15)] MRCoNS from hand swab and nasal swab respectively. High antibiotic resistance was observed against **β-lactams (71%) followed by Lincosamide (13%) and** Aminoglycosides (13%). Out of 268 Gram negative isolates, 8 isolates were identified as *K. pneumonia*, 62 were *Klebsiella* sp., 37 were *E. coli* and 161 were other Gram-negative bacteria. The high antibiotic resistance was observed against Penicillins (62%) followed by Cephalosporins (45%) and Tetracyclins (9%). The lowest Resistance was observed for Aminoglycosides (1%). Phenotypic confirmatory test for extended-spectrum β-lactamase (ESBL)/ AmpC β-lactamase (AmpC)/ Metallo-beta-lactamase (MBL) producing gram negative isolates comprised of 40%, 23% and 4% respectively (Shome BR *et al.*, 2020b).

7d. 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

First and 2nd longitudinal survey was conducted in the Kamrup District, Guwahati viz., (Silagrant (NGTC Ward 4), Garchuk and North Guwahati Town Committee (NGTC) wards 1-3] and in the three sites surveyed samples were collected from the 38 households. A total of 102 [Silagrant (n=35), Garchuk (n=32) and NGTC wards (n=35) samples characterized were resulted in 168 Gram positive and 152 Gram negative bacterial isolates (Silagrant, 45 and 42; from Garchuk, 61 and 55 and from NGTC, 62 and 55] gram positive and Gram-negative bacterial isolates were identified and subjected to Antimicrobial susceptibility testing (ABST) by automated BD-Phoneix (M-50) ID and AST system. First sampling AST data revealed no significant difference in resistant bacteria at three sites however, variations among the sites were observed. A total of 765 bacterial DNA (269 Gram positive and 485 Gram negative) from all the six partner institutes (NIVEDI 203 and 218; CIFT 30 and 66; GMCH 34 and 110; IVRI 8 and 36; IIT 1 and 11 Gram positive and Gram negative and NEH 48 Gram negative isolates) were processed for whole genome sequencing at Cambridge, UK. A total of 5 Genome of MRSA of bovine origin from Karnataka were submitted to NCBI-Gen Bank under accession Nos JABTVD000000000 (Color scheme: dark green), JABTVE00000000 (orange), JABTVF00000000 (brown), JABTVG00000000 (red), JABTVH00000000 (light green) depicted in a circular plot. Bioinformatics analysis resulted in a total of 40 antibiotic resistance genes detected in nuclear genomes of all 5 isolates. Resistance to all important groups of drugs viz., fluoroquinolones, aminoglycoside, tetracycline, macrolide, carbapenems were also observed among the isolates. SCCmec analysis revealed 4 out of 5 isolates were possessing SCCmec-V element. Eight plasmids were detected in the present study for 5 isolates of size ranging from 2632 to 19,624 bp, detailed analysis of methicillin resistant Staphylococci and multidrug resistant Enterobacteriaceae are under progress.

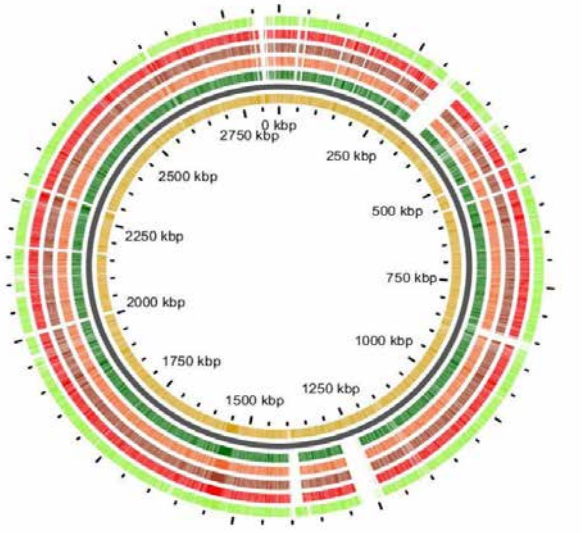


Fig. 1: Circular plot of 5 *Staphylococcus aureus* genomes of bovine origin.

This study was carried out to investigate the antibiotic use and its divers for antimicrobial resistance and transmission dynamics from livestock to people in Assam. During the reported period, the questionnaires were developed for different stakeholders namely, veterinarians, consumers, households and meat shops/ meat markets. The pretesting of the veterinarians and household survey questionnaires was completed and 60 veterinarians were surveyed to elicit various information on antimicrobial use in livestock. The household survey in the identified sites and the households under various co-operatives located in per-urban areas of Guwahati will be undertaken in the ensuing year (Shome BR *et al.,* 2020c).

8. Bluetongue

8a. Economic impact of Bluetongue Virus (BTV) in Sheep

Bluetongue (BT) is a non-contagious infectious disease of domestic and wild ruminants caused by the BT virus (BTV), which belongs to the genus Orbivirus within the family Reoviridae. The BT disease has a potential to spread rapidly. Thus, it creates one of the major barriers in International Trade of animals and its products. It causes economic losses in terms of high morbidity, mortality, abortion, fatal death and deformities as well as meat and wool losses. On average 2%–30% of the animals infected by BT dies. However, the number may reach up to 100% in highly susceptible sheep. Measurement of economic losses caused by this important disease would provide information useful in determining research priorities and in drawing attention to the effects of BTV in sheep economy. Quantification of disease losses would help to know the economic impact of disease and to know what efforts are required to avoid the losses and at what cost. Thus, an attempt was made to assess the economic losses arising due to BTV at farm level and to study the factors influencing such economic losses.

In the past one year conducted field survey, completed following activities like review of literature on Bluetongue Virus (BTV) disease, collected and compiled research articles on Economic impact of various diseases. Collected and compiled Incidence, Outbreak and Deaths of animals due to Bluetongue Virus (BTV) for the last 10 years. Pilot survey conducted to know the incidence and losses in Chitradurga, Bellary, Raichur, Tumkur, Kolar and Chikkaballapur districts of Karnataka. Visited and interacted deputy directors, assistant directors and veterinary doctors of animal husbandry department of Karnataka regarding BTV impacts on farmers and the state and India's economy. Collected details of information to prepare questionnaire/schedule. Finalized the questionnaire/schedule with Co-PIs. Finalized districts, blocks and villages for primary data collection to assess the disease impact (Sathish *et al.,* 2020)

9. Brucellosis

9a. Surveillance of ovine brucellosis with reference to *Brucella ovis*

The districts in Karnataka selected for this study is given in Fig. 2. During the period under report, survey schedules collected from 21 sheep flocks were analyzed and comparison of smooth lipopolysaccharide (sLPS) of *Brucella abortus* S99 and *B. melitensis* 16 M strains in detecting *Brucella* antibodies in sheep sera was carried out. Analysis revealed that the percent positivity due to smooth *Brucella* spp. is 38.03 % and *B.ovis*is 3.93 % in Karnataka. It has also been observed that the abortion in sheep in the *Brucella* endemic places is around 15.69 % which may play an important role in the economic loss of the sheep farmers. Among the aborted sheep, 84.21 % were having *Brucella* antibodies (82.46 % is of smooth *Brucella* spp. antibodies and 1.75 % is of rough *B. ovis*antibodies). In breeding rams, 58.06 % have shown antibodies against smooth *Brucella*spp and 12.9 % against *B. ovis*. This study clearly shows the necessity of control program for small ruminant brucellosis. On comparing *B. melitensis* 16M and *B. abortus* S99 sLPS (smooth lipopolysaccharide) antigen based ELISA for ovine brucellosis in sheep sera (n=287), an increased sensitivity of 1.3 % with *B. melitensis*s LPS antigen has been observed. Further evaluation on use of both combined antigens in ELISA for ovine brucellosis is underway (Nagalingam *et al.,* 2020).

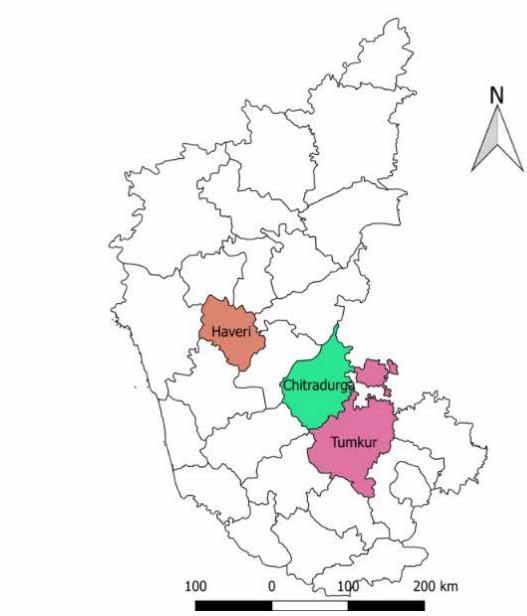


Fig 2: Selected Study districts in Karnataka for obtaining samples.

9b. Brucellosis Control programme (B-CP)

Brucellosis is a bacterial disease caused by various *Brucella* species, which mainly infect cattle, swine, goats, sheep and dogs. Humans generally acquire the disease through direct contact with infected animals, by eating or drinking contaminated animal products or by inhaling airborne agents. Expansion of animal industries and urbanization, and the lack of hygienic measures in animal husbandry and in food handling, partly account for brucellosis remaining a public health hazard. Since NIVEDI has facilities for brucellosis diagnosis, the samples were received regularly from various states of the country for brucellosis diagnosis and confirmation. During the period under reporting, 3172 cattle, 181 goat, 135 pig, 133 animal handlers and 55 adult cattle (doubtful vaccination status) serum samples received from various organized and unorganized farms. Animal serum samples were tested for *brucella* infection by RBPT and iELISA. RBPT was performed as a preliminary test for the detection of anti-brucella antibodies followed by iELISA by using smooth lipopolysaccharide (sLPS) antigen and species specific IgG-HRP conjugate. Human samples were screened by RBPT and RBPT positive samples were further evaluated by SAT and SAT (serum agglutination test) by preparing twofold serial dilutions of the serum starting at 1:10 to 1:1280 dilution. A titre of 1:160 titre (320 IU/ml) and above was declared positive for human brucellosis .The tests recorded the sero-prevalence as 6.37%, 7.18%, 5.93% and 15.04% in cattle, goat, pig and animal handlers, respectively. Post vaccinated cattle (Adult) sera samples from an organized farm of Haryana tested for vaccinal antibodies by cELISA showed 65.05% positivity. These results provided to the stake holders and advisory was provided as per the farm holdings. Similarly, brucellosis infected individuals were immensely benefited for the timely diagnosis. Serological diagnosis/ confirmation for brucellosis in multispecies is much sought service in the country and it also facilitates to assess the current status of the disease in the country (Shome R *et al.*, 2020).

9c. Sero-epidemiological study of brucellosis in livestock in North East Region of India using cELISA and Fluorescent Polarization Assay

Brucellosis is an important zoonosis that constitutes a serious public health hazard which is caused by a bacterium belonging to the genus *Brucella*. There are battery of tests available for the diagnosis of brucellosis, among those tests, competitive enzyme linked immune sorbent assay (cELISA) is reported with high performance and greater diagnostic accuracy in the areas where *B. abortus* S19 vaccination is under practice.

In cELISA, the high affinity infection antibodies compete with the highly reactive monoclonal antibodies for the binding sites on SLPS antigen. Whereas, low affinity of vaccinal antibodies failed to compete with the monoclonal antibodies for the binding sites thereby excludes the interference in the detection system. Competitive ELISA (cELISA) is highly useful technique in the areas where smooth *B. abortus* S19 vaccination is under practice as a preventive measure for brucellosis. Under the project, competitive ELISA (cELISA) was standardized, evaluated and validated

In India, DADF has implemented mass vaccination of all the female bovine calves between 4-8 months of age in the brucellosis endemic areas simultaneous to the brucellosis surveillance. The conventional diagnostic tests used in the surveillance are associated with the reduced specificity due to the interference of antibodies raised against the other Gram negative bacteria also the vaccinal antibodies. Whereas, in the developed cELISA, antibody resulting from vaccination typically will not react and is found highly specific than any other conventional tests while screening the vaccinated animals for brucellosis. Hence the presently developed test is of high applicability in the post-vaccination

sero-monitoring of brucellosis in the country. The test has sensitivity and specificity of 94% and 96% (Fig. 3). The monoclonal antibody based diagnostic test appears to be of first of its kind from India and awaiting commercialization and patent (Roy *et al.,* 2020).

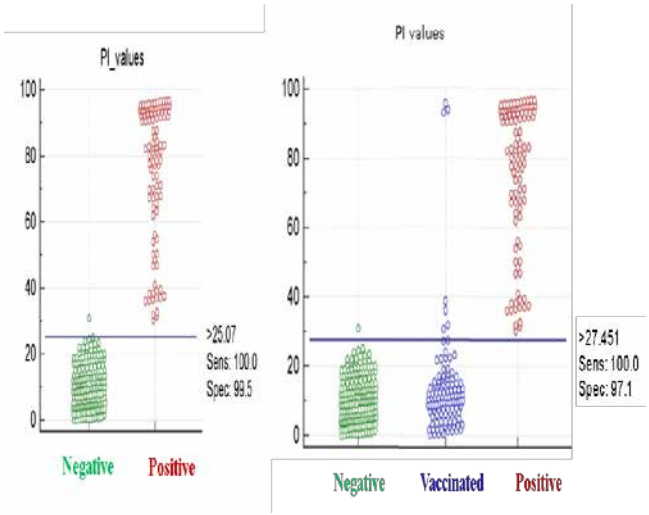


Fig. 3: Interactive dot diagram of cELISA drawn using non-vaccinated positive and negative samples (Left) and non-vaccinated positive, negative and vaccinated serum samples (Right)

9d. Seroepidemiology of Brucellosis

Swine Brucellosis caused by *Brucella suis,* is an important zoonotic disease characterized by abortion, birth of dead or weak piglets, orchitis, lameness and sometimes paralysis. Brucellosis in livestock is documented in many Indian states but in Nagaland, a pig rearing state of India, the disease was not reported. Nagaland state has 0.70 million pigs with highest per capita pork consumption and tribal farmers are dependent on pig farming. The present study was designed to determine the sero-prevalence of swine brucellosis through cross-sectional study design. A total of 1550 serum samples were sourced from nine out of eleven districts, 43 out of 74 blocks (58.10% of total blocks) and 59 out of 1428 villages designated as epi units (4.13% of total villages) and tested by indirect ELISA using smooth lipopolysaccharide (sLPS) antigen and rabbit anti-pig IgG-HRP conjugate. The apparent prevalence (AP) and true prevalence (TP) were calculated with 95% confidence interval as per the sensitivity (94%) and specificity (92%) of the laboratory standardized iELISA protocol. Overall 6.84% apparent prevalence in the entire state with highest sero-prevalence of 52.83% was recorded in one district. Sero-prevalence of 6.82%, 5.22% and 4.14%, in three districts and 2% in two districts was noted. Within the district, block level prevalence varied from 13.79% to 100% and disease clustering was even obvious at epi units with 100%, 15% and 10% prevalence in two, three and four epi units, respectively. Anti-*Brucella* antibodies were absent in two districts,18 blocks and 25 epi units. Non-significantly higher sero-prevalence in male (7.40%) compared to female pigs and significantly higher prevalence in >24 month old pigs (17.85%) was recorded (Fig. 4). This is the first and largest study from mountainous Nagaland state that identified swine brucellosis endemic districts, blocks and villages which will help policy makers for implementing control measures in the absence of vaccination policy for swine brucellosis (Shome R and Nagalingam, 2020).

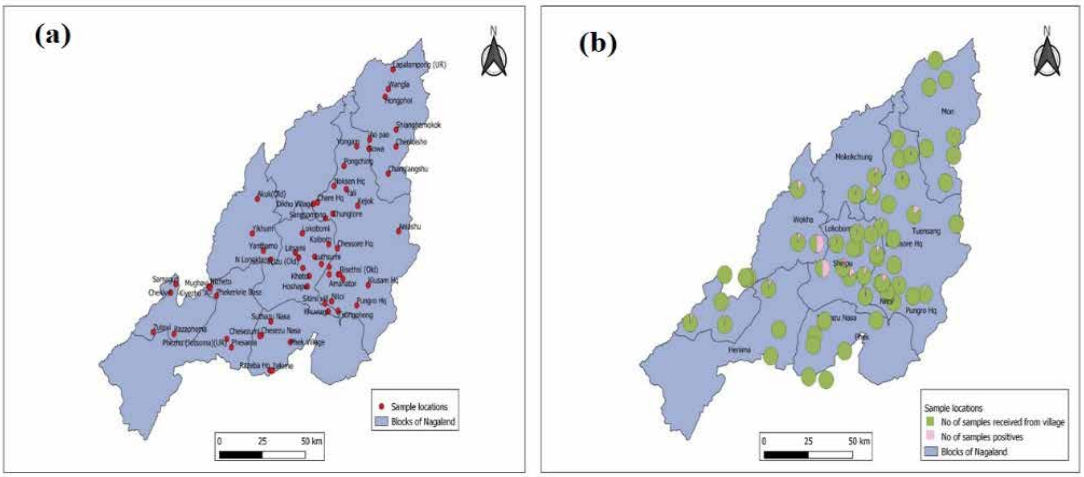


Fig. 4: Map depicting sampling sites and seroprevalence in the state of Nagaland

10. Classical Swine Fever

10a. Development of assay for detection of antibodies against CSFV infection in pigs

A total of 807 pig serum samples received from different states i.e., Arunachal Pradesh, Chhattisgarh, Goa, Kerala, Maharashtra, Mizoram, Odisha, Rajasthan were tested for the presence of CSFV antibodies and found 266 Positive for CSFV, showing the prevalence of (32.96%) using Ab check kit (Fig. 5). A total of 10 CSF isolates were tested for the presence of CSFV infection using Priocheck CSFV-Ag strip kit, out of which 8 samples were found positive. The cumulative sero-prevalence of CSFC in India during 2010 to 2020 are given in Table 2.

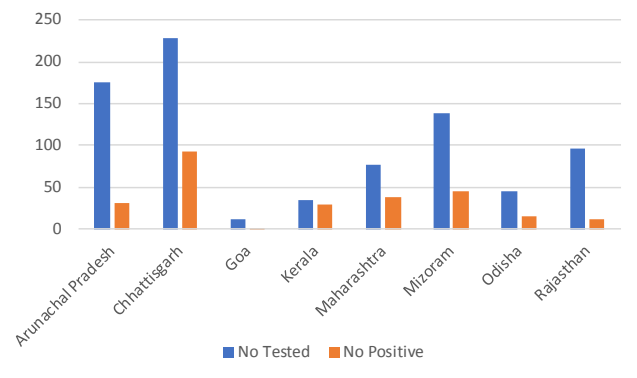


Fig. 5: Seropositivity of CSFV antibodies in various states in India by using CSF Ab check kit

Table 2: Cumulative Sero-prevalence of CSFV in India during 2010-2020

Sl No	Year	No Tested	No Positive	Percent Positivity
1	2010-11	1257	237	18.85
2	2011-12	426	191	44.83
3	2012-13	1110	535	48.19
4	2013-14	373	160	42.8
5	2014-15	94	28	29.78
6	2015-16	493	365	74.04
7	2016-17	563	366	65.01
8	2017-18	95	5	5.26
9	2018-19	5847	2162	36.98
10	2019-20	488	94	19.26
11	2020-21	807	266	32.96
	Total	11553	4409	38.16

The Indirect ELISA kit for detection of antibodies against CSFV in Pigs was released by the Hon'ble Shri Narendra Singh Tomar, Union Minister of Agriculture and Farmers Welfare on 16th July 2020 (Patil *et al.*, 2020a).

10b. Epidemiological study of Classical swine fever (CSF), Porcine reproductive and respiratory syndrome (PRRS) and Porcine torqueteno (TTV) in North East (NE) region of India

A total of 193 pig serum samples from Mizoram were screened for the detection of antibodies against the CSF by indirect ELISA using Priocheck kit. Out of which 12 (6.21%) samples were found positive for CSFV antibodies. Of which, 9 samples (4 serum and 5 tissue) from Mizoram were subjected to virus isolation of which all 9 samples found negative for CSFV by RT-PCR using 5' UTR.A total of 33 samples (25 serum, 5 blood, 3 tissue) from Karnataka, Goa and Maharashtra were tested for CSFV antibodies and 2 samples from Maharashtra were found positive for CSFV by single step RT-PCR using 5'UTR showing the prevalence of 6.0%.A total of 11 pig tissue samples from Arunachal Pradesh were subjected to virus isolation of which 2 samples were found positive by RT-PCR using 5' UTR and those 2 isolates were stored in -80C. A total 5pig tissue samples from Maharashtra processed for CSFV by RT PCR using 5'UTR primers, of which one was found positive for CSFV infection. A total of 6 pig blood and 6 nasal swabs were received from

Odisha processed for CSFV infection by RT PCR using 5'UTR primers, all samples were found negative for SF infection. CSF isolates: One from Maharashtra and two from Arunachal Pradesh were preserved in -80C (Patil *et al.,* 2020b).

10c. Development of diagnostic test for detection of classical swine fever virus

During the period the monoclones against PEG precipitated whole CSFV (Fig. 6) were characterized by Indirect ELISA using CSFV-E2-BCAD gene as antigen. The purified two monoclones 2F2.1C3 and 1C9.1G10 were tested against recombinant CSFV-E2 at 100ng, obtained a value up to 2.2 OD at 450nm in most of the wells. Healthy swine tissue and blood samples were used as negative control and non-immunized mice sera were used as blank. Plates read after 5-8 min after substrate is added. Whole plate was coated with recombinant CSFV-E2 antigen and test sample was NIVEDI mAb with anti-mouse HRP conjugate. The CSFV virus was propagated in PK-15 cell line and the cell culture supernatant was collected for the production of viral antigen. Produced CSFV virus in bulk and purified using PEG precipitation method (Patil *et al.,* 2020c).

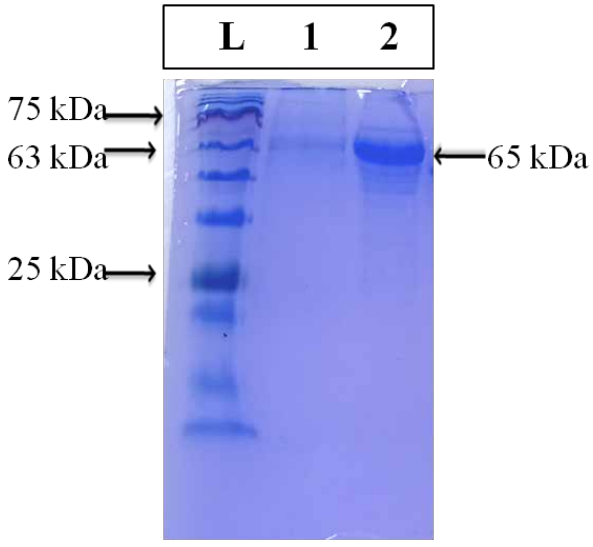


Fig. 6: Concentration of CSFV virus using PEG method **(L:** Prestained ladder, **1:** CSFV virus before PEG precipitation, **2:** CSFV virus after PEG precipitation)

10d. Development of Infectious Disease Information System (IDIS) and Risk assessment models for Transboundary animal diseases (TAD) & other emerging livestock diseases in NE region of India

Classical swine fever (CSF) is also called hog cholera and more commonly called as swine fever, is a systemic, exceptionally contagious and notifiable disease of viral origin affecting domestic and wild pigs (Pathogens 2020, 9, 500; doi:10.3390/pathogens9060500). Data was collected by department of Microbiology, College of veterinary science though various surveillance activities. There were 114 cases of CSF 16 different districts for the period of 2005-2019 in Assam State were analysed in the present study. Predictor variable layers were obtained from open sources which includes bioclimatic variables. The risk factors data were retrieved from GES DISC "GLDAS_NOAH025_M.2.1" dataset. Various risk factors were environmental variables such as potential evaporation rate (W/m^2), pressure (Pa), specific humidity (g/kg), rainfall (mm), soil moisture (kg/m^2), temperature (^oC) and wind speed (m/s) and the remote sensing variables like Normalized Difference vegetative index (NDVI) and Land Surface temperature (LST) were extracted from MODIS satellite images. Atmospherically corrected NDVI was collected on 16-day interval at 250-meter resolution using MODIS product MOD13Q1 and LST was collected on 8-day intervals using MOD11A2 at 1 KM resolution. The data on livestock pig population were collected from 20th livestock census of India at the village level. All the risk factors are organized as raster (grid) type files and each predictor should be a raster representing a variable of Interest. These raster data was typically stored in geo TIFF format. The data was retrieved by specifying the coordinates and time period (dates). A number of machine learning models were fit to annotated data and tested for accuracy in terms of discrimination power in the present study.

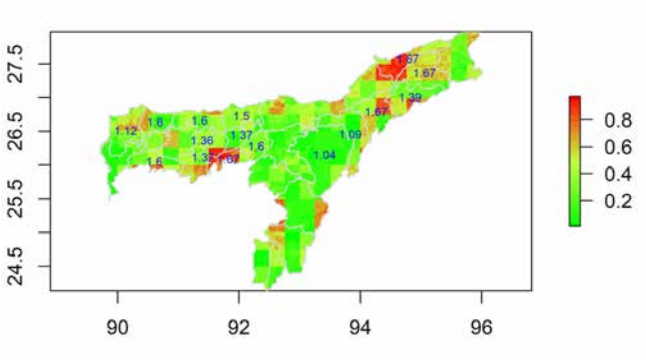


Fig. 7: Predicted Risk map with basic reproductive number (R0) for CSF in Assam state

This risk map shows the occurrence of Classical Swine Fever in Assam. Relatively high R0 was observed in Kamrup Metropolitan, Dhemaji, Jorhat, Dibrugarh, Chirang, Baksa, Goalpara and Morigaon. The livestock

population in these districts was around nine lakh eighty thousand that are susceptible for CSF infection. Meanwhile the R0 was comparatively moderate in Kokrajhar, Nalbari, Darrang, Karbi Anglong, Golaghat and Sivasagar. The livestock population in these districts was around ten lakh eighty thousand (Suresh *et al.*, 2020a).

11. Cysticercosis

11a. Understanding the genetic diversity of *Taenia solium* cysticercosis and development of recombinant antigen based diagnostic assay for serosurveillance

T.solium cysticercosis is a potentially eradicable neglected zoonotic disease with public health importance with pigs and human act as the intermediate hosts. During the reporting period, the *Cysticercus* collected from slaughtered pigs of Karnataka and Andhra Pradesh was genetically characterized based on mitochondrial (COX 1 and Cytb) and ribosomal (TBR and ITS-1) DNA markers. The study confirms the existence of two mitochondrial lineages of the parasite as Asian and African/American. Cytochrome Oxidase 1 based analysis revealed the existence of two sub-lineages of the parasite within the Asian lineage based on the polymorphism at 994 position as 994A and 994G. In India, both the sub-lineages were identified and genetic divergence among different Indian isolates was evident. The cysts collected in the present study were more closely related to those of China and Indonesia than with other Indian isolates. The genetic distance between four different strains of *T. solium* was computed based on TN 93 model using the sequence of COX 1 represents the divergence between Asian lineage and African/American lineages of *T.solium* and is depicted in Fig. 8. Darker shades of grey represents more distance between isolates. Further, COX1 was found to be the most appropriate marker for genetic characterization of *T.solium* and the sequence analysis did not indicate the presence of *T. asiatica* in the examined pigs and African/ American lineages of *T.solium* could not be encountered in the present study. Further, indirect ELISA based on recombinant antigens of *T.solium*was standardized in the laboratory. Further, indirect ELISA based on recombinant antigens of *T.solium*was standardized in the laboratory (Siju *et al.*, 2020a).

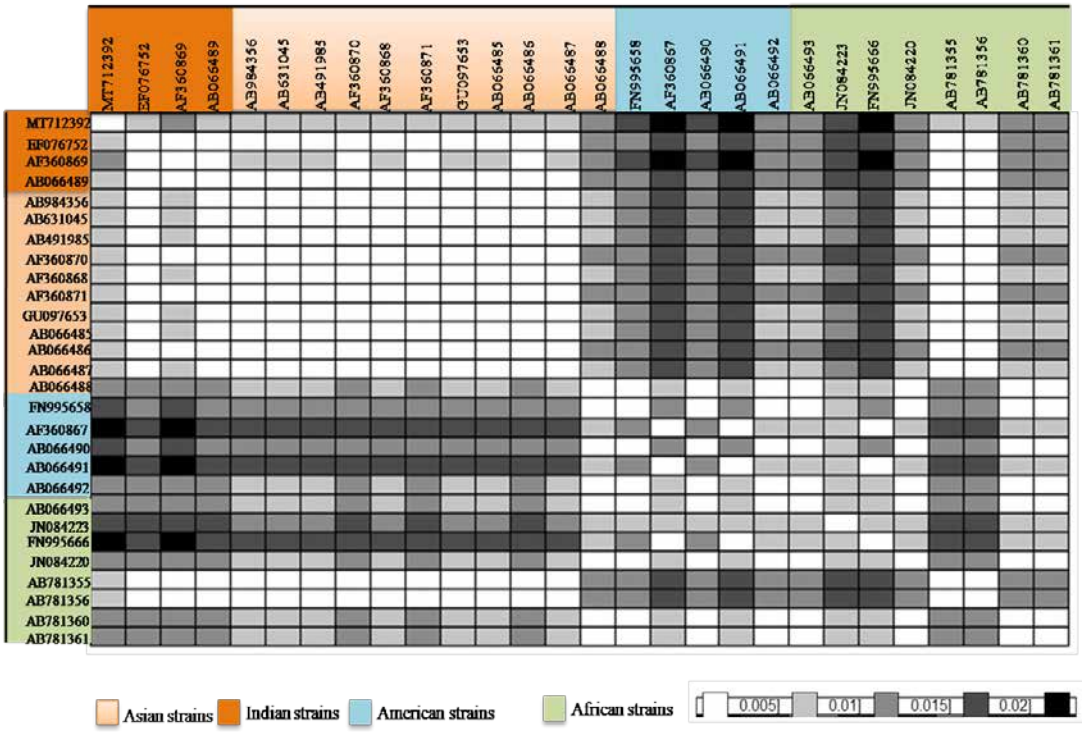


Fig. 8: Genetic distance between different isolates of *T.solium*. Darker shades of grey represents more distance between the isolates.

12. Fasciolosis

12a. Epidemiological Surveillance of Transmission Foci of Fasciolosis

Fasciolois caused by *Fasciolagigantica* is a major constraint to livestock industry and snails of the genus *Radix* (*Lymnaea)* acts as intermediate host for the parasite. Understanding the transmission foci of fasciolosis by snail surveillance is a crucial step in effective management of the disease. During 2020, a total of 585 snails were collected representing 13 lakes of Karnataka (Bengaluru rural, Kolar, Mandya, Ramanagara, Tumakuru and Hassan) and were morphologically characterized. The screening of snails by PCR targeting 28S rDNA of *F.gigantica* revealed the prevalence of infection in snails as 17.94%. Molecular taxonomic studies of *Lymnaea* sp. snails by employing COX1 as the genetic marker to identify the species of snail that can act as intermediate host for *F.gigantica* infection in Karnataka were carried out. Phylogenetic analysis based on Maximum likelihood method revealed the existence of other *Radix sp*. of snails as the intermediate host for *F.gigantica* infection in addition to *R.auricularia* and *R.rufescens* in Karnataka state (Siju *et al.,* 2020b).

12b. Precision diagnostic approach for fasciolosis in cattle and buffaloes

Fasciolosis is one of the economically important diseases in cattle and buffaloes and predominantly caused by *Fasciolagigantica* in the tropical climate of India. The present project was aimed to develop a diagnostic test to detect immature fasciolosis in bovines. During this period period, a recombinant cathepsin B5 (r cathB5) was expressed in prokaryotic host (*E.coli*). Native cathepsin was also prepared from excretory secretory antigens from adult fluke. The immunoreactivity of r cathB5 was measured in relation to native cathepsin in ELISA system, employing a group of samples collected from cattle and buffaloes. The indirect ELISA employing r cathB5 showed 95.8% sensitivity, 90.6% specificity with a Cohen's kappa value of 0.861 when compared with native cathepsin antigen (Fig. 9).However more numbers of samples are required for further validation of the assay (Sengupta *et al.,* 2020a).

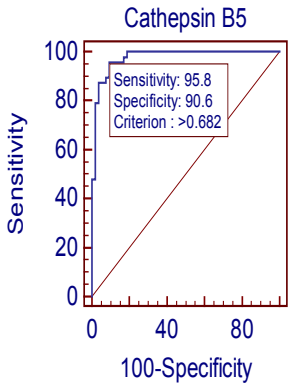


Fig. 9: Receiver Operating Characteristic curve of indirect ELISA r-cathB5 in comparison to native cathepsin antigen

13. Haemorrhagic septicaemia

13a. Epidemiology of haemorrhagic septicaemia [HS] in India

Pasteurella multocida infections occur among large and small ruminants which greatly affect the economic sustainability of farmer's livelihoods that are practicing animal husbandry. For epidemiological studies, virulence associated and/or housekeeping/ repetitive genes either in single or multiple copies are being extensively targeted for bacterial pathogen detection and differentiation. In the reporting period, *Pasteurella multocida* strains (n=41) isolated from different animals (sheep/ goat/ cattle/ buffaloes/ pigs /rabbits) were characterized by molecular typing and their virulence gene profiling. Virulence profiling of isolates indicated that *omp87, ompA, ptfA, sodA, sodC, nanB, fur* and*exbB* were present in 100% of isolates. Whereas, prevalence of other genes were; *nanH* (90%), *oomph* (71%), *pfhA* (63%), *plpB* (80%), *hsf-1* (12%), *hsf-2* (37%), *pmHAS* (78%), *toxA* (78%), *hgbA* (37%), *hgbB* (81%), *tbpA* (78%) and *fimA*(98%), among isolates. There was no influence of host or place on prevalence of virulence genes when assessed by fitting a Hierarchial Bayesian ordinal regression model. The results showed that a considerable level of genetic diversity existed among circulating *P. multocida* isolates despite belonging to the same geographical origin. The genetic diversity or clustering based on either virulence or repetitive elements among isolates could be largely driven by multiple factors acting together which lead to manifestations of particular disease symptoms.

Biofilm production, hitherto uncharacterized feature among circulating *P. multocida* strains, was studied along with the antimicrobial susceptibility pattern (Fig. 10). On the basis of biofilm forming ability, all the strains were categorized into average four groups in six different culture conditions: strong biofilm-forming (22%), moderate (20%), weak (51%), and non-adherent (7%). Strains from serogroups A and B formed significant biofilm in at least one culture condition whereas strains from serogroup D were unable to form biofilms. All strains were found to be susceptible to tetracycline. In addition, the correlation between diverse factors (host, capsule type, clinical condition and *tadD* gene) as well as antimicrobial susceptibility in biofilm production were analyzed by Joint distribution models, showing that enrofloxacin and azithromycin resistant strains were positively correlated with strong biofilm production (Shivachandra *et al.,* 2020).

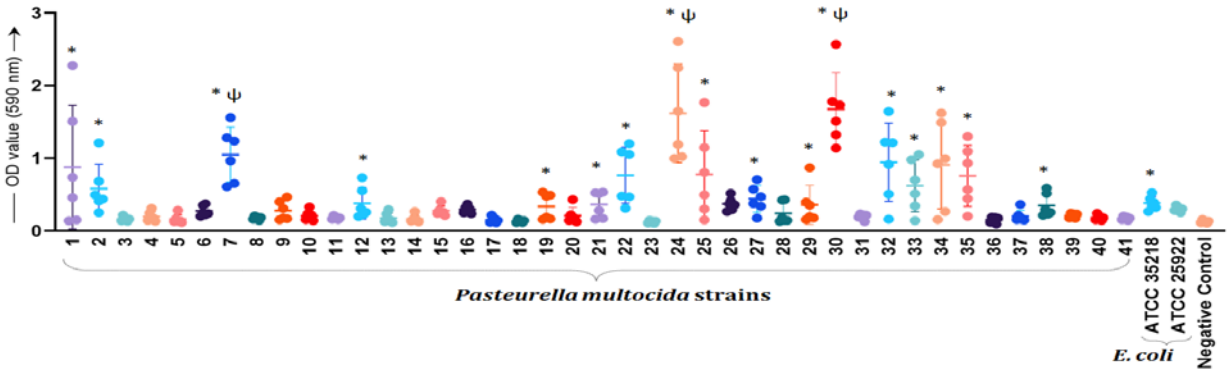


Fig. 10: Biofilm based adherence properties as exhibited by different *P. multocida* strains.

13b. Understanding the carrier status of Small Ruminants (Sheep and Goats) in endemic areas with respect to *Pasteurella multocida*

A total of 50 samples from sheep and goats were processed for isolation of *Pasteurella multocida.* None of them were positive. Molecular characterisations of the isolates were done by Antibiotic resistance genes PCR for quinolones and tetracycline and six found positive. Partial gene sequencing of few genes of *Pasteurella multocida* isolates were carried out included KMT gene, putative filamentous hemagglutinin (pfhA) –virulence gene, Ribosomal RNA (23S) gene and RNA Polymerase B(rpo B) during the period. Gene sequences were submitted in the NCBI website. Sequencing analysis of the genes (Fig. 11) was done using MEGA software using Maximum Likelihood method (Sridevi *et al.,* 2020).

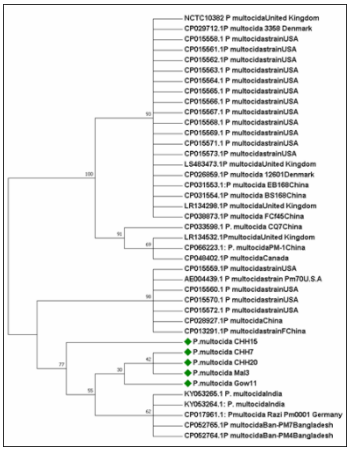


Fig. 11: Sequence analysis of pfhA gene

14. Infectious Bovine Rhinotracheitis

14a. Seroepidemiology of Infectious Bovine Rhinotracheitis (IBR) in India

Infectious Bovine Rhinotracheitis (IBR) is an infectious disease caused by Bovine herpesvirus-1 (BoHV-1) belonging to *Herpesviridae* family. The disease is characterized by abortion in cattle and buffaloes during 2nd and 3rd trimester of pregnancy causing huge economic loss to the dairy industry. Presence of IBR antibodies in animals is indication of the animal was exposed to the virus previously and the owner/policymaker has to plan for prevention and control measures.

During the year 2020, a total of 911 bovine serum samples received from six states/UT *viz*, Andaman

and Nicobar (n=418), Karnataka (n=175), Kerala (n=100), Madhya Pradesh (n=100), Odisha (n=100) and Telangana (n=18) were tested for the presence of IBR antibodies using the ICAR-NIVEDI's Avidin-Biotin ELISA kit (Fig. 12). It was found that out of 911 sera, 266 samples were found to be positive for IBR antibodies with overall seropositivity rate of 29.20%.

Further, in the country between the years 1995-96 and 2020-21, a total of 96,861 bovine serum samples were screened for IRB antibodies of which 33,397 sera were found positive with an overall national prevalence of 34.47% (Table 3). A total of four IBR AB ELISA kits were also prepared and supplied to three laboratories in India. With that a sum of Rs.3.20 lakhs was saved as import exchequer (Patil and Hemadri, 2020).

Table 3: The Cumulative sero-prevalence of IBR in India during 1995-2020

Sl. No	Year	No. Tested	No. Positive	Percent Positive
1	1995-96	3428	1303	38.01
2	1996-97	3521	1096	31.12
3	1997-98	1442	599	41.53
4	1998-99	1675	767	45.79
5	1999-01	6883	2776	40.33
6	2001-02	3373	785	23.27
7	2002-03	7933	3271	41.23
8	2003-04	1300	668	51.38
9	2004-06	9564	3507	36.66
10	2006-07	2820	1197	42.44
11	2007-08	4270	1242	21.08
12	2008-09	4821	1423	29.51
13	2009-10	4496	1494	33.22
14	2010-11	1483	621	41.87
15	2011-12	2275	507	22.28
16	2012-13	5632	1468	26.06
17	2013-14	6327	3296	52.09
18	2014-15	1022	322	31.50
19	2015-16	5883	1224	20.81
20	2016-17	9923	2702	27.23
21	2017-18	1276	345	27.03
22	2018-19	5480	2072	37.81
23	2019-20	1267	451	36
24	2020-21	911	266	29.19
	Total	**96861**	**33397**	**34.47**

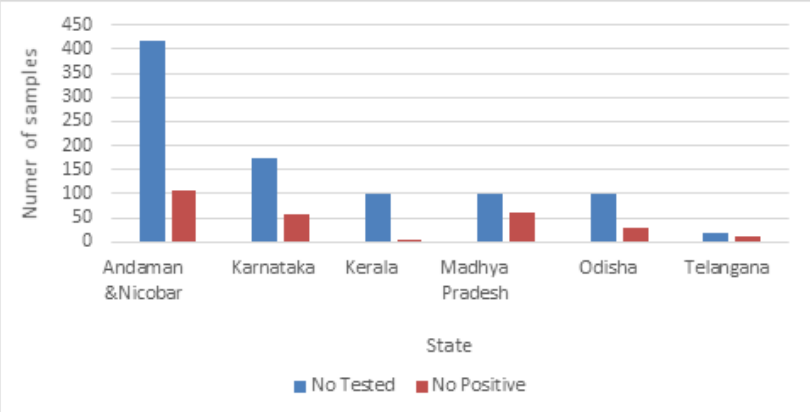


Fig. 12: Seroprevalence of IBR in different states of India during 2020.

15. Japanese encephalitis

15a. Standardization of serological and molecular tests and surveillance of Japanese encephalitis virus infection in pigs in southern part of Karnataka state

The project was proposed to standardize diagnostic tests for identification of anti-JEV antibodies and JEV RNA in in pig population of southern part of Karnataka state. The number of pigs in each district in southern part of Karnataka state has been obtained from livestock census data of 2019 and sample size calculation is underway. The consumables required for the molecular diagnostic assays is in progress. Under molecular assays two reverse transcription polymerase chain reactions targeting JEV specifically and one RT-PCR to detect flaviviruses are planned for standardization. For serological detection standardization of virus neutralization test and Haemagglutination Inhibition test has been planned (Chethan Kumar *et al.*, 2020).

15b. Immuno-epidemiological characterization of pigs as an amplifying host of Japanese Encephalitis

Pig plays a critical role in infectious cycle of JEV as an amplifying host with varied exhibition of evidence of disease in itself. Immunological studies focusing on quantitative and qualitative characterization of the host-virus interaction in pig will be key to answer the questions like why outbreaks vary with time and place. Taking immuno-epidemiological approach to understand the host immune response to JE virus across different host factors like age, sex, physiological status, frequency of viral exposure, will shed light on the mechanisms behind the role of pig as amplifying host. Such studies will aid in new approaches for treating and preventing JE. The current project with objectives i. Estimate the effect of amplifying host factors on sero-prevalence of JE in endemic areas during peak transmission period, ii. to characterize the humoral immune response in correlation to detection of viral RNA in sero-positive pigs over period of multiple transmission cycles and to characterize tissue specific cell mediated immune response in correlation to detection of viral RNA in various organs of sero-positive pigs. The major achievement for the period includes Development and standardization of quantitative PCR for detection of JE.A qPCR protocol was developed and standardized for screening the samples collected in the project work (Fig. 13). The targeted gene is M with PCR product size of 134 (Hiremath *et al.*, 2020a).

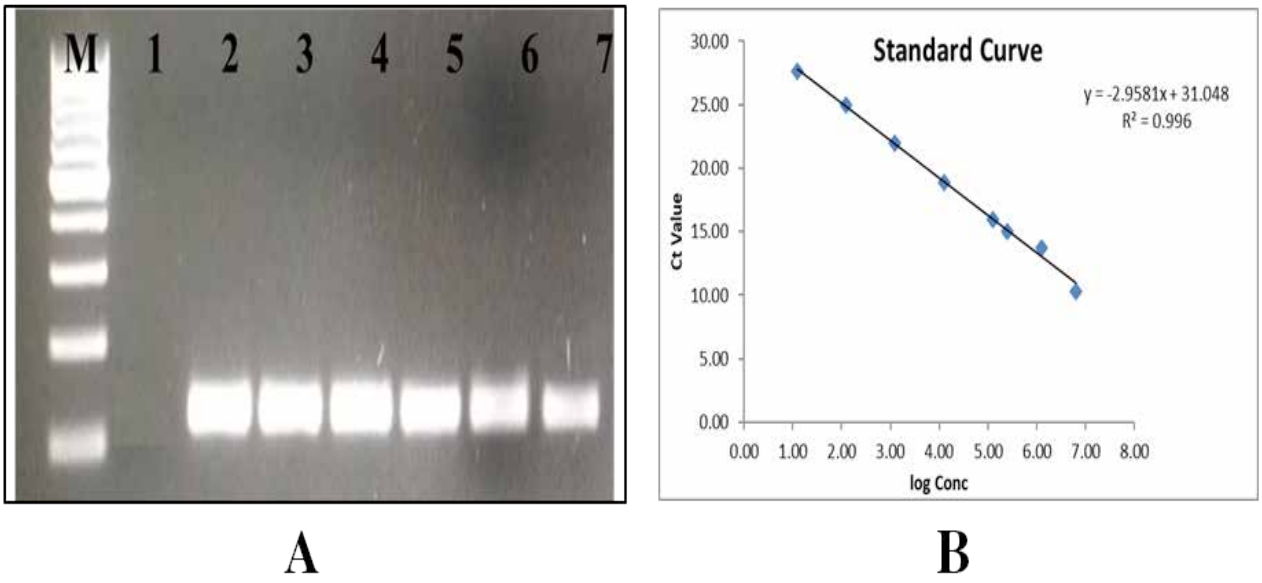


Fig. 13: Standardization of qPCR for JEV: **A.** Gel picture showing the specific amplicon of size of 134bp, M-100bp Ladder, 1- Negative Control, 2-1.248pg/ul,3-0.1248pg/ul, 4- 0.01248 pg/ul, 5-0.001248 pg/ul, 6-0.0001248 pg/ul, 7-0.00001248 pg/ul **B.** Standard curve to quantify the JEV RNA

16. Leptospirosis

16a. Development of recombinant multi-antigenic and fusion proteins-based immune diagnostics for the surveillance of leptospirosis

This project envisaged to express the recombinant protein (s) of pathogenic *Leptospira* in the *E. coli* expression system to develop sero-diagnostics for surveillance of leptospirosis. During this period, the revival of the recombinant clones containing the genes of the target proteins was carried out and the expressed recombinant antigenic proteins (Leptospiral surface adhesion protein, OMP, and Lipoprotein) of pathogenic *Leptospira* in the *E. coli* system was confirmed and characterized by SDS-PAGE and western blot analysis for its potential use as diagnostic antigens in immuno-diagnostics. The purified protein was stored in the freeze-dried form for further use. The preparation of the Latex beads coated with recombinant protein (s) and the assessment of the prepared beads reactivity either single or in combination with other proteins as the multi-antigenic format in Latex Agglutination Test (LAT) with a standard panel of positive and negative sera, is in progress. Further, the cloning and expression of the recombinant fusion proteins (LSA plus Lipoprotein) of pathogenic *Leptospira* in the *E. coli* system was carried out and characterized, and confirmed by SDS-PAGE and western blot analysis. Further, evaluation of these multi-antigenic proteins and fusion recombinant proteins as a diagnostic antigen in immunoassay LAT/ELISA is in progress (Balamurugan and Nagalingam, 2020).

16b. Development of Recombinant Antigen based Diagnostics for Bovine and Human Leptospirosis

This project envisaged to express the recombinant protein (s) of pathogenic *Leptospira* in the *E. coli* expression system to develop sero-diagnostics for human and bovine leptospirosis. The genes of the target proteins (Leptospiral surface adhesion protein and Lipoprotein) were amplified, cloned, expressed, and characterized. Latex beads coated with recombinant protein (s) was prepared and assessed its reactivity in Latex Agglutination Test (LAT), initially with a panel of standard positive and negative serum, followed by field serum samples from cattle with a history of abortion or other reproductive disorders and human serum samples with the history of pyrexia of unknown origin. The diagnostic sensitivity and specificity of LAT were assessed in comparison with the Microscopic Agglutination Test (MAT) and the Bovine LeptoLAT kit is under validation for detection of antibodies against *Leptospira* for diagnosis of bovine leptospirosis. The final project report was submitted to ICMR, as the project was completed in February 2020 and the patent was filed "*Recombinant leptospiral surface antigen-based immuno-diagnostic test for Leptospirosis*" [Application No. 202041022882, TEMP/E-1/52065/2020-CHE, dated 01.06.2020] (Balamurugan *et al.*, 2020a)

17. Peste des petits ruminants

17a. Evaluation of in-house population assay for surveillance of peste des petits ruminants (PPR)

During this period, the revival of the recombinant clone containing the PPRV N-terminal region of Nucleoprotein coding gene sequences for the target truncated PPRV-NPN-protein was carried out and the expressed recombinant protein in the *E. coli* was confirmed and characterized by SDS-PAGE and western blot analysis for its potential use as a diagnostic antigen in immuno-diagnostics. The purified protein was stored in the freeze-dried form for further use. Further, the recombinant protein showed stability on lyophilized form at -20 °C storage as there was no forfeiture in the antigenicity as evaluated by the reactivity of the protein in the ELISA. Further, on assessing the stability of the reconstituted antigen in terms of its reactivity in ELISA following several freeze-thawing, it was observed that rPPRV-NPN antigen exhibited the desired level of reactivity up to 10 cycles of freeze-thawing. The antigen and antibodies coated ELISA modules (for ABrAC ELISA for PPRV antigens detection and ABrC-ELISA for PPRV antibodies detection) were assessed for their stability for diagnosis of PPR. Further, the stored modules were periodically used for testing the panel of samples every month interval for assessing its stable storage at 4 °C and its suitability for transport at 4 °C for the rapid diagnosis to use ready-made antibodies/ antigens coated modules/plates for either PPRV antigen /antibodies detection as the case may be. It was found suitable for detecting the PPRV antigens up to 6 months so far tested (ABrAC-ELISA) and for detecting PPRV antibodies up to 3 months so far tested (ABrC-ELISA) using the control panel samples.

On evaluation of ABrAC-ELISA with indigenous PPR s-ELISA kit using 274 clinical specimens showed the relative diagnostic sensitivity (DSn) of 86.49 % and diagnostic specificity (DSp) of 96.20 % with 94.89 % of the accuracy. This less sensitivity may be due to the limited positive numbers of clinical samples employed in the assay evaluation. Similarly, on evaluation of sera (n=391) from vaccinated, infected and non-vaccinated sheep and goats samples by PPR commercial ID. vet Screen ® PPR kit and in-house developed ABrC-ELISA revealed a relative DSn of 98.77 % and DSp of 90.54 % with an accuracy of 95.65 % (Balamurugan, 2020a).

17b. Assessment of the economic impact of priority animal diseases and the cost-effectiveness of their control strategies in India- A PPR survey

The project intends to quantify the economic impact of three major diseases in livestock in India viz., PPR, HS and Brucellosis using value chain approach. As per the approved sampling plan, to assess the impact of PPR, the survey was undertaken in Bellary and Mandya districts of Karnataka and Ananthapur district of Andhra Pradesh. A total of 298 sheep and goat rearing households were surveyed in Karnataka and 158 households in Andhra Pradesh. The survey in Prakasam district, Andhra Pradesh is in progress. Besides farmers survey, sheep and goat traders and retailers were also surveyed in Karnataka and Andhra Pradesh. After completion of survey in Prakasam district, the system dynamic models will be fitted using the surveyed data and data elicited through the participatory discussion with all the stakeholders. (Govindaraj *et al.,* 2020a).

17c. PPR Control Programme, Surveillance, Monitoring and Vaccination Impact of PPR in Sheep and Goats in India

During the period under report, the nation-wide sampling plan for sero-surveillance and sero-monitoring of PPR vaccination has been prepared under the PPR-CP program for implementation in the national strategic plan for eradication 2025, DAHD, GoI, for the eradication of PPR in consonance with PPR Global Control and Eradication Strategy (GCES) by 2030. The temporal and spatial epidemiological analysis of PPR outbreaks in sheep and goats and its control in India was carried, which revealed the reported outbreaks have been progressively declined in most of the states due to the implementation of a mass vaccination strategic program since 2011. The PPR risk-areas showed wide variations with different levels of enzooticity. Andhra Pradesh, West Bengal, and Karnataka states were the top three states on the reported outbreaks during 1995-2010, whereas during 2011-15 and 2015-2019 Jharkhand and West Bengal states had reported more PPR outbreaks (Fig. 14). Further analysis of the economic impact of the PPR in the identified long term PPR-CP implemented (Karnataka) and recently implemented (Madhya Pradesh) states of India was carried out, using the primary data collected from 410 and 350 households in three districts of Madhya Pradesh (MP) and Karnataka, respectively and the estimated loss during 2018-19 was found to be ~ 192 crore and ~ 47.5 crorein Karnataka and MP, respectively. The project was completed in March 2020 (Balamurugan *et al.*, 2020b).

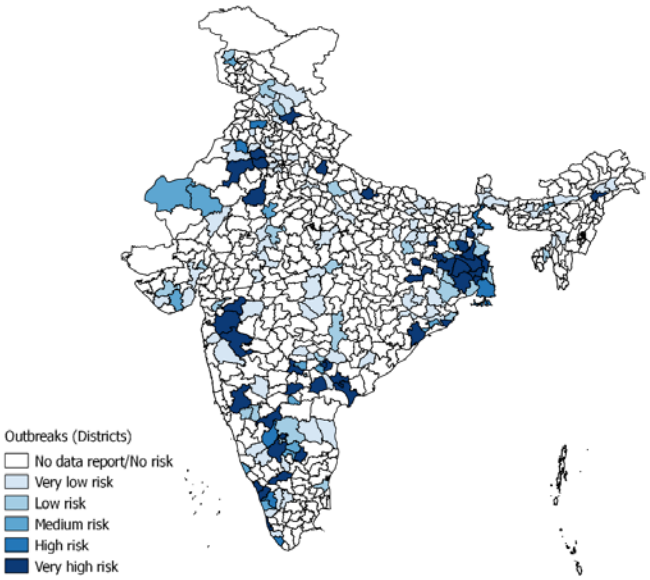


Fig. 14: Endemic districts of reported PPR outbreaks in different states of India (2016-2019)

17d. Seroprevalence of *Peste des Petits Ruminants* (PPR) in Sheep and Goats in India

The cross sectional study on sero-prevalence of PPR antibodies was carried out. A total of 24,625 serum samples from 29 states/union territories (UTs) were screened of which 10,756 samples were found positive for anti-PPRV antibodies by IVRI-PPR c ELISA kit. The results revealed variation in the anti-PPRV antibodies prevalence between states/UTs, which may be due to vaccination strategy (outbreaks focused vaccination or mass vaccination) and how well it was implemented because a high proportion of village with <30% sero-prevalence was observed in regularly unvaccinated region and vaccinated states had >60% immune population, with ongoing mass vaccination in Karnataka, Andhra Pradesh, Telangana

and Chhattisgarh states strongly indicated >90% reduction in reported PPR outbreaks. Hence, initial mass vaccination followed by vaccination of young ones above 4-5 months old and unvaccinated goats and sheep helped in the control of PPR. Therefore, high coverage mass vaccination is required to eliminate the PPR virus. The state-wise PPR seroprevalence/ immunity status in India has been depicted in the Fig. 15 (Balamurugan 2020b).

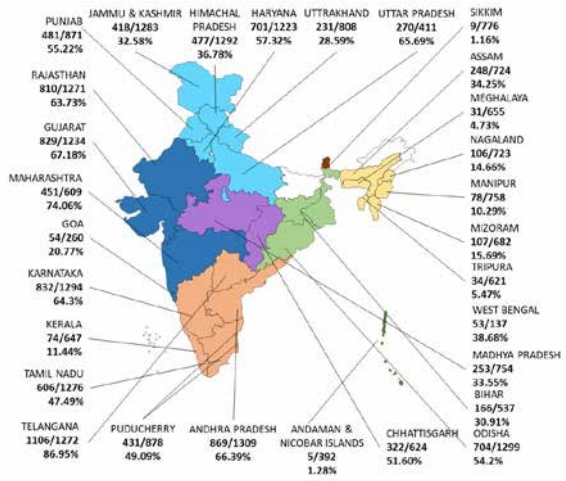


Fig. 15: Status of PPR sero-prevalence/immunity status in small ruminants in different states of India

18. Sheep and Goat Pox

18a. Estimation of economic loss of sheep and goats Pox in endemic states of India

The study envisaged to assess the economic loss due to sheep and goat pox in Maharashtra state. It was planned to collect primary data from four sheep and goat pox risk districts of Maharashtra. Based on cumulative number of outbreaks during the specified period, total number of attacks/1000 heads of sheep and goats, frequency of pox outbreaks in considered period and population density the districts were grouped into four risk groups and one district in each group was surveyed. In High risk group- Sangli district, Medium risk group- Solapur district, low risk group-Pune district and no risk group-Satara district was selected randomly. The estimated sample size for Maharashtra state was 385 sheep and goats rearing households. During the reported period, the Sangli and Solapur districts were surveyed and survey in remaining two districts is in progress. After completion of survey deterministic models will be fitted to assess the loss due to pox in Maharashtra (Govindaraj *et al.,* 2020b).

18b. Monitoring and Surveillance of Sheep Pox and Goat Pox Diseases

A total of 25 outbreak samples from different agro-climatic regions of India were included for detection and characterization of Capripox viruses. Where ever possible the gross and postmortem lesions were recorded. Out of 118 clinical samples, 101 samples comprising scabs (58), nasal (30) and ocular (3) swabs, and tissues (10) were found positive for Capripox viruses through specific amplification of partial P32 gene with amplicon size of 237bp. The full length of P32 gene was amplified in 28 representative isolates from 25 outbreaks with expected amplicon size of 1006bp. Full length P32 gene of all the SPPV and GTPV isolates showed specific complete coding sequence at 972bp and 969bp, respectively. The results of phylogenetic analysis based on nt sequences of complete P32 gene of SPPV and GTPV isolates from Indian and foreign CaPVs isolates revealed three major clusters were noticed namely, SPPV, GTPV and LSDV lineages for all the isolates of CaPVs. Multiple sequence analysis of Indian P32 sequences, indicated 99.5-100% and 98.1-99.7% sequence identity among SPPV and 99.5-100% and 98.5-99.7% sequence identity among GTPV sequences at nucleotide (nt) and amino acid (aa) levels, respectively.

The ORF117 was amplified, cloned and over expression of ORF117 protein was carried out and was confirmed by colony PCR, RE digestion and PAGE. The recombinant ORF177 was found to be more reactive than other proteins with western blot from filed convalcent serum samples. The recombinant fusion protein based developed can be used as diagnostic antigen in detecting capripox antibodies in vaccinated or pox infected sheep and goats as sero-diagnosis assay. Further testing with filed serum samples found the ORF117 antigen is suitable for detection in ELISA format. Further validation with serum samples revealed 98% sensitivity and 96% specificity with sheep pox and 97% sensitivity and 98% specificity with goat pox (Reddy *et al.,* 2020).

19. Trypanosomosis

19a. Molecular and sero-diagnosis of surra in livestock in north eastern states of India

A total of 2460 serum samples and 1722 blood samples have been analyzed for the presence of trypanosoma in different animal species of three NE States of India comprising Assam, Mizoram and Tripura. Serology employing ELISA/CATT revealed 26.96, 25.71, 25, and 19.54 percent positive whereas PCR revealed 9.82, 12.85, 3.12, 4 and 5.29 positive in cattle, buffalo, goat, pig and dog respectively from the study area. Selected PCR positive samples were sequenced and analyzed. Sequence analysis revealed existence of only one species i.e. *Trypanosoma evansi* (Fig. 16). Sequences of VSG gene of *T. evansi* from six different species in NE states screened in this study were homologous. The climatic data were extracted from the satellite based dataset and analysed for any correlation with seroprevalence in Mizoram. Study revealed diurnal temperature range, relative humidity, leaf area index, soil moisture and air temperature were significant risk factors that influence seropositivity probably favouring vector population (Table 4) (Sengupta *et al.*, 2020b).

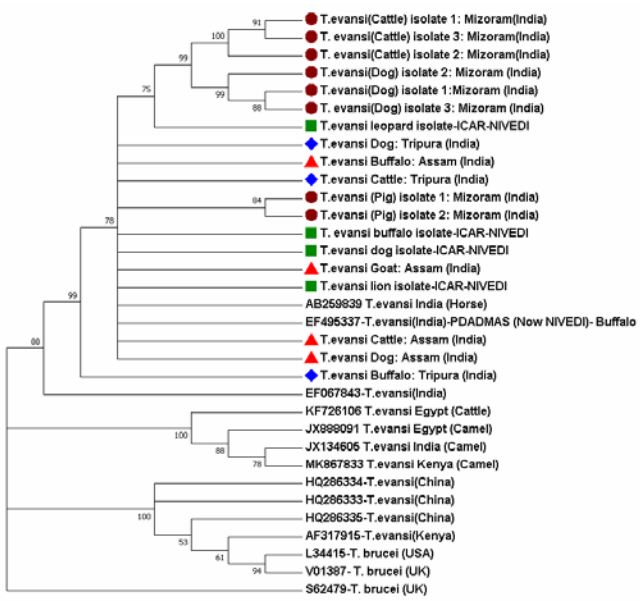


Fig. 16: Phylogenetic tree analysis of *T.evansi* VSG gene of species screened from Assam, Mizoram and Tripura using Maximum likelihood method.

Table 4: Linear discriminant analysis of climate parameters influencing vector population and indirect-ELISA results of Mizoram (Set A: Positive for presence of antibodies against *T.evansi*; Set B: Negative for presence of antibodies against *T.evansi,* Values in bold represent statistical significance of that parameter between the two data sets at 95% CI).

S.No	Parameter	Set A Mean ±SD	Set B Mean ±SD	Wilks' λ	F-value	p-value (95%CI)	Discriminant function coefficient
1	Diurnal Temperature range (°C)	8.93 ±2.03	8.67±2.03	0.977	11.085	**0.001**	-2.574
2	Leaf area index	0.40± 0.11	0.42± .09	0.992	3.903	**0.049**	-0.137
3	Normalized difference vegetation index	0.63± 0.12	0.63± 0.13	1.000	0.014	0.907	1.042
4	Wind speed (Km/h)	2.11±0 .23	2.19±0 .43	1.000	0.036	0.849	-0.624
5	Land surface temperature (°C)	26.18±2.72	26.02±2.36	0.974	0.382	0.536	-
6	Air Temperature (°C)	22.03±3.90	23.02±3.60	0.984	7.923	**0.005**	-8.335
7	Potential evaporation rate (mm/season)	174.35±48.09	170.65±44.21	0.998	0.737	0.391	2.007
8	Relative Humidity (%)	72.71±20.21	76.85±19.49	0.990	5.031	**0.025**	0.518
9	Soil moisture (%)	29.57±7.85	31.74±7.11	0.980	9.686	**0.002**	-
10	Rainfall (Inches)	6.55±0.36	7.11±0.86	0.965	0.065	0.797	-

20. Disease Informatics

20a. National Animal Disease Referral Expert System (NADRES)

India being an agriculture-based country, livestock sector plays a vital role in contributing to the economy. Disease surveillance has a significant contribution towards animal health. Forewarning of livestock diseases is based on the concept that dealing with disease epidemic in its early stages is easier and more economical than having to deal with it once it is occurred and widespread. Robust reporting and forewarning system enable the concerned authorities in disease preparedness and awareness of the risk associated with livestock disease. Therefore, the economic loss due to morbidity and mortality of the animals is reduced and helps to increase the productivity in terms of egg, meat and dairy products.

National Animal Disease Referral Expert System (NADRES) database is a weather-based forewarning system enabled with artificial intelligence system developed by ICAR- NIVEDI that forecast potential threats from pathogens two months in advance to provide the stakeholders sufficient time for awareness and preparedness to act (Fig. 17).For the purpose of forecasting, meteorological & remote sensing parameters were extracted and forecasted using Auto Regressive Integrated Moving Average (ARIMA) models. Forecasted data of weather parameters including remote sensing variables along with host density were further modelled using Artificial Intelligence system of algorithms to predict the risk of 13 diseases at reasonable accuracy with lead time of 2 months to enable the stakeholdes to better preparedness and response. The predicted risks were classified into 6 levels *viz*., No risk, very low risk, Low risk, Moderate risk, High risk, and Very high risk. Predicted risk maps of the livestock disease are generated using R software and were regularly communicated to all State animal husbandry departments, Department of Animal Husbandry & Dairying (DAHD), Govt. of India and AICRP ADMAS centers so as to enable them to respond when there is probable risk of infectious disease(Table 5) (Suresh *et al*., 2020b).

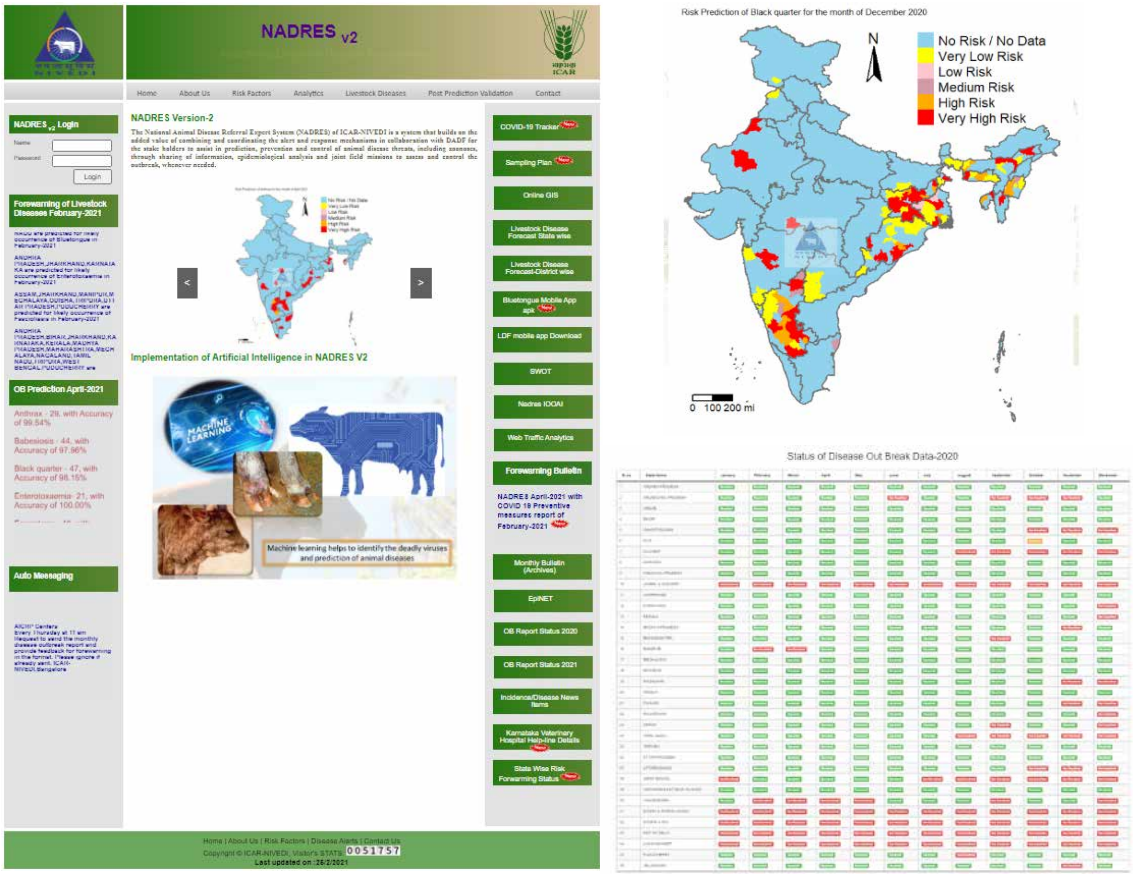


Fig. 17: NADRES V2 Web application implemented with Artificial intelligence for entry, analysis, prediction and monitoring data disease and climate related data.

Table 5: The number of outbreaks predicted and reported by different state on quarterly basis.

Livestock diseases	Jan-March 2020		April-June 2020		July-Sep 2020		Oct-Nov 2020	
	No of Districts predicted the disease	No of Districts reported the disease*	No of Districts predicted the disease	No of Districts reported the disease*	No of Districts predicted the disease	No of Districts reported the disease*	No of Districts predicted the disease	No of Districts reported the disease*
Anthrax	68	5	80	4	121	1	60	2
Babesiosis	139	87	142	62	137	66	80	7
Black quarter	152	4	195	8	208	2	92	2
Bluetongue	22	1	3	2	1	0	10	2
Enterotoxaemia	57	9	70	6	66	8	45	0
Fascioliasis	163	32	150	52	152	56	111	2
Foot and mouth disease	261	8	158	42	232	6	212	2
Haemorrhagic septicaemia	166	12	175	16	262	6	113	6
Peste des petits ruminants	201	47	178	24	162	13	99	13
Sheep & Goat pox	127	12	75	15	91	6	66	2
Swine fever	127	15	107	23	120	13	75	9
Theileriosis	113	67	149	67	106	37	86	52
Trypanosomiasis	111	42	133	107	104	138	84	0
Total	1707	341	1615	428	1762	352	1133	99

*Note: Outbreak data for the month of Dec 2020 is yet to be received and updated.

20b. Development of an expert system for cattle diseases diagnosis: A participatory approach

The prevalence studies on subclinical mastitis (SCM) and clinical mastitis (CM), major mastitis pathogens namely *Staphylococcus* species, *Streptococcus* species, *Escherichia coli* from India and the World was searched from online and offline databases. The studies were selected after reviewing by following the Preferred reporting items for systematic reviews and meta-analysis (PRISMA) guidelines.

Table 6: Prevalence estimates for mastitis and major mastitis pathogens for India and the World by using meta-analysis

Sl No	Particulars	Prevalence estimates (%)	
		India	World
1	Subclinical mastitis	45	42
2	Clinical mastitis	18	15
3	*Staphylococcus* species	41	28
4	*Streptococcus* species	18	12
5	*Escherichia coli*	15	11

The meta-analysis was done by using R software with meta package. The number of studies included for meta-analysis were 222 and 150 from the World and 103 and 37 studies from India on SCM and CM, respectively. The prevalence estimates for *Staphylococcus* species, *Streptococcus* species, *Escherichia coli* was obtained from 156, 129, 92 studies, respectively from the World and 72, 57, 54, respectively from India. The prevalence estimates obtained were given in Table 6.

The prevalence estimates determined will be helpful for the policy makers and stakeholders in planning the effective utilization of scarce resources in high risk areas compared to other areas in India and the World (Krishnamoorthy *et al.*, 2020).

20c. Development of an early warning system for economically important livestock diseases

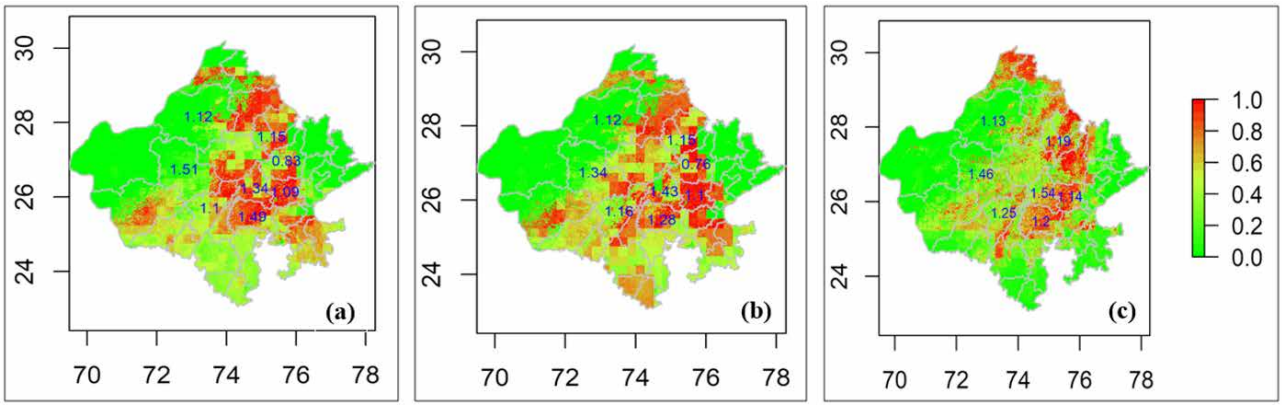
Project was initiated in the month of August 2020. During the period under report, collation long-term district level disease data for four initial focal diseases across India (Bluetongue, Haemorrhagic Septicaemia, Black Quarter and *Peste-des- petits ruminants*), and environmental variables were initiated. The aim of this project is to develop early warning system for priority livestock diseases by using statistical methods and remotely sensed variables for planning systematic vaccination and other timely control measures (Chanda *et al.*, 2020b).

20d. All Indian network programme on Gastro intestinal parasitism

Haemonchosis is a devastating disease in sheep in India imposing huge economic loss to the small

ruminant sector. During this period, disease data on haemonchosis (EPG) (2002–2017) received from CSWRI, Avikanagar unit were analysed. The EPG data was categorised into three groups as (a) >500 EPG, (b) >1000 EPG & (c) > 2000 EPG to study the contribution of risk factors for the precipitation of disease severity. Using space-time cluster model, significant disease clusters were identified. Further, ecological and environmental variables responsible for the significant disease cluster formation at village level were identified by employing Linear Discriminant Analysis (LDA). The identified risk parameters were further utilized for spatial risk modelling and mapping. Environmental factors that were found to be significantly associated with the disease incidence at *p*-value≤0.05 were considered for risk modelling. The study revealed the potential risk factors as Enhanced Vegetation Index (EVI), Leaf Area Index (LAI), Potential Evapotranspiration Rate (PET) and Specific Humidity.

The R_0 value was 0.83 to 1.51 for group I (>500 EPG) with districts like Jodhpur, Bhilwara, Ajmer and Sikar showed high disease severity. R_0 values 0.76 to 1.43 for group II (>1000 EPG) with districts like Ajmer, Jodhpur, Bhilwara and Pali demonstrated high disease severity and R_0 values 1.13 to 1.54 for group III (>2000 EPG) revealed that the districts at high risk are Ajmer, Jodhpur, Pali and Bhilwara (Fig.18). Further it may be possible that the places/region having low R_0 to shift to high R_0 values in near future due to migration of infected animals from one place to another (Sengupta *et al.,* 2020c).



(a) EPG >500 (b) EPG >1000 (c) EPG >2000

Fig. 18: R0 Values Imposed on Risk Map District wise (2001-2016)

20e. Modelling the effects of climate variability on transmission of vector-borne livestock diseases in India using remote sensing and geographical information System

Risk modelling was performed for bluetongue disease in Karnataka State using supervised machine learning algorithms with input features like meterological variables derived from GES DISC GLDAS_NOAH025_M.2.1, remote sensing variables such as NDVI, LST, EVI, NDMI were derived from MODIS products and livestock population densities. Further analysis was performed to derive the Basic Reproduction Number (R_0), which measure a transmission potential of a infectious disease, it is the average number of secondary infections produced by a typical case of an infection in population when everyone is susceptible. Risk maps for Bluetongue incidence in Karnataka was generated with R_0 values overlaid on the population of Sheep and Goat using machine learning algorithms (Fig. 19). Kolar, Udupi, Mandya and Mysore have the highest R_0values, i.e. the highest susceptible population for Bluetongue incidence. High risk of the disease can be found in the Northern, south eastern and central region of the Karnataka state.

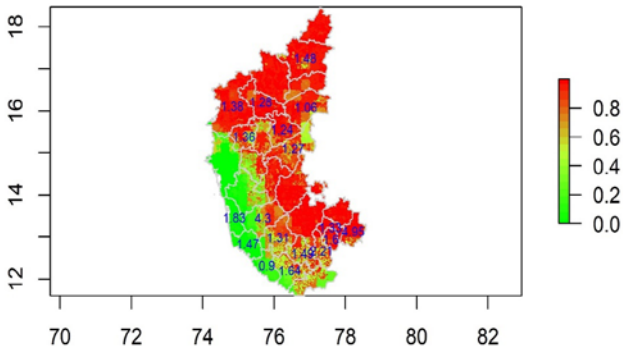


Fig . 19: Risk map with R0 values superimposed for Bluetongue in Karnataka

El Nino and La Nina are two opposing climate patterns that break these normal conditions. This phenomenonis called as *El Nino*-Southern Oscillation (ENSO) cycle. *El Nino and La Nina* can both have global impacts on weather, wildfires, ecosystems, and economies. The disease risk modelling was performed for infectious Bluetongue in Tamil Nadu to find the type, pattern and impact of risk in El-Nino and La-Nina subsets (Fig. 20). The risk maps revealed that the effect of EL-NINO and LA-NINA on Bluetongue disease occurrence in Tamilnadu. Type and pattern of Risk of BT is relatively low in La-Nina years compared to El-NINO years (Suresh *et al.,* 2020c).

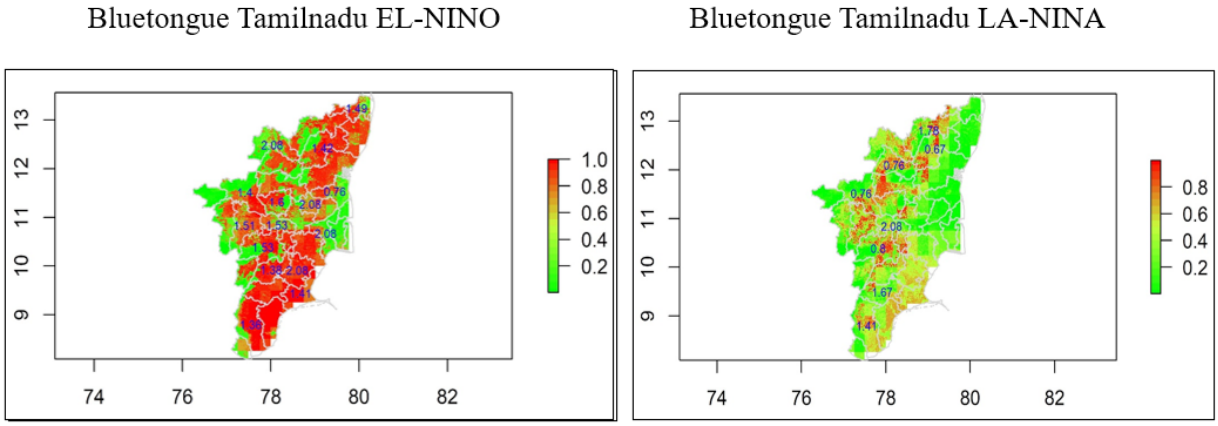


Fig. 20: Risk maps showing incidence of Bluetongue in Tamilnadu influenced by EL-NINO and LA-NINA effect.

21. Other Research Projects

21a. Immuno-epidemiological characterization of respiratory viral persistence in Pig

There are number of infectious diseases that threaten pig industry in India. The respiratory viral infection are more common and challenging to control and prevent resulting in heavy economic loss to pig farmers. The diseases like CSF, PRRS, PPV and PCV2 occur either individually or concomitantly to cause disease characterized by varied severity. Some of these viruses are known persist in secondary lymphoid organs of recovered pigs. Understanding the factors that influence viral persistence in pigs is important in order to decipher its significance in disease transmission and in disease epidemiology. Hence, the current project aims at estimating the tonsillar persistence of respiratory viruses in slaughtered pigs and genetic characterization of persistent respiratory viruses. Further, the evaluating the host immune response against persistent respiratory viruses in tonsil is important to understand the disease epidemiology. In the reporting year, the significant achievement includes the standardization PCR and screening of four tonsil samples on pilot scale for CSF, PRRS, PPV and PCV2 (Fig. 21) and all four were positive for PCV2 and PPV (Hiremath *et al.,* 2020b).

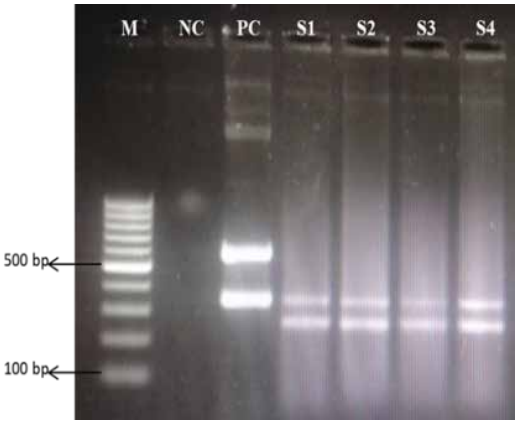


Fig. 21: Screening of tonsil samples for CSF, PCV, PPV and PRRSV by mPCR:M: 100 bp ladder, NC: Negative control, PC: Positive control, S1, S2, S3 & S4: Samples:

21b. Development and validation of novel multiplex serodiagnostic for diagnosis of porcine respiratory disease complex

The multiplex sero-diagnostic methods which are less time demanding, cost effective and consume very small quantity of clinical samples are need of the hour especially for multi-etiological disease condition like Porcine Respiratory Disease Complex caused by 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 expression of recombinant PPV VP2 protein (Fig. 22). Further development of ELISA based on PPV VP2 is underway (Hiremath *et al.,* 2020c)

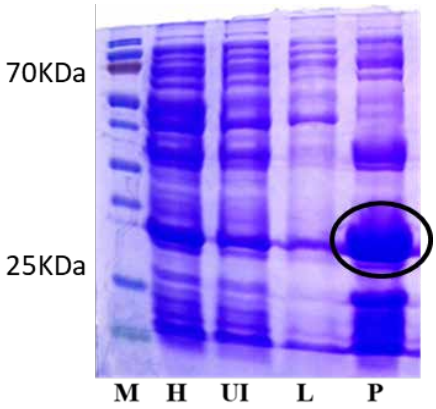


Fig. 22: Expression of recombinant PPV VP2 Protein:M-Marker (70-10KDa), H-Host, UI- Uninduced, L-Lysate and P-Pellet (Expected Size: ~30KDa)

21c. All India Network Project on Outreach Programme on Zoonotic Diseases

During the reported period, studies on leptospirosis, toxoplasmosis, and Q-fever were carried out as per the work plan. A total of 776 serum samples from animals {cattle (n=323), goats (n=142), Pigs (n=149) and humans {Pyrexia of Unknown Origin (PUO) with neurological cases (n=100), random samples (n=62)} were screened for leptospirosis by microscopic agglutination test (MAT), of which, 185 animals {cattle (n=103), pigs (n=25), goats (n=18)} and 39 humans {PUO (n=7), random (n=32)} samples showed positive reactivity for *Leptospira* specific antibodies when using 18-28 reference pathogenic Leptospira panel of antigens (Table 7). A total of 134 serum samples from dairy cattle with a history of abortion and reproductive disorders were screened for toxoplasmosis using *Toxoplasma gondii* ruminant kit (KLB30038), which revealed seropositivity of 3.73 % (5/ 134). On screening of 50 serum samples from small ruminants (46-sheep and 4-goat) with a history of abortions/and reproductive disorders by using commercially available Q-fever ELISA kit (ELISACOXLS2), none of the samples were positive for *Coxiella burnetii*antibodies (Balamurugan *et al.,* 2020c).

Table. 7: State-wise serum samples tested for leptospirosis in animals and humans

States/Districts/ Places	Species	No. of samples tested by MAT	No. of samples reacted in MAT	Percent Positivity
Assam	Pigs, Cattle, Goats	554 (Pigs-149, cattle-263, goats-142)	130 (Pigs-25, cattle-87, Goats-18)	23.47 % (Overall) 33.07 % (Cattle) 16.79 %, (Pigs) 12.68 % (Goats)
Raipur, Chhattis-garh,	Cattle	11	6	54.5 %
Pune, Maharashtra	Cattle	31	-	-
Hyderabad, Telangana	Cattle	18	10	55.55 %
Karnataka	Human	100	7	7 %
Ahmedabad, Gujarat,	Human	62	32	51.6 %
Total	Animals and Humans	(Livestock-614, Humans-162)	185 (Live-stock-146, Hu-mans-39).	

21d. Intersectoral coordination for prevention and control of zoonotic diseases

ICAR-NIVEDI has been identified as a key institution in the Southern region working in the field of zoonotic diseases and involved in Capacity Building, Surveillance & Diagnosis of zoonotic diseases to Strengthen Intersectoral Coordination in the Southern states (Kerala, Karnataka, Telangana, and Lakshadweep). Under this program, NIVEDI

undertaking the activities such as laboratory support for the diagnosis of identified zoonotic diseases; facilitation of the meeting of state zoonosis committees; joint training of medical and veterinary professionals, and preparation of relevant IEC materials catering to the needs of Karnataka, Kerala, Lakshadweep and Telangana states.

During the reported period, ICAR- NIVEDI, organized "Stakeholders Review Meeting for the Leptospirosis Control" sponsored by the National Centre for Disease Control (NCDC), Delhi at the ICAR NIVEDI campus, Bengaluru, on March 7, 2020 (Fig. 23), as a follow-up on the previous stakeholder meeting and capacity building training program on leptospirosis conducted earlier during 2017 and 2019 to evaluate action taken and update the layout of road map for preparedness for leptospirosis control. Brucellosis and Taenia Solium (Cysticerocosis) technical bulletins were prepared for the dissemination of information about this zoonotic disease to different stakeholders as per need for generating awareness. Further, diagnosis service was provided as and when required to the state surveillance units for leptospirosis and trypanosomiasis. Out of 16 human blood samples tested by PCR and CATT, none of the samples were found positive for trypanosomiasis. For leptospirosis, a total of 194 serum samples from humans {Pyrexia of Unknown Origin (PUO) with neurological cases (n=124), random samples (n=70) from endemic state} were screened for leptospirosis by microscopic agglutination test (MAT), of which, 55 humans {PUO plus neurological cases (n=20), random (n=35)} samples showed positive reactivity for *Leptospira* specific antibodies when using 18 or 28 reference pathogenic *Leptospira* panel of antigens. Further, 29 sera samples were also tested by Ig M ELISA, which showed 18 samples were positive for *Leptospira* antibodies (Balamurugan and Shome BR, 2020)

Fig. 23: Participants of Stakeholders Review Meeting for the Leptospirosis Control, sponsored by National Centre for Disease Control (NCDC), Delhi, organized by ICAR NIVEDI on March 7, 2020

21e. Optimizing Forest Benefits whilst Minimizing Impacts of Emerging Zoonotic Diseases: Co-developing an Interdisciplinary Tool for Forests in India

During the period under report different activities were carried out under the objectives assigned for ICAR-NIVEDI. Morphological identification of 1000 ticks of*Haemaphysalisspp* was completed. Out of 1000 *Haemaphysalis*, species wise break up is as follows ; *H.spinigera : 602, H.bispinosa : 160, H.turturis : 82, H.indica : 120, H.cornigerashimoga : 19, H.meghalimae and H.minuta : 4 each, H.intermedia: 7, H.centropi and H.kysanurensis : 1 each.* DNA barcodes of 92 samples of different tick species were generated. Identification of behavioural risk factors for occurrence of KFD was carried out. The questionnaire data collected from 227 households was completed and analysed. Among the variety of adaptation strategies implemented, vaccination, avoiding forest visits, wearing of protective clothing and footwear, application of dimethyl phthalate (DMP) oil and income diversification were identified by respondents as important adaptive measures during the outbreak seasons. We identified significant differences between individuals in exposure to disease information and its contribution to substantive adaptive action. Households reported several barriers to implement adaptation strategies including, lack of disease information, low efficacy of existing vaccine, distrust and livelihood concerns (Chanda, 2020c).

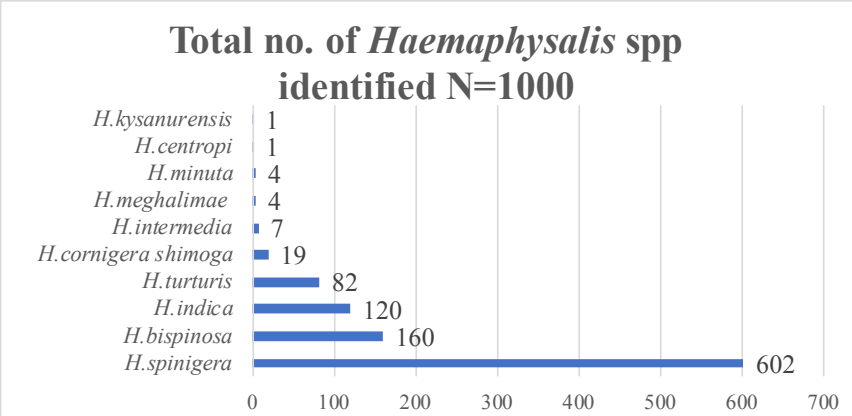


Fig. 24: Morphological identification of the *Haemaphysalis spp.* collected from field sampling in Shimoga district of Karnataka and Wayanad district of Kerala

21f. Molecular platform for epidemiology, disease mapping and development of diagnostics for economically important diseases of duck

Detection of positive selected sites on hemagglutinin (HA) and neuraminidase (NA) gene in poultry birds of H5N1 avian influenza viruses Avian influenza viruses are type A (H5N1) influenza virus and belongs to the family Orthomyxoviridae, this virus comprising of eight segments in its genome and is single stranded negative-sense Ribonucleic acid (RNA). In different bird species the virus causes mild to severe infection and are classified as low to highly morbific influenza virus. Outbreaks of very high pathogenic avian influenza (H5N1) viruses are being reported in poultry in almost all countries including Asia. It has been reported that the spread is very fast and found that this virus is spreading in avian species since several years. In this study, the evidence of positive selection prominent to mutations was analyzed for the Hemagglutinin (HA) and Neuraminidase (NA) nucleotide sequences of H5N1 avian influenza from chicken, duck and goose across Asia. H5N1 avian influenza viruses are being a severe risk to the public health. Detection of positive selection sites in Hemagglutinin (HA) and Neuraminidase (NA) genes will help to trace the evolutionary path of these viruses from different poultry hosts. The positive/ diversifying selection (dN/dS (ω) >1) was found to be showing significant signals in mutation of HA and NA genes and is evolving rapidly. The cumulative dN/dS (ω) ratio was found ranging from 0.21 to 0.23 in HA gene and 0.16 to 0.25 in NA gene of Avian Influenza Virus from chicken, duck and goose. Furthermore, statistical Bayesian model methods were applied to interpret the genetic diversity of H5N1 strain, the evolutionary rates were ranging from 2.36x10-3 to 5.19x10-3 in HA gene and 2.28x10-3 to 6.25x10-3 in NA gene from chicken, duck and goose respectively, which revealed a rapid evolution in these viruses with respect to their genetic ancestor. Substitution rates and selection pressure in these three different hosts indicate that their dynamics of mutation and replication remain similar among the species studied and are important for evolution (Patil *at al.*, 2020d).

21g. Maintenance and updating of National Livestock Serum Repository (NLSR)

ICAR-NIVEDI maintains a National Livestock Serum Repository (NLSR) and presently, it contains more than 1,00,000 catalogued serum samples of various livestock species, collected since the year 2011. Since the institute has been mandated with animal disease monitoring and surveillance, every year, the received serum samples are screened for many livestock diseases including zoonotic diseases. Due to COVID-19 pandemic, the serum repository did not receive any new serum samples. However, during the year, additional parameters such as the Optical Density/percent positivity values were updated in the records of serum samples collected during 2018-19 and 2019-20. This information was used for short listing of positive and negative serum against diseases such as bluetongue, *Peste des Petits Ruminants*, porcine reproductive and respiratory syndrome, Crimean-congo hemorrhagic fever and porcine parvo virus infection. These short listed reference serum samples were lyophilized, aliquoted and stored for future use. These serum samples can be used as a positive and negative control panels for developing new diagnostic tests against the above said diseases. In addition, the regular updating of the catalogue of NLSR was done (Hemadri *et al.*, 2020b).

21h. Disease burden quantification in small ruminants and impact of adopting preventive interventions on rural livestock farmers in Odisha

During the reported period, the treatment and control villages were identified in the project implemented districts in Odisha viz., Balangir and Kalahandi. A total of eight treatment villages and 16 control villages were identified for implementation. The base line survey was conducted in the identified villages and structured vaccination programme was implemented in the treatment villages. The baseline results indicated that the disease incidence in sheep and goats was 3.62 % and 4.67 % in treatment and control villages, respectively. The vaccination programme under the project includes administration of ET, PPR, FMD and Pox vaccine. Further, the deworming and mineral mixture supplementation activities were also undertaken. These technology interventions will be evaluated using *quasi-experimental techniques* in real field situations after completion of the planned activities (Govindaraj *et al.,* 2020c)

21i. Assessment of adoption of biosecurity practices for prevention of infectious diseases of ruminants in Southern India

Livestock farmers in India face endemic disease challenges that threaten animal health and welfare. Adoption of biosecurity practices considered as essential for the control of both epidemic and endemic diseases. Hence, this study on comprehensive assessment of the existing biosecurity practices, knowledge on disease and management strategies to reduce transmission and the perceptions of various stakeholders on biosecurity practices in prevention of infectious diseases of ruminants was initiated.

During September 2020 survey was conducted in *Hire halli*, *Kolihalli* villages in *Tumkur* district and *Chikkabelavangala* village of *Bengalruru* Rural district to know the existing biosecurity practices in the village and management practices adopted by the livestock farmers. Data were collected from livestock farmers having cow and sheep and goats and interviewed on diseases preventive biosecurity measures, occurrences of diseases outbreaks in various time periods of a year. Secondary data were also collected in the form of existing biosecurity guidelines and data on disease incidence from reports of DAHD, GOI and corroborated with filed level veterinary health care providers and finally interview schedule was prepared (Narayanan *et al.,* 2020).

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22. NIVEDI's Agribusiness Incubation centre for Animal Husbandry and Veterinary Services (NaaViC)

22a. Agri-Business Incubator (ICAR-NAIF)

Agri-business Incubator (ABI) at ICAR-NIVEDI is supported under National Agricultural Innovation Fund (NAIF) scheme of ICAR under Incubation Fund (Component-II) Intellectual Property and Technology Management Unit (IP&TM) in addition to existing 25 ABI under ICAR. The main objectives of the programme are establishment of additional agri-business incubation centres as leaders in NARS for providing technology, skill up gradation, and incubation leading to promotion of viable enterprises and generation of employment opportunities to entrepreneurs; to undertake last mile scaleup from pilot level of value chain in collaboration with stakeholders; and to impart training and capacity building to prospective entrepreneurs in agri-business ecosystem.

Being a newly established incubation facility, NaaViC, ABI, has been actively involved in various promotional activities and boot camps along with knowledge enhancing webinars where experts from various sectors like Poultry, Aquaculture, Dairy Sector, etc have been roped in to deliver informative lectures to the participants who included students, professors, scientists, and the public at large. In COID-19 pandemic time, the webinars (>15) that were conducted in the virtual mode were attended by hundreds of participants (>800) who then later contacted our incubation center for further information and guidance.

Additionally, the ABI team traveled to various incubation centers, agricultural colleges, KVK (Krishi Vigyan Kendras), Engineering Colleges, etc to create awareness of the scheme and conducted more than 30 boot camps. The team also completed several MoUs (>5) with leading institutes and R&D institutes. This collaboration will enable us to further increase student participation and help young entrepreneurs and startups to build on their innovations and become successful business entities. In addition, ABI has planned to launch several programs which will run throughout the year, specially designed for entrepreneurs, start-ups, Ideapreneurs having innovative ideas and wish to avail physical/virtual incubation at NaaViC, ICAR-NIVEDI (Shivachandra *et al.,* 2020).

22b. Agri-Business Incubator (RKVY-RAFTAAR)

In India's lockdown and looming crisis, Team NaaViC strived its best to keep the agri-entrepreneurs well informed about the business opportunities through a series of Webinars, Blog articles and Mentorship support on diverse topics by leading experts. From the First cohort, a total of 16 startups (Seed stage: 10, Pre-seed state: 6) pitched their ideas in front of the RC and 9 startups (Seed stage: 6, Pre-seed stage: 3) got selected to receive a total outlay of 1.1 crore as Grant-in-aid from the ministry. The first installment amount was released to all the winners.

The Second cohort call for agripreneurship program was launched on 1/05/2020, and a total of 289 applications were received under NEO (n=169) and NEST (n=120) programme. The first RIC meeting for 2nd Cohort was held on 13/10/2020, which recommended a total of 33 entrepreneurs for Two-month long Virtual Training Programme (28/10/2020 to 28/12/2020). The second RIC meeting for 2nd Cohort was held on 29/12/2020, which recommended 16 proposals for RC meeting. Further, the Third cohort call for agripreneurship program was launched on 23/10/2020, and a total of 177 applications were received under NEO (n=95) and NEST (n=82) programme. The first RIC meeting for 3rd Cohort recommended a total of 28 entrepreneurs for Two-month long Virtual Training Programme (23/01/2021 to 25/03/2021). During the lockdown period, 10 virtual (webinars) trainings on various topics were organized and more than 2500 candidates were trained. A total of 10 MoUs were signed with various institutes/ incubators to promote agri-preneurship. During the Covid-19 pandemic, one of our incubate, M/s Herboneeds Biotech, developed 'COVIMINT' an immunity booster health supplement, which he donated to various health workers in the locality.

Team NaaViC received a "Best Incubator Award" during Annual workshop of R-ABIs from the Knowledge partner, UAS-Dharwad. The award was given on the merits of incubators performance in implementing the Agripreneurship program (Shivachandra *et al.,* 2020).

Signing of MoU and release of Grant-in-Aid to startups at NaaViC, ICAR-NIVEDI

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Outreach Programmes

23a. Mera Gaon Mera Gaurav (MGMG)

An innovative initiative "*Mera Gaon Mera Gaurav* (My Village My Pride)" has been planned to promote the direct interface of scientists with the farmers to hasten the lab to land process. The objective of this scheme is to provide farmers with required information, knowledge and advisories on regular basis by adopting villages. Under this scheme, scientists will select villages as per their conveniences and will remain in touch with the selected villages and provide information to the farmers on technical and other related aspects in a time frame through personal visits or on telephone. 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 5 team adapting 25 villages belonging to Bengaluru rural district. During 2020, a meeting was conducted in three MGMG villages (*Ramagondanahalli, Gantiganahalli, Nagadasanahalli*) on 29.12.2020 and the theme of the programme was creating awareness on cleaning and on treatment and safe disposal of bio-degradable and non-bio-degradable wastes.

During the meeting the villagers were informed about the safe use and disposal of bio-degradable and non-bio-degradable wastes. Further, awareness was created about the proper way of wearing mask, hand washing to prevent COVID-19 infection and video regarding the same was played and the participants were taught about these techniques. Further, the participants were also informed about clean milk production and prevention of mastitis in cows. During the meeting California mastitis test kits and leaflets concerning prevention of mastitis were distributed to the participants.In the month of December 2020 yet another MGMG team conducted an interactive meeting with MGMG adapted village *Konnaghatta, Doddabalapura*, Bengaluru rural district with livestock farmers, general public and staff of gram panchayat on the importance of hygiene, cleanliness, wearing mask, frequent hand washing and maintaining social distance in prevention and control of COVID-19 and other contagious diseases. In commemoration of Swachha Bharat Abhiyan during another MGMG team conducted a walkathon at *Veerasagara, Mylappanahalli, Lingarajapura* of Bengaluru rural district in supporting the largest cleanliness mission taken up by the Government of India.These programmes were coordinated by Drs. Narayanan G, Sathish Gowda, C.S, and M. Nagalingam.

Creating mass awareness on clean milk production,importance of cleanliness, COVID "Appropriate Behaviours" to the general public in the MGMG adopted villages

23b. Swachha Bharat Abhiyan (SBA)

Swachha Bharat Abhiyan 2020 at ICAR-NIVEDI was systematically planned in light of all the flagship programmes of Government of India which includes *Swachhta Pakhwada*, Digital India, COVID-19 "Appropriate Behaviour", *Swasth Bharat*, *Atmanirbhar Bharat*, doubling farmer's income, and women empowerment. The activities witnessed enthusiastic participation of staff, students, invitees (minister, officers, progressive farmers, common public, etc.) to fulfil the goals of *Swachh Bharat Abhiyan*. Through digital mode webinars on waste water management, rain water harvesting, waste to wealth were arranged by inviting experts in the concerned areas. On the eve of *Rashtria Kisan Diwas* (23.12.2020) a grand programme was organized with mobilization of more than 100 innovative farmers from different districts of Karnataka and highlighted the government's programmes on cleanliness, income doubling technologies and farmer's welfare schemes being implemented by the government. The staff of ICAR-NIVEDI and village people have actively participated in the cleanliness drives organized both within and outside the campus and inculcated interest among them for a change in the health management. The quiz competition conducted under *Swachh Bharat* encouraged staff to be abreast with current happening related to hygiene and health as well as motivated them to take up cleanliness related activities at their homes and surroundings. After this cleanliness movement it was observed that people have started disposing off their waste in designated places within campus and reprimanded those violating it. Distribution of pamphlets conveying message on "stop using plastics" "Causes of Malaria, Dengue diseases" "Clean Water" "Clean House", "Clean Environment for Healthy India" created mass awareness about the prevention of these vector borne diseases by maintaining the hygienic conditions in their home and environment. The overall impact of the above programmes resulted in general hygiene maintenance, beautification and making the campus safe place to work under COVID-19 situation. Swachha Bharat Abhiyan programmes coordinated by Drs. Narayanan G, Sathish Gowda, C.S, and M. Nagalingam.

Various activities within and outside of ICAR-NIVEDI celebrating SBA 2020

23c. Scheduled Caste Sub-Plan (SCSP)

Institute Scheduled Caste Sub-Plan 2019-20 was implemented in Veeradimmanahalli village, Challekere Taluk, Chitradurga District in collaboration with Karnataka State Sheep and Wool Development Corporation Ltd., Chitraduragaand Veterinary Hospital, Purlahalli, Department of Animal Husbandry and Veterinary Services, GoK. A total of 62 beneficiaries belonging to resource poor SC category received each unit of sheep (5 Ewe and 1 Ram), feed, mineral, vitamin, feed supplements, deworming medicine, mineral mixtures and drinking water vessel. All the 372 sheep were vaccinated against Enterotoxaemia and insured in the month of March, 2020. During animal distributionScientist-Farmers interaction was conducted and awareness created on scientific animal husbandry practices, vaccination and deworming schedule. Follow up visits were conducted by the team and animals were to know the health and lambing status of animals. Few ewes gave birth to lambs. All sheep were vaccinated against PPR and HS in the month of May, 2020. Insurance were claimed against the death of animals and amount was credited to beneficiary account during the period (Patil *et al.,* 2020).

Distribution of sheep to SCSP beneficiary at Veeradimmanahalli

Vaccination of sheep with PPR and HS vaccine at Veeradimmanahalli

23d. Socio Economic Upliftment of The Scheduled Caste Livestock Farmers and Farm Women in Rural Areas Through Improved Livestock Production Technologies

Inclusive economic growth and development and ensuring its benefits to all sections of the society is the ultimate aim of our country, which was given in the Directive Principle State Policy of the Indian constitution. The progress made during the reporting period were identified eligible beneficiaries through baseline survey and formed five farmers interest groups during October and November months of 2020. Overall, 270 families were surveyed from three villages, which consists of 149, 23 and 98 families from Pemmadevarahalli, Veernagar and Bilekalpalya villages respectively. Majority of house type in all these three villages are kuccha type. Main occupations of villagers are daily wages (Stone crushing) followed by rainfed farming / agriculture, animal husbandry and others. It was found that, median of total income and assets value of Pemmadevarahalli, Veernagar and Bilekalpalya villages respectively are Rs.235000/-, Rs.91000/- and Rs.129000/-. Based on this median of total income and assets values 75, 14 and 42 families were selected as beneficiaries from Pemmadevarahalli, Veernagar and Bilekalpalya villages(Narayanan *et al.,* 2020).

Base line survey at Bilekalpalya of Gubbi taluk and Pemmedeverahalli village of Koratagere taluk of Tumkuru District,Karnataka.

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23e. Biosafety Laboratory Facility

ICAR-NIVEDI has state of art containment facility which is biosafety level 2++ category. It supports major research activities of the institute. Being a unique facility in the country, annually number of people visit laboratory for various purposes. The biosafety unit of the institute is instrumental in 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 major maintenance works include epoxy coating of entire laboratory and wall painting. Additionally, the 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 (Fig..).

Hands on Training for usage of PPE for Housekeeping staff during Covid Period)

Sanitization work done for BSL2+ during Covid period

Publications

24a. Research Publications in Journals

1. Akshatha BM, Isloor S, Sundareshan S, Veeresh BH, Nuthanalakshmi V, Sinha AY, Rathnamma D, Veeregowda BM, Upendra HA, Bhat AS, Shome BR, Hegde R, Prabhu KN, Sunagar R, Waryah, Gogoi-Tiwari J, Trilochan K, Mukkur and Hegde NR. (2020). Biofilm production, antibiotic resistance and the presence of ica, bap, agr and blaz genes in bovine mastitis-associated *Staphylococcus aureus* isolates from Karnataka. Indian Journal of Comparative Microbiology, Immunology and Infectious Diseases, 41(1): 39-49.http://krishi.icar.gov.in/jspui/handle/123456789/46358

2. Alamuri A, Kumar KV, Irshadullakhan K, Halala R, Shome BR and Balamurugan V. (2020). Changing trend in the prevalence and emergence of Leptospira serogroup-specific antibodies in livestock in Gujarat, India. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences,90(5): 1145-1151.http://krishi.icar.gov.in/jspui/handle/123456789/46520

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24b. Presentation in conference/ symposium/ workshop/ seminars/ other fora

1. Alamuri A, Veena S, Vinod Kumar K, Kalyani IH, Rahman H, Shome BR and Balamurugan V. (2020). Prevalence of leptospirosis in livestock in enzootic districts of Gujarat, India. In XXXIII Annual Convention of Indian Association of Veterinary Microbiologists Immunologists and Specialists in Infectious Diseases and National Conference on Challenges and Threats of Microbes to Animals and Humans at ICAR-Indian Veterinary Research Institute, Izatnagar during 6-7th February, 2020. Pp.65.

2. Balamurugan V, Alamuri A, Varghese B, Vinod Kumar K, Govindaraj G, Hemadri D and Roy P. (2020). Distribution of serogroup specific *Leptospira* antibodies and its prevalence in Sheep and Goats in coastal districts of endemic states of Southern Peninsular India. In XX Indian Veterinary Congress, XXVII Annual Conference of IAAVR and National Symposium, Madras Veterinary College, during February 21-22th, 2020.

3. Balamurugan V, Anusha A, Sengupta P P, Sushma RAT, Sridevi R, Nagalingam M and Rahman H. (2015). Seroepidemiology of Leptospirosis and Toxoplasmosis by Latex Agglutination Test. In XIII Annual conference of Indian Association of Veterinary Public health specialists held at Veterinary College, KVAFSU, Bangalore during 10-12th February, 2015. Pp.306.

4. Balamurugan V, Varghese B, Muthuchelvan D, SowjanyaKumari S, Vinod Kumar K, Dheeraj R, Govindaraj G, Suresh KP, Hemadri D and Roy P. (2020). Seroprevalence study of Peste des petits ruminants in small ruminants in the North Eastern Region of India. In XXXIII Annual Convention of Indian Association of Veterinary Microbiologists Immunologists and Specialists in Infectious Diseases and National Conference on Challenges and Threats of Microbes to Animals and Humans at ICAR-Indian Veterinary Research Institute, Izatnagar during 6-7th February, 2020. Pp.62.

5. Balamurugan V, Varghese B, Muthuchelvan D, Vinod Kumar K, Suresh KP, Govindaraj G, Hemadri D and Roy P. (2020). Cross-sectional serosurvey study of peste des petits ruminants in small ruminants in the northeastern Sikkim state of India. In XX Indian Veterinary Congress, XXVII Annual Conference of IAAVR and National Symposium, Madras Veterinary College during 21-22th February, 2020.

6. Balamurugan V, Vinod Kumar K and Alumuri A. (2020). Epidemiology of bovine leptospirosis in tropical subcontinent: Indian current scenario and future perspectives. In National Symposium and XIV Biennial Conference of Association of Public Health Veterinarians (APHV), College of Veterinary Sciences & AH, Uttar Pradesh, Pandit DeenDayal Upadhyaya PashuChikitsa Vigyan Vishwavidyalaya, Evam Go-AnusandhanSansthan, Mathura during 24-25th January, 2020.

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Complex, Pusa during 18-20th January, 2020. Pp.156.

8. Balamurugan V. (2020). Current status of PPR in India: its diagnostics and control. In National webinar on "Transboundaries and emerging infectious diseases: challenges in diagnosis and control" in association with Indian virological society organized by the Depatment of Veterinary Microbiology, Assam agricultural university, Khanapara, Guwahati during 18 November, 2020.

9. Balamurugan V. (2020). Leptospirosis: Overview and Indian Perspectives. In "Emerging bacterial infections of canine with special reference to leptospirosis" Training programme organized by the College of Animal Biotechnology, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana under the aegis of DBT-Canine Research Centre, Network Project during 14-15th December, 2020

10. Feroze RG, Nimia V, Shome R and Shome BR (2020). Frequency and genetic diversity of extended spectrum beta-lactamase, AmpC beta-lactamase and metallo beta-lactamase producing *Eschrichia coli* from human and animal populace: A One health molecular surveillance approach, held during AIIMS-ASM 2020 jointly organized by All India Institute of Medical Sciences, New Delhi and the American society of Microbiology during 7-8 October, 2020.

11. Hiremath J, Chanda MM, Prajakta PB, Kashyap P, Subhashri, Patil SS, Hemadri D and Roy P. (2020). Genetic Characterization of Porcine Circovirus 2 in North East and Southern India. In IVS International Conference on Evolution of Viruses and Viral Diseases at INSA, New Delhi during 18-20thFebruary, 2020.

12. Hiremath J, Chanda MM, Yogisharadhya, Reddy GBM, Patil SS and Roy P. (2020). IBSA: A mobile application that assists in adopting laboratory biosafety as per national guidelines. In XXXIII Annual Convention cum Conference of Indian Association of veterinary Microbiologists, Immunologists and Specialist in Infectious Diseases (IAVMI) on Challenges and Threats of Microbes to Animals and Humans, Organized at ICAR-IVRI, Izatnagar, Uttar Pradesh, India during 6-7th February 2020.

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14. Krishnamoorthy P, Suresh KP, Kavitha SJ and Shome BR. (2020). Prevalence of major mastitis pathogens in cattle and buffaloes of the world based on systematic review and meta-analysis. In online International Veterinary Pathology Congress 2020 on "Role of veterinary pathology in controlling emerging and re-emerging diseases of livestock and poultry: An one health approach" held at Nagpur Veterinary College, Nagpur, Maharashtra during 26-29th December, 2020. Pp.105.

15. Prajapati A, Mohanty NN, Yogisharadhya R, Chanda MM, Shivachandra SB and Hemadri D. (2020). Immunogenicity of recombinant NanB N-terminal protein of *Pasteurella multocida* B:2 in mouse model. In International e-conference on 'Immunology in 21st Century for improving animal health held at SVPUAT, Meerut India during 7-8th August, 2020.

16. Prajapati A, Parveen A, Janofer U, Yogisharadhya R, Mohanty NN, Hiremath J, Chanda MM and Shivachandra SB. (2020). Evaluation of ERIC-PCR and REP-PCR as molecular typing tools for pathogenic *Pasteurella multocida* of diverse host origin. In XXXIIIAnnual Convention of IAVMI and National Conference held at ICAR-Indian Veterinary Research Institute (IVRI), Izzatnagar, Uttar Pradesh, India 6-7th February, 2020.

17. Prajapati A, Parveen A, Janofer U, Yogisharadhya R, Nagarjuna Y, Hiremath, J, Chanda MM andShivachandra SB. (2020). Bacterial isolation and typing of *Pasteurella multocida* from clinical cases of livestock. In 107th Indian Science Congress-2020 held at UAS-Bengaluru, GKVK campus, Karnataka, India during 3-7th January, 2020.

18. Rajkumar S, Nayak N, Kumar HBC and Chakurkar EB. (2020). An Outbreak of favus in poultry flocks in Goa. In Proceeding of the world Veterinary Poultry Association conference 2020. Held at NIANP, Bengaluru during 28th February 2020.

19. Reddy GBM. (2020). Molecular Diagnosis and Epidemiology of Animal Rabies in India. In Virocon 2020: International Conference on Evolution of Viruses and Viral Diseases, at Indian National Science Academy, New Delhi, India during 18-20th February, 2020. Pp.254.

20. Sengupta PP, Pavithra BS, Siju SJ,Sudhagar S, Chandu AGS, Rangaraj R and Roy P.(2020). Cloning, expression and characterization of Cathepsin B5 of *Fasciolagigantica* for early diagnosis of bovine baesiosis. In 20th Indian Veterinary Congress, XXVII Annual Conference of IAAVR and National Symposium of Veterinary Research Priorities in translational animal health, production and food safety held at TANUVAS, Chennai during 21-22nd February, 2020. Pp. 96.

21. Sengupta, PP. (2020). Presented online a lead paper, as fellow presentation, entitled Sensitive advanced approaches for diagnosis of surra in animals. In Scientific Session of the National Academy of Agricultural Sciences, New Delhi during 22-25th June, 2020.

22. Sharma G, Dey TK, Garlapati S, Grace D, Shome R and Lindahl JF. (2020). Secondary effects of COVID-19 on One Health. E poster presented in virtual 6th World One Health Congress,during 30th October-3thNovember, 2020.

23. Sridevi R. (2020). GIS in Animal Disease Epidemiology. In UGC sponsored National Seminar on New Horizons in Animal Sciences held at Sri Meenakshi Government Arts College for Women. Madurai. Tamilnadu during 25th February,2020.

24. Swain PS, Rajendran D, Rao SBN, Krishnamoorthy P, Mondal S, Selvaraju S and Dominic G. 2020. Nano zinc supplementation affects immunity, hormonal profile, hepatic superoxide dismutase 1 gene expression and vital organ histology in Wistar albino rats. In International webinar on "Climate smart livestock and poultry production through nutritional interventions" held at Institute of Animal Nutrition, Chennai, Tamil Nadu during 23-24th November, 2020.

24c. Manuals/ Book chapter

Manuals

1. Suresh KP, Balamurugan V, Govindaraj and Roy P. (2020). Sampling plan for SerosurveillanceandSeromonitoring of Peste des Petits Ruminants (PPR). Prepared under National PPR Control Programme (as per OIE/ FAO-Global Control and Eradication Strategy for PPR guidelines) for National PPR Control and Eradication Strategy 2025. Submitted to Department of Animal Husbandry & Dairying (DAHD), Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India. Published by Director, ICAR-NIVEDI, Bengaluru.

Book/ Book chapter

1. Gnanavel V, Kumar A, Bhanuprakash V, Balamurugan V and Singh RK. (2020). Capripoxvirus and Orf Virus. In Animal-Origin Viral Zoonoses. Livestock diseases and Management, Edited by Malik YS, Singh RK and Dhama K.Springer Publications. ISBN 978-981-15-2651-0. Pp.203-222

2. Patil SS, Suresh KP and Parimal Roy. (2021). Pig Diseases and Management, ICAR NIVEDI, Bengaluru. Today & Tomorrow's Printers and Publishers, New Delhi. ISBN 10: 81-7019-676-3 (India); ISBN 13: 9788170196761.

3. Sridevi R and Siju SJ (2021) Non Progressive Atrophic Rhinitis (NPAR) in Pigs. In Pig Diseases and Management Edited by Patil, SS, Suresh KP and Roy P. Today and Tomorrow's Printers and Publishers. New Delhi. Pp.39-54.

4. Vinod Kumar K, Alamuri A and Balamurugan V. (2020). Swine Leptospirosis. In Pig Diseases and Management, Edited by Patil, SS, Suresh KP and Roy P. Today and Tomorrow's Printers and Publishers. New Delhi. ISBN 9788170196761. Pp. 83-110

24d. Technical Bulletins/ Booklets/Leaflets

1. Nagalingam M. Shome R and Balamurugan V. (2020). "Brucellosis" -Technical Bulletin. NIVEDI/ Tech. Bulletin/2020. Published by Director, ICAR-NIVEDI. Bengaluru.
2. Siju S, Sengupata PP and Balamurugan V. (2020). "*Taenia Solium* (Cysticerocosis)" -Technical Bulletin. NIVEDI/Tech. Bulletin/2020. Published by Director, ICAR-NIVEDI. Bengaluru.
3. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ, Roy P. (2020). Livestock Disease Forewarning Monthly Bulletin-March 2020, ICAR NIVEDI, Bengaluru. (January – December 2020, Volume 8, Issue 1–12): 12 issues
4. Suresh KP, Patil SS, Parmial Roy, Mohapatra JK, Saravanan S and Singh RK. (2020). Sampling Plan for Serosuveillance and Seromonitoring of FMD, in India under National FMD control Programme (Volume I & II: Serosurveillance and Seromonitoring), ICAR-NIVEDI, Bengaluru (Revision 2).
5. Shivachandra, S.B., Yogisharadhya, R., and Manjunath Reddy, G. B. (2020). NaaViC, Poster in English (A3 and A2 size), ICAR-NIVEDI, Bengaluru, Karnataka.
6. Shivachandra, S.B., Yogisharadhya, R., and Manjunath Reddy, G. B. (2020). NaaViC, Poster in Kannada (A3 and A2 size), ICAR-NIVEDI, Bengaluru, Karnataka.
7. Shivachandra, S.B., Yogisharadhya, R., and Manjunath Reddy, G. B. (2020). NaaViC, Flyer in English, ICAR-NIVEDI, Bengaluru, Karnataka.
8. Shivachandra, S.B., Yogisharadhya, R., and Manjunath Reddy, G. B. (2020). NEO, Agri-preneurship Orientation programme, ICAR-NIVEDI, Bengaluru, Karnataka.
9. Shivachandra, S.B., Yogisharadhya, R., and Manjunath Reddy, G. B. (2020). NEST, Startup Incubation programme, ICAR-NIVEDI, Bengaluru, Karnataka
10. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ and Roy P. January 2020. Livestock disease forewarning monthly Bulletin-March 2020. 8(1): 1-87. http://krishi.icar.gov.in/jspui/handle/123456789/35503
11. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ and Roy P. February 2020. Livestock disease forewarning monthly Bulletin-April 2020. 8(2): 1-87.http://krishi.icar.gov.in/jspui/handle/123456789/35504
12. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ and Roy P. March 2020. Livestock disease forewarning monthly Bulletin-May 2020. 8(3): 1-88. http://krishi.icar.gov.in/jspui/handle/123456789/35505
13. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ, Roy P. April 2020. Livestock disease forewarning monthly Bulletin-June 2020. 8(4): 1-93. http://krishi.icar.gov.in/jspui/handle/123456789/35506
14. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ, Roy P. May 2020. Livestock disease forewarning monthly Bulletin-July 2020. 8(5): 1-93. http://krishi.icar.gov.in/jspui/handle/123456789/35507
15. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ, Roy P. June 2020. Livestock disease forewarning monthly Bulletin-August 2020. 8(6): 1-94.http://krishi.icar.gov.in/jspui/handle/123456789/37131
16. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ, Roy P. July 2020. Livestock disease forewarning monthly Bulletin-September 2020. 8(7): 1-93. http://krishi.icar.gov.in/jspui/handle/123456789/38068
17. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ, Roy P. August 2020. Livestock disease forewarning monthly Bulletin-October 2020. 8(8): 1-93. http://krishi.icar.gov.in/jspui/handle/123456789/39436

18. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ, Roy P. September 2020. Livestock disease forewarning monthly Bulletin-November 2020. 8(9): 1-97.http://krishi.icar.gov.in/jspui/handle/123456789/41146

19. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ. October 2020. Livestock disease forewarning monthly Bulletin-December 2020. 8(10): 1-105.http://krishi.icar.gov.in/jspui/handle/123456789/41816

20. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ. November 2020. Livestock disease forewarning monthly Bulletin-January 2021. 8(11): 1-106.http://krishi.icar.gov.in/jspui/handle/123456789/42299

21. Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Siju SJ. December 2020. Livestock disease forewarning monthly Bulletin-February 2021. 8(12): 1-108.http://krishi.icar.gov.in/jspui/handle/123456789/43180

24e. Popular Article

1. Sridevi R, Ramya M, Jacob SS and Nagalingam M. (2020) Livestock animal diseases and Outbreak Investigations. Livestock Line, 14 (3):18-21.

2. Udharwar SV, Shivasharanappa N and Kumar HBC. (2020). Vaccination of Goats (Marathi). Mugadhara Magazine, 2020: 38-39.

Capacity Building/ Human Resource Development

25a. Training/Refresher Course/Summer/Winter School/Seminars/ Conferences/Symposia/Workshops/Krishi Mela/Fairs Organized

Sl. No.	Name of Seminar /Workshop /Training	Venue	Date
1	Basic Excel Training- (SCSP)	ICAR-NIVEDI	30th January, 2020
2	Two days Indo-UK project Workshop on Bioinformatics organized along with University of Cambridge, UK	Guwahati	17 to 18th February, 2020
3	Orientation workshop on 'Disease Burden Quantification in Small Ruminants and Impact of Adopting Preventive Interventions on Rural Livestock Farmers in Odisha'	Animal Disease Research Institute, Cuttack	27th February, 2020
4	Advanced training on molecular diagnosis of anthrax conducted at Centre for Wildlife Health	Odisha University of Agriculture and Technology, Bhubaneswar	4-6th March, 2020
5	Stakeholders Review Meeting for the Leptospirosis Control	ICAR- NIVEDI	7th March, 2020
6	Skill and Knowledge of Veterinarians for better livestock health and production (RKVY-RAFTAAR)	UAS, Dharwad	12th March, 2020 to 14th March, 2020
7	Machine Learning	ICAR-NIVEDI	19th March, 2020
8	RKVY-RAFTAAR funding for Agriculture Startups	ICAR-NIVEDI	15th April, 2020
9	Microsoft Office Applications- (SCSP)	ICAR-NIVEDI	18th May, 2020 to 16th June, 2020
10	Webinar on Impact of Modern Intellectual Property Rights, Regime & Technology Management on Entrepreneurship Development In Livestock Sector (RKVY-RAFTAAR)	ICAR-NIVEDI	22nd June, 2020
11	Webinar on Financial management and valuation in Agriculture and Allied sector(RKVY-RAFTAAR)	ICAR-NIVEDI	22nd July, 2020 to 23rd July, 2020
12	Evaluation of Milestones and Deliverable of Individual grant in Aid winning startups (Review meeting)	ICAR-NIVEDI	13th August, 2020
13	Webinar on Entrepreneurship Opportunities in veterinary and animal husbandry: From ideas to reality (RKVY-RAFTAAR)	ICAR-NIVEDI	10th September, 2020
14	Webinar on Profitable solutions for day to day issues in dairy farming (RKVY-RAFTAAR)	ICAR-NIVEDI	19th September, 2020
15	Webinar on The financial aspects that matter for a startup (RKVY-RAFTAAR)	ICAR-NIVEDI	24th September, 2020
16	Webinar on Modern Solutions in Sheep Farming (RKVY-RAFTAAR)	ICAR-NIVEDI	03rd October, 2020
17	Webinar on Business Prospects in Meat Sector (RKVY-RAFTAAR)	ICAR-NIVEDI	09th October, 2020

Sl. No.	Name of Seminar /Workshop /Training	Venue	Date
18	Webinar on Agri-Business Incubator: Models and Prospects under National Agricultural Research Systems (ICAR-NAIF-ABI)	ICAR-NIVEDI, Bengaluru	21st October, 2020
19	Two months virtual training on Agripreneurship Orientation Program(AOP) for shortlisted pre-seed stage startup (NEO) under RKVY-RAFTAAR Scheme	ICAR-NIVEDI	28th October, 2020 to 29th December, 2020
20	Two months virtual training onStart upAgribusines Incubation Program (SAIP) for shortlisted seed stage startup (NEST) under RKVY-RAFTAAR Scheme	ICAR-NIVEDI	28th October, 2020 to 29th December, 2020
21	Annual Scientist's meet of AICRP on Animal Disease Monitoring and surveillance	Virtual Meet, ICAR-NIVEDI,	10-11th November, 2020
22	Geographic Data Analysis	ICAR-NIVEDI	18th November, 2020
23	Antimicrobial resistance Week –World Antimicrobial Awareness Week 2020	ICAR-NIVEDI	18th November, 2020 to 24 November, 2020
24	Webinar on Promoting Agri startups –Experiences of ecosystem partners in collaboration with MANAGE, Hyderabad(ICAR-NAIF-ABI)	ICAR-NIVEDI, Bengaluru	21st November, 2020
25	Data management and Advanced statistics in R	ICAR-NIVEDI	10th December, 2020
26	Webinar on Techno-Management Development program (T-MDP) on Extruded Food Products Manufacturing in collaboration with IIPM, Bengaluru(ICAR-NAIF-ABI)	ICAR-NIVEDI, Bengaluru	14th December, 2020
27	Orientation on RKVY-RAFTAAR program and funding opportunities	GKVK, Benagluru	17th December, 2020
28	Webinar on Entrepreneurship opportunities in Prawn/ Shrimp aquaculture(ICAR-NAIF-ABI)	ICAR-NIVEDI, Bengaluru	18th December, 2020
29	Webinar on Waste to wealth (ICAR-NAIF-ABI)	ICAR-NIVEDI, Bengaluru	22nd December, 2020
30	Swachha Bharat Abhiyan 2020	ICAR-NIVEDI, Bengaluru	16th to 31st December, 2020

25b. Training/Refresher Course/Summer/Winter School/Seminars/ Conferences/Symposia/Workshops/Krishi Mela/Fairs Programmes participated

Sl. No.	Name of Seminar /Workshop / Training	Venue	Date	Attended by
1	107th Indian Science Congress.	UAS, Bengaluru	3-7th January, 2020	Dr. S.S. Patil, Dr. S.B. Sathish, Dr. Jagadish Hiremath, Dr. R. Yogisharadhya
2	Serosurveillence and seromonitoring of FMD/Brucellosis Control Programme	NASC, New Delhi	6-7th January 2020	Dr. K.P. Suresh
3	Conference: Autophagy and Lysosomes (ICAL2020)	Indian Institute of Sciences, Bengaluru	16-18th January, 2020	Dr. R. Sridevi
4	Meeting: ICAR- network project on OPZD for the year 2018-19	Nagpur Veterinary College, Nagpur	17-18th January, 2020	Dr. V. Balamurugan
5	Conference: Evolution of viruses and viral diseases at Indian National Science Academy	ICAR-NIANP, New Delhi	18-20th January, 2020	Dr. Jagadish Hiremath
6	29th National Congress of Veterinary Parasitology 2020	College of Veterinary Science and Animal Husbandry, Jabalpur	5-7th February, 2020	Dr. P. Krishnamoorthy
7	Indo-Australian Workshop On Transfer of Mitigation Technologies for Heat Stress in Farm Animals	ICAR-NIANP, Bengaluru	5-7th February, 2020	Dr. GBM Reddy
8	XXXIII Annual conference of IAVMI on Challenges and Threats of Microbes to Animals and Humans	ICAR-IVRI, Izatnagar	6-7th February, 2020	Dr. Jagadish Hiremath
9	National Horticultural Fair organized by ICAR-Indian Institute of Horticultural Research	ICAR-IIHR, Bengaluru	5-8th February, 2020	Dr. Narayanan G. Dr. Sathish Gowda, C.S. Dr. Govindaraj G.
10	Indo-UK project Workshop on Bioinformatics	Guwahati	17 -18th February, 2020	Dr. B. R. Shome
11	Evolution of Viruses and Viral diseases VIROCON 2020	Indian National Science Academy, New Delhi	18-20th February, 2020	Dr. V.Balamurugan, Dr. GBM Reddy

Sl. No.	Name of Seminar /Workshop / Training	Venue	Date	Attended by
12	Training on Prevention and control on Antimicrobial resistance (AMR) in the context of an overall One health approach involving both veterinary and human fields	New Delhi	18-21st February, 2020	Dr. P. Krishnamoorthy
13	20th Indian Veterinary Congress and National Symposium of Veterinary Research Priorities in translational animal health, production and food safety	TANUVAS, Chennai	21-22nd February, 2020	Dr. P.P. Sengupta Dr. V.Balamurugan
14	Annual R-ABI Worskshop& Investors' Meet	UAS, Dharwad	25th February, 2020 to26th February, 2020	Dr R Yogisharadhya R
15	User Interaction Meet 2020	National Remote Sensing Center, Hyderabad	26-27th February, 2020	Dr. K.P. Suresh
16	Antimicrobial resistance knowledge dissemination program for Veterinary doctors	ICAR-NIVEDI	28th February, 2020	Dr. B. R. Shome
17	Workshop: Strategies for Climate Resilient Animal Husbandry Practices in Karnataka	Veterinary College, Hassan	10th March, 2020	Dr. GBM Reddy
18	Monkey pox: An Introduction under Health Emergencies Programme	WHO	20th March, 2020	Dr. S.S. Patil
19	Pandemic Influenza Vaccines:	WHO	23th March, 2020	Dr. S.S. Patil
20	COVID-19: Operational Planning Guidelines and COVID-19 Partners platform to support country preparedness and response	WHO	26th March, 2020	Dr. S.S. Patil
21	Influenza sentinel surveillance training: National Influenza and Vaccination Plans	WHO	28th March, 2020	Dr. S.S. Patil
22	Competency-Based Learning: Introduction under Health Emergencies Programme	WHO	29th March, 2020	Dr. S.S. Patil
23	Management and Facilitation of an After Action Review (AAR) under Health Emergencies Programme	WHO	06th April, 2020	Dr. S.S. Patil

Sl. No.	Name of Seminar /Workshop / Training	Venue	Date	Attended by
24	Certified Peer review course	ELSEVIER	07-8th April, 2020	Dr. S.S. Patil
25	Antimicrobial Stewardship: A competency based approach) under Health Emergencies Programme	WHO	09th April,.2020	Dr. S.S. Patil
26	Clinical Care Severe Respiratory Infection (SARI) under Health Emergencies Programme	WHO	11th April,.2020	Dr. S.S. Patil
27	GO Training 2.0 (About EBOLA disease etc) under Health Emergencies Programme	WHO	15th April,.2020	Dr. S.S. Patil
28	Webinar: Novel Microbes and Newer Threats	Sathyabama Institute of Science and Technology, Indian Association of Applied Microbiology andCalifornia University of Science and Medicine, USA.	20-30th April, 2020	Dr. V. Balamurugan
29	FAO programme on Peste des petits ruminants Global Eradication Programme (PPR-GEP) implementation	PPR Global Research and Expertise Network Chair (GREN)	24th April, 2020	Dr. V. Balamurugan
30	Carnataka Cardiology Academy-Scientific Programme-Webcast	Bengaluru	28-29th April, 2020	Dr. K. P. Suresh
31	Training: Science Communication for smart Scholars	ICAR-CIFE, Mumbai	26th May to 8th June, 2020	Dr. R .Sridevi
32	Start-up To Corporate Workshop (RKVY-RAFTTAR)	Pusa Krishi, New Delhi	30th May, 2020	Dr SB Shivachandra Dr GB Manjunatha Reddy Dr R Yogisharadhya
33	Scientific Session of the National Academy of Agricultural Sciences,	NAAS, New Delhi	22-25th June, 2020	Dr. P.P. Sengupta
34	PPR Eradication Campaign South Sudan E-Launch	FAO South Sudan and Animal Production and Health Division, FAO	23rd June, 2020	Dr. V. Balamurugan

Sl. No.	Name of Seminar /Workshop / Training	Venue	Date	Attended by
35	Webinar: the occasion of Celebration World Zoonoses Day	Association of Public Health Associations Mumbai Veterinary College, Mumbai	6th July, 2020	Dr. V. Balamurugan
36	Implementation of Access Online Management Development and Benefit Sharing Regulations in Sensitization Workshop	ICAR-NAARM, Hyderabad	7-10th July, 2020	Dr. M. Nagalingam
37	Webinar: Benefits and support offered by 'Department of Science and Technology	Startup India, New Delhi	08th July, 2020	Dr SB Shivachandra Dr GB Manjunatha Reddy Dr R Yogisharadhya
38	International Webinar, COVID-19 Pandemic: Crisis and Aftermath	Jacob Institute of Biotechnology and Bioengineering, Sam Higginbottom University of Agri. Technology and Sciences	20-2th July, 2020	Dr. S.S. Patil
39	Webinar: current scenario and future strategies for management of parasites in animals	SDAU, Sardarkrushinagar	28-29th July, 2020	Dr. Siju S. J
40	Webinar: Microbiome, Immunity and Vaccines	Indian Association of Veterinary Microbiologists, Immunologists & Specialists in Infectious Diseases (IAVMI), Bareilly	30th July, 2020	Dr. B. R. Shome
41	Training: Analysis of experimental data using R	ICAR-NAARM, Hyderabad	5-11th August, 2020	Dr. P. Krishnamoorthy, Dr. R. Sridevi, Dr. M. Nagalingam Dr. Siju S. J,
42	Webinar: Bioinformatic Analysis On Soil Microbial Community Sequence Data	ICAR- IARI, New Delhi	12-13th August, 2020	Dr. M. Nagalingam
43	Orientation workshop and training program for ABI units (virtual)	Virtual ICAR-NAARM, Hyderabad	17th August 2020 to 19th August, 2020	Dr SB Shivachandra Dr GB Manjunatha Reddy Dr R Yogisharadhya
44	Workshop: ABC of Scientific Writing	Organised by ICAR-NRRI, Cuttack and KVK	18th August- 2nd September, 2020	Dr. R. Sridevi

Sl. No.	Name of Seminar /Workshop / Training	Venue	Date	Attended by
45	Abiotic Stress in Agriculture Geospatial characterization and management options	ICAR NIASM, Baramati	27th August, 2020	Dr. K.P. Suresh
46	Workshop: Generating the highest level of evidence through Systematic Review and Meta-analysis: best Alternative for hospital-based projects during the current pandemic situation	National Institute of Pharmaceutical Education and Research, Guwahati	28-29th August, 2020	Dr. P.P. Sengupta Dr. V. Balamurugan Dr. P. Krishnamoorthy Dr. R. Sridevi Dr. Siju S. J
47	Webinar: Microbiome, Immunity and Vaccines	Indian Association of Veterinary Microbiologists, Immunologists & Specialists in Infectious Diseases (IAVMI)	30th August, 2020	Dr. V. Balamurugan
48	Webinar: One Health Perspectives of Antimicrobial Resistance	IAVPHSand Karnataka Veterinary, Animal & Fisheries Sciences University, Bidar	4th September, 2020	Dr. V. Balamurugan
49	Webinar: Future Perspectives in Agricultural Education	ICAR- IARI, New Delhi	5th September, 2020	Dr. V. Balamurugan, Dr. M. Nagalingam
50	Workshop-cum-training: Intellectual Property Rights in Agricultural Research & Education in India	NAHEP and IP&TM Unit, ICAR, New Delhi	12-28th September, 2020	Dr. M. Nagalingam
51	Webinar: Live Stock Management	Haryana Institute of Public Administration, Gurugram	14 -18th September, 2020	Dr. K. P. Suresh
52	Accessing Taylor and Francis Journals	Taylor & Francis Group	15th September, 2020	Dr. P. Krishnamoorthy Dr. R. Sridevi
53	Webinar: Novel approaches and emerging issues in parasitic diseases of veterinary and medical importance	Veterinary College, Bengaluru	16-18th September, 2020.	Dr. P. Krishnamoorthy Dr. Siju S. J
54	Webinar: T and F e-resources A session on accessing Taylor & Francis journals	CeRA, ICAR-DKMA, New Delhi	16th September, 2020.	Dr. V. Balamurugan Dr. P. Krishnamoorthy Dr. Siju S. J

Sl. No.	Name of Seminar /Workshop / Training	Venue	Date	Attended by
55	Webinar: Agri Supply Chain, Challenges & Opportunities	IKP Knowledge park, Bengaluru	18th September, 2020	Dr SB Shivachandra Dr GB Manjunatha Reddy Dr R Yogisharadhya
56	Webinar: Finding Peer Reviewers" and "Making Editorial Decisions"	BMC Journal	23rd September-7th October, 2020	Dr. V. Balamurugan
57	Webinar: Training on quality Management System (INFAAR)	INFAAR network, New Delhi	24th September, 2020	Dr. B. R. Shome
58	Webinar: An update on canine vector-borne parasitic diseases	Madras Veterinary College, Chennai	24th September, 2020	Dr. Siju S. J
59	Webinar: Biosafety issues related to COVID-19 testing and Zoonotic Diseases	College of Veterinary Science and Animal Husbandry, Mathura	28th September, 2020	Dr. V. Balamurugan
60	Webinar: How to Publish open access and succeed with your Publication	CeRA, ICAR-DK-MA, New Delhi	5th October, 2020	Dr. V. Balamurugan Dr. P. Krishnamoorthy Dr. R. Sridevi
61	Virtual Global Summit on Artificial Intelligence: Responsible AI for Social Empowerment (RAISE 2020)	New Delhi	5-9th October, 2020	Dr. Jagadish Hiremath
62	Webinar- Antibiotic Resistance: Renewed Fight	AIIMS-ASM. New Delhi	7-8th October, 2020	Dr. B. R. Shome
63	Multi-stakeholder National Workshop on "PPR control & eradication in India"	DAHD, New Delhi	27th October, 2020	Dr. V. Balamurugan
64	Webinar: AMR Mitigation for Food Safety - ONE HEALTH	Ayurvet Research Foundation, DAHD and SVPUAT, Meerut	30th October, 2020	Dr. B. R. Shome Dr. P. Krishnamoorthy
65	Lumpy Skin Disease –OIE Emergency Response webinar on Regional general and laboratory consultation	Global framework for the progressive control of transboundary animal diseases in association with OIE Asia Pacific and DAHD, GoI	24th September, 2020 to 25th September, 2020	Dr D Hemadri Dr Md. Mudassar Chanda Dr G B Manjunatha Reddy Dr Chethan Kumar HB Dr R Yogisharadhya

Sl. No.	Name of Seminar /Workshop / Training	Venue	Date	Attended by
66	Webinar on Fund Raising & GST, All that you need to know	IKP Knowledge park, Bengaluru	25th September, 2020	Dr SB Shivachandra Dr GB Manjunatha Reddy Dr R Yogisharadhya
67	International one health webinar on Relative contributions of the different sources of Toxoplasma gondii, a globally important pathogen of major public health concern	GADVASU, Ludhiana	5th November, 2020	Dr. Siju S. J
68	Research Methodology, Data Management and Biostatistics using web-based statistical software.	Webinar (delivered seminar/talk)	7 -8th and 28-29th November, 2020	Dr. K.P. Suresh
69	Training: Analysis of Experimental Data using SAS	ICAR-NAARM, Hyderabad	9-17th November, 2020	Dr. Siju S. J
70	PPR Global Eradication Programme 3rd PPR Global Research and Expertise Network (PPR GREN)	OIE/FAO	9-12th November, 2020	Dr. V. Balamurugan
71	All India Network Programme on Bluetongue	Virtual Meet	16th November, 2020	D. Hemadri
72	Webinar: Transboundaries and emerging infectious diseases: challenges in diagnosis and control	Indian virological society and Assam Agricultural University, Khanapara, Guwahati	18th November, 2020	Dr. V. Balamurugan Dr. P. Krishnamoorthy
73	Webinar: Climate smart livestock and poultry production through nutritional interventions	Institute of Animal Nutrition, TANUVAS, Chennai	23-24th November, 2020	Dr. P. Krishnamoorthy
74	Training: Advanced Bioinformatics Tools and its Applications in Agriculture	ICAR-NAARM, Hyderabad	07-11th December, 2020	Dr. M. Nagalingam
75	Training: common Zoonotic diseases in West Bengal under the aegis of Intersectoral coordination programme for Prevention and control of Zoonotic diseases	East Regional coordinator, NCDC-ISCP	16th December, 2020	Dr. V. Balamurugan

Sl. No.	Name of Seminar /Workshop / Training	Venue	Date	Attended by
76	Workshop: Emergency Preparedness for Prevention of Transboundary Infectious Disease in Indian Livestock and Poultry	TANUVAS, Chennai	19th December, 2020	Dr. K.P. Suresh Dr. Jagadish Hiremath
77	Webinar on Experiences of successful start-ups and their journey	IIT, Kharagpur	23rd December, 2020	Dr SB Shivachandra Dr GB Manjunatha Reddy Dr R Yogisharadhya
78	Veterinary Pathology Congress 2020	Nagpur Veterinary College, Nagpur	26-29th December, 2020	Dr. P. Krishnamoorthy Dr. GBM. Reddy
79	Workshop: Modern Interventions in Environmental Management	ICAR-IIAB, Ranchi	30th December, 2020	Dr. R. Sridevi

Miscellaneous

26a. Committees

Research Advisory Committee (RAC)

Name and Address	Position
Dr. C. Balachandran, VC, TANUVAS, Chennai-600 051, Tamil Nadu	Chairman
Dr. Parimal Roy, Director, ICAR_NIVEDI, Bengaluru	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,Telengana	Member
Dr. Manoj V Murhekar, Director & Scientist G, ICMR-NIE, Chennai-600 077, Tamil Nadu	Member
Dr. V.V.S. Suryanarayana, Retd. Principal Scientist, ICAR-IVRI, Visakhapatnam-530040, Andhra Pradesh	Member
Dr. Manoj Raje, Chief Scientist, CSIR-IMT, Chandigarh-160036	Member
Dr. Ashok Kumar, ADG (AH), ICAR, Krishi Bhavan, New Delhi-110 001	Member
Shri Mallappa Gowda, Progressive farmer, Saraswathipuram, Mysuru-570009, Karnataka	Member
Shri Ashok Allapur, Progressive farmer, Sindhagi,-586128, Vijayapura, Karnataka	Member
Dr. V. Balamurugan, Principal Scientist, ICAR-NIVEDI	Member Secretary

12thRAC meeting was held on 1st February 2020

Institute Management Committee (IMC)

Name and Address	Position
Dr. Parimal Roy, Director	Chairman
Dr. Ashok Kumar, ADG (AH), ICAR, New Delhi	Member
Dr. B.C. Ghosh, Principal Scientist, ICAR-NDRI, Bengaluru	Member
Dr. A.K. Samanta, Principal Scientist, ICAR-NIANP, Bengaluru	Member
Dr. B. P. Srinivasa, Principal Scientist, ICAR-IVRI, Bengaluru	Member
Dr. P. K. Rout, Principal Scientist, CIRG, Makhdoom	Member
Sh. Mallappa Gowda, Mysore	Member
Sh. Ashok Allapur, Vijayapura	Member
Sh. Vijaya Kumar, AF& AO	Member
Sh. Raghuraman V, AO	Member Secretary

Priority Setting, Monitoring and Evaluation Cell (PME)

Name and Address	Position
Dr. P. P. Sengupta, Principal Scientist	Nodal officer
Dr. V. Balamurugan, Principal Scientist	Co-Nodal officer
Dr. G. Govindaraj, Senior Scientist	Co-Nodal officer
Dr. M. Nagalingam, Scientist	Co-Nodal officer
Dr. Siju Susan Jacob, Scientist	Co-Nodal officer
Dr. A. Prajapati, Senior Technical Officer	Co-Nodal officer

Intellectual Technology Management Committee (ITMC)

Name and Address	Position
Dr. Parimal Roy, Director	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, Senior Scientist	Member
Dr. M. Nagalingam, Scientist	Member Secretary

ITMC meetings were conducted during 21st January, 31st January, 16th March and 17th August 2020

Institutional Animal Ethics Committee (IAEC)

Name and Address	Position
Dr. Parimal Roy, Director	Chairman
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 theinstitute
Dr. R. G. Prakash, Senior Technical Officer, JNCASR, Jakkur, Bengaluru	Socially Aware Nominee
Dr. B. R. Shome, Principal Scientist	Biological Scientist
Dr. V. Balamurugan, Principal Scientist	Scientist of different discipline
Dr. Siju Susan Jacob, Scientist	Veterinarian
Dr. P. Krishnamoorthy, Senior Scientist	Member Secretary

16th IAEC meetings was held on 29th February 2020

Women's cell

Name and Address	Position
Dr. Rajeswari Shome, Principal Scientist	Chairperson
Dr. R. Sridevi, Scientist	Member
Dr. G. Govindaraj, Senior Scientist	Member
Dr. V. Raghuraman, Administrative Officer	Member
Dr. Siju Susan Jacob, Scientist	Member Secretary

Institutional Biosafety Committee (IBSC)

Name and Address	Position
Dr. Parimal Roy, Director	Chairman
Dr. Suresh H Basagoudanavar, Sr. Scientist, ICAR-IVRI, Bengaluru	DBT Nominee
Dr. N. Ravi Sundaresan, Asst. Professor, Dept. of Microbiology and Cell Biology, IISc, Bengaluru	Outside Expert
Dr. Sankey Srinivas, Chief Medical Officer, ICAR-IVRI, Bengaluru	Biosafety Officer
Dr. Divakar Hemadri, Pr. Scientist, ICAR-NIVEDI, Bengaluru	Internal Member
Dr. G. B. Manjunatha Reddy, Scientist, ICAR-NIVEDI, Bengaluru	
Dr. M. Nagalingam, Scientist, ICAR-NIVEDI, Bengaluru	
Dr. Jagadish Hiremath, Sr. Scientist, ICAR-NIVEDI, Bengaluru	Member Secretary

Hindi Implementation Committee

Name and Address	Position
Dr. Parimal Roy, Director	Chairman
Dr. Divakar Hemadri, Principal Scientist	Co-Chairman
Dr. Rajeswari Shome, Principal Scientist	Member
Dr. Manjunatha Reddy, Scientist	Member
Sh. A.Vijay Kumar, AF&AO	Member
Dr. Awadhesh Prajapati, Senior Technical Officer	Member secretary

26b. Distinguished Visitors

1. Dr. Sanjeev Kumar Balyan, Hon'ble Minister of State for FAH&D, New Delhi
2. Shri. S.R. Vishwanath, MLA Yelahanka assembly constituency, Bengaluru
3. Dr. C. Balachandran, Vice-Chancellor, TANUVAS, Chennai
4. Prof. Gaya Prasad, Vice Chancellor, SVPUA&T, Meerut
5. Dr. Chandish R. Ballal, Director, ICAR-NBAIR, Bengaluru
6. Dr. K. Prabhudas, Former Director, PD_ADMAS, Bengaluru
7. Dr. Praveen Malik, Animal Husbandry Commissioner, DAHD, New Delhi
8. Dr. Praveen Kumar,Additional PS to Hon'ble Minister of State for FAH &D, New Delhi
9. Dr. Ashok Kumar, ADG (AH), ICAR, Krishi Bhavan, New Delhi
10. Dr. Ajith Shewale, Assistant Director, NCDC, New Delhi
11. Dr. Manoj Raje, Chief Scientist, CSIR-IMT, Chandigarh
12. Dr. D. Mohana Krishna, Joint Director (CDP), DPH&FW, Vijayawada
13. Dr. Sheela S, Assistant Director (Public Health), DoHS, Trivandrum, Kerala
14. Dr. A. P. Sugunan, Scientist G, National Institute of Epidemiology, Chennai
15. Dr. G. Ravi Kumar, Professor, Zoonoses Research Laboratory, TANUVAS, Chennai
16. Dr. S. Nagarathna, Professor, Dept. of Neuromicrobiology, NIMHANS, Bengaluru
17. Dr. T.N. Prakash Kammardi, Ex-Chairman of Karnataka Agricultural Prices Commission

18. Dr. B. Srinivas, Director, BAMUL, Bengaluru
19. Dr. Vijay Bhaskar, Senior Veterinarian and Deputy Manager, BAMUL, Bengaluru
20. Dr. Gangaiah, Chief Veterinary Officer and Deputy Manager, BAMUL, Bengaluru
21. Dr. Chithra Reddy, Gynecologist, Mother Hood Hospital, Bengaluru

26c. Staff Position (2020)

Sl. No	Name of the Officers & Staff	Designation	As per the 7th CPC Pay Level
1.	Dr. B.R. Shome	Director (Actg.) (RMP)	Level-14
Scientific Staff			
2.	Dr. (Mrs.) R. Shome	Principal Scientist	Level-14
3.	Dr. Divakar Hemadri	Principal Scientist	Level-14
4.	Dr.P.P.Sengupta	Principal Scientist	Level-14
5.	Dr.K.P. Suresh	Principal Scientist	Level-14
6.	Dr.V. Balamurugan	Principal Scientist	Level-14
7.	Dr. Sharanagouda S Patil	Principal Scientist	Level-14
8.	Dr.S. B. Shivachandra	Principal Scientist	Level-14
9.	Dr. G. Govindaraj	Senior Scientist	Level-13A
10	Dr. Jagadish Hiremath	Senior Scientist	Level-12
11.	Dr. P. Krishnamoorthy	Senior Scientist	Level-12
12.	Dr.(Mrs) R. Sridevi	Senior Scientist	Level-12
13.	Dr. Md. Mudassar Chanda	Senior Scientist	Level-12
14.	Dr. M. Nagalingam	Scientist	Level-11
15.	Dr. G. B. Manjunatha Reddy	Scientist	Level-11
16.	Dr. Narayanan G.	Scientist	Level-11
17.	Dr.(Mrs) Siju Susan Jacob	Scientist	Level-11
18.	Dr. Sathish Gowda C.S.	Scientist	Level-10
19.	Dr. Chethan Kumar H.B.	Scientist	Level-10
Technical Staff			
1.	Dr. Yogisharadhya R.	STO	Level-10
2.	Dr. Awadhesh Prajapati	STO	Level-10
Administrative Staff			
1	Sh. Raghuraman V.	AO	Level-10
2	Sh. A. Vijay Kumar	AF& AO	Level-7
3	Sh. Narayanaswamy N.	AAO	Level-7

Sl. No	Name of the Officers & Staff	Designation	As per the 7th CPC Pay Level
4	Mrs. Saranya A.	Steno-Gr-III	Level-4
5	Sh. K. Vijayaraj	Steno-Gr-III	Level-4
6	Mrs. Sridevi G.C.	LDC	Level-2
8	Sh. Gangadhareshwara L.	LDC	Level-2
Skilled Supporting Staff (SSS)			
1	Sh. M. K. Ramu	SSS	Level-2
2	Sh. Hanumantharaju	SSS	Level-2
3	Sh. H. S. Umesh	SSS	Level-1

26d. Joined/Promoted/Superannuation

1. Dr.(Mrs.) R. Sridevi, Scientist promoted as Senior Scientist w.e.f. 10th February 2018
2. Dr .Mohd. Mudassar Chanda, Scientist promoted as Senior Scientist w.e.f. 10th February 2019
3. Sh. Rajeevalochana, AAO superannuated on 30th June 2020
4. Sh. Narayanaswamy, Assistant promoted as Assistant Administrative Officer (AAO) w.e.f. 1st July 2020
5. Dr. Chethan Kumar H.B, Scientist (Veterinary Public Health) joined ICAR-NIVEDI, Bengaluru on 20th August 2020 consequent upon transfer from ICAR-CCARI, Goa

26e. Budget

Revised Estimate and Expenditure of ICAR-NIVEDI (2020-21)

(in lakh rupees)

Major Heads	Plan	
	Revised Estimate	Expenditure
Grants for creation of capital assets (Capital)		
Works	43.27	43.27
Equipments	5.75	5.71
Information Technology	0.00	0.00
Library Books & Journals	0.00	0.00
Vehicles & Vessels	0.00	0.00
Livestock	9.40	9.40
Furniture & Fixture	0.60	0.60
Grant in Aid-Salaries (Revenue)		
Establishment Expenses (Salaries)	680.29	680.29
Grants in Aid-General (Revenue)		
Pension and Retirement Benefits	72.67	76.67
Travelling Allowances	2.05	2.05
Research & Operational Expenses	100.84	100.84
Administrative Expenses	210.04	206.06
Miscellaneous Expenses	7.37	7.37
AICRP on ADMAS	169.68	169.68
NADSC (SCSP)	15.00	15.00
NEH	40.00	40.00
Grand Total	1356.96	1356.94

Revenue Receipts (2020-21)

(in rupees)

Description	Amount
License Fee	2,70,047
Interest earned from loans & advances	0
Interest earned from Short term deposits	6,74,622
Interest earned from Training	1,13,200
Income generated from sale of kits	4,55,777
Miscellaneous receipts	13,40,450
Total	**28,54,096**

26f. All India Coordinated Research Project on Animal Diseases Monitoring and Surveillance (AICRP on ADMAS)

The 28th Annual Review Meet of AICRP on Animal Disease Monitoring and Surveillance was organized as a virtual meet by ICAR-NIVEDI during 10 - 11th November, 2020. 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 expert to 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 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 their centre's progress report. The work performed by the centres were appreciated by the house and the experts provided general recommendations along with centre wise recommendations where ever required.

28th Annual Review Meet (virtual) of AICRP on ADMAS held at ICAR-NIVEDI, Bengaluru on 10-11th November, 2020

NIVEDI Activities

Meetings

ICAR-NIVEDI organized online meeting with M/s. Agri Innovate India Limited, New Delhi to assess the technical and commercial feasibility, handholding requirement as well as preferred modes of commercialization on 29th July, 2020.

Virtual 28th Annual review meeting of AICRP on Animal Disease Monitoring and Surveillance (ADMAS) was held under the Chairmanship of Hon'ble Dr. B.N. Tripathi, DDG (Animal Science), ICAR, New Delhi during 10-11th November, 2020 and reviewed the progress made during the year 2019-20 by the 31 ADMAS centres spread across India.

ICAR-NIVEDI celebrated the 150th Birth anniversary of Mahatma Gandhi during 28th September to 2nd October, 2020.

The 14th Institute Research Committee (IRC) virtual meeting of ICAR-NIVEDI under the Chairmanship of Dr. Parimal Roy, Director, was held on 7th August, 2020 and all the scientists presented the progress report of the Institute research projects for the year 2019-20.

Institute Technology Management Committee (ITMC) meeting of ICAR-NIVEDI was held on 17th August

2020 under the Chairmanship of Dr. Parimal Roy, Director to review the patent applications.

The 12th Research Advisory Committee (RAC) meeting of ICAR-NIVEDI held on 1st February, 2020 under the Chairmanship of Dr. C. Balachandran, Vice-Chancellor, TANUVAS, Chennai, reviewed the progress of Institute research activities and provided necessary guidance for improvement

Institute Technology Management Committee (ITMC) meetings of ICAR-NIVEDI were held during 21st and 31st January and 16th March, 2020 under the Chairmanship of Dr. Parimal Roy, Director to review the technologies and patent and copyright filing, etc

ICAR- NIVEDI, organized "Stakeholders Review Meeting for the Leptospirosis Control" sponsored by National Centre for Disease Control (NCDC), Delhi on 7th March, 2020.

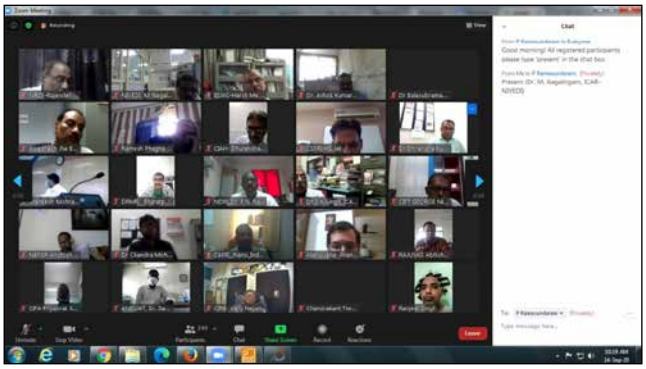
ICAR- NIVEDI, organized "Stakeholders Review Meeting for the Leptospirosis Control" sponsored by National Centre for Disease Control (NCDC), Delhi on 7th March, 2020.

Institutional Activities

ICAR-NIVEDI organized COVID-19 testing for the staff members by Bruhat Bengaluru Mahanagara Palike (BBMP) officials held during 2nd September and 12th October, 2020.

Dr. P. Krishnamoorthy, Senior Scientist visited AICRP on ADMAS centre of Tamil Nadu and discussed with Dr. A. Sundaresan, Principal Investigator and Dr. K. Karunanidi, Co-PrincipalInvestigator about the

implementation of NICRA project work in Tamil Nadu state on 16th December, 2020.



Dr. M. Nagalingam, Scientist participated in webinar on "Intellectual property rights in agricultural research and education in India" organized by National Agricultural Higher Education Project & Intellectual Property and Technology Management Unit, ICAR, New Delhi during 12-28th September, 2020.

Dr. P. Krishnamoorthy and Dr. G.B.M. Reddy, Scientists participated in the online International Veterinary Pathology Congress 2020 organized by Nagpur Veterinary College, Maharashtra during 26-29th December, 2020.

ICAR-NIVEDI staff taking integrity pledge on 27th September 2020

Dr. D. Hemadri, Principal Scientist and MGMG team members visited Gantiganahalli village, Bengaluru Rural district on 29th December, 2020.

The Swachhta Pakhwada was organized at ICAR-NIVEDI from 16-31st December, 2020

Shri Rajeevalochana, AAO was superannuated on 30th June, 2020 and farewell function was organized.

ICAR-NIVEDI organized the Annual medical health checkup for the staff members under the supervision of Dr. S. Srinivas, Chief Medical Officer, ICAR-IVRI on 26th June, 2020.

Dr. P. Krishnamoorthy, Senior Scientist created awareness on Hand hygiene and Swacchh Bharat Abhiyan programme by audiovisual aids among the school children at Government School, Kodipalya, Bengaluru Rural district on 17th February, 2020.

Celebrations

ICAR-NIVEDI celebrated the Agricultural Education day to commemorate the birth anniversary of First President of India Dr. B. Rajendra Prasad on 3rd December, 2020

ICAR-NIVEDI celebrated 70th Year of Adoption of Constitution of India on 26th November, 2020

ICAR-NIVEDI celebrated the 150th Birth anniversary of Mahatma Gandhi during 28th September to 2nd October, 2020.

The 74th Independence Day was celebrated at ICAR-NIVEDI on 15th August, 2020 and Dr. Parimal Roy, Director addressed the staff members on the occasion.

The 20th Institute Foundation day of ICARNIVEDI was celebrated on 1st July, 2020 and Hon'ble Dr. Trilochan Mohapatra, Secretary, DARE and DG, ICAR, Dr. B.N. Tripathi, DDG (Animal Science), ICAR, New Delhi addressed the staff of ICAR-NIVEDI during the occasion and Directors of other ICAR institutes also participated in the programme.

The 65th Karnataka Rajyotsava was celebrated by organizing various cultural events at ICARNIVEDI on 28th November, 2020.

ICAR-NIVEDI organized the Rashtriya Kisan Diwas celebrations by inviting 102 farmers from Karnataka on 23rd December, 2020.

ICAR-NIVEDI organized the Vigilance awareness week and conducted various activities and competitions to the staff members and distributed certificates to the winners during 27th October to 2nd November, 2020.

The World Antimicrobial Awareness week was celebrated at ICAR-NIVEDI by organizing various events and competitions to NIVEDI staff during 18-24th November, 2020.

The 71st Republic day was celebrated at ICAR-NIVEDI on 26th January, 2020 and Dr. Parimal Roy, Director addressed the staff members on this occasion.

ICAR-NIVEDI celebrated the constitution day on 10th March, 2020

ICAR-NIVEDI celebrated International Women's day on 10th March, 2020

Distinguished Visitors

Hon'ble Dr. Sanjeev Kumar Balyan, Minister of State for Fisheries, Animal Husbandry and Dairying (FAH&D), Government of India, New Delhi visited ICAR-NIVEDI and interacted with the Scientists on 12th November, 2020.

Hon'ble Shri S.R. Vishwanath, MLA of Yelahankam constituency visited ICAR-NIVEDI and interacted with Director and Scientists on 10th March, 2020.

Exhibitions

ICAR-NIVEDI participated in the National Horticultural Fair organized by ICAR-Indian Institute of Horticultural Research during 5-8th February, 2020 and exhibited the institute research activities.

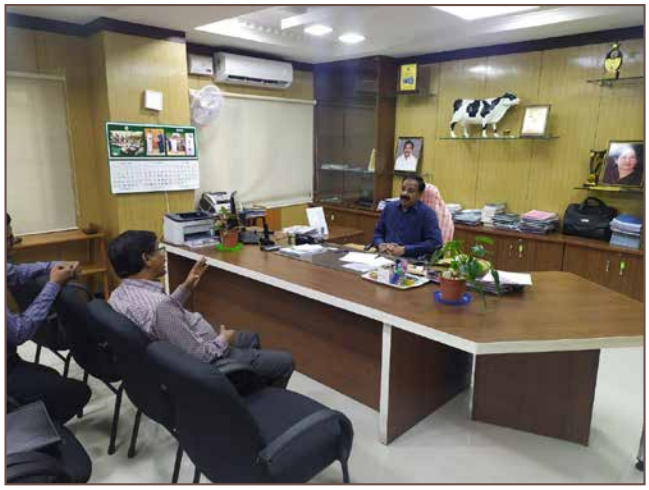
Awards

NaaViC has won the '**Best performing Agri-Business Incubator Award'** in the Annual & Review Workshop hosted by knowledge partner, UAS, Dharwad on February 25, 2020, under RKVY-RAFTAAR Scheme.

Visits NIVEDI

Dr. S.S. Patil, Principal Scientist as Member, Technical Expert Committee inspected the Central cattle breeding farm, Hessarghata, Bengaluru for suitability of FMD vaccine quality test in calves under NADCP (FMD) Project on 4th February, 2020.

Dr. S.S. Patil, Dr. Sridevi, Dr. Narayanan and their team collected information of 62 beneficiaries under SCSP at Veeradimmanahalli, Challakere, Chitradurga, Karnataka on 25th January, 2020.



Dr. Parimal Roy, Director, ICAR-NIVEDI visited the AICRP on ADMAS centre in Chennai, Tamil Nadu and reviewed the progress of the work undertaken by the centre. He had discussion with Shri A. Gnanasekaran, IAS, Director, Department of Animal Husbandry and Veterinary Services, Government of Tamil Nadu on 26th February, 2020.

Capacity Building Programmes

Dr. R. Sridevi, Scientist attended International conference on Autophagy and Lysosomes held at Indian Institute of Science, Bengaluru during 16-18th January, 2020.

Dr. P. Krishnamoorthy, Senior Scientist nominated by Government of India and participated in the European Commission and Better Training for Safer Food (BTSF) initiative sponsored International training programme on "Antimicrobial Resistance" held at New Delhi during 18- 21st February, 2020.

Dr. K.P. Suresh, Principal Scientist organized training programme on "Basics of Microsoft Excel" for beneficiaries under SCSP programme on 31st January, 2020.

Dr. G. Govindaraj, Dr. M. Nagalingam, Dr. S.J. Siju, Scientists of ICAR-NIVEDI organized orientation workshop on 'Disease Burden Quantification in Small Ruminants and Impact of Adopting Preventive Interventions on Rural Livestock Farmers in Odisha' at ADRI, Cuttack on 27th February, 2020.

Infrastructure

As part of Swachh Bharat Abhiyan, ICAR-NIVEDI created awareness on importance of wearing face mask in the work place to staff members on 21st March, 2020.

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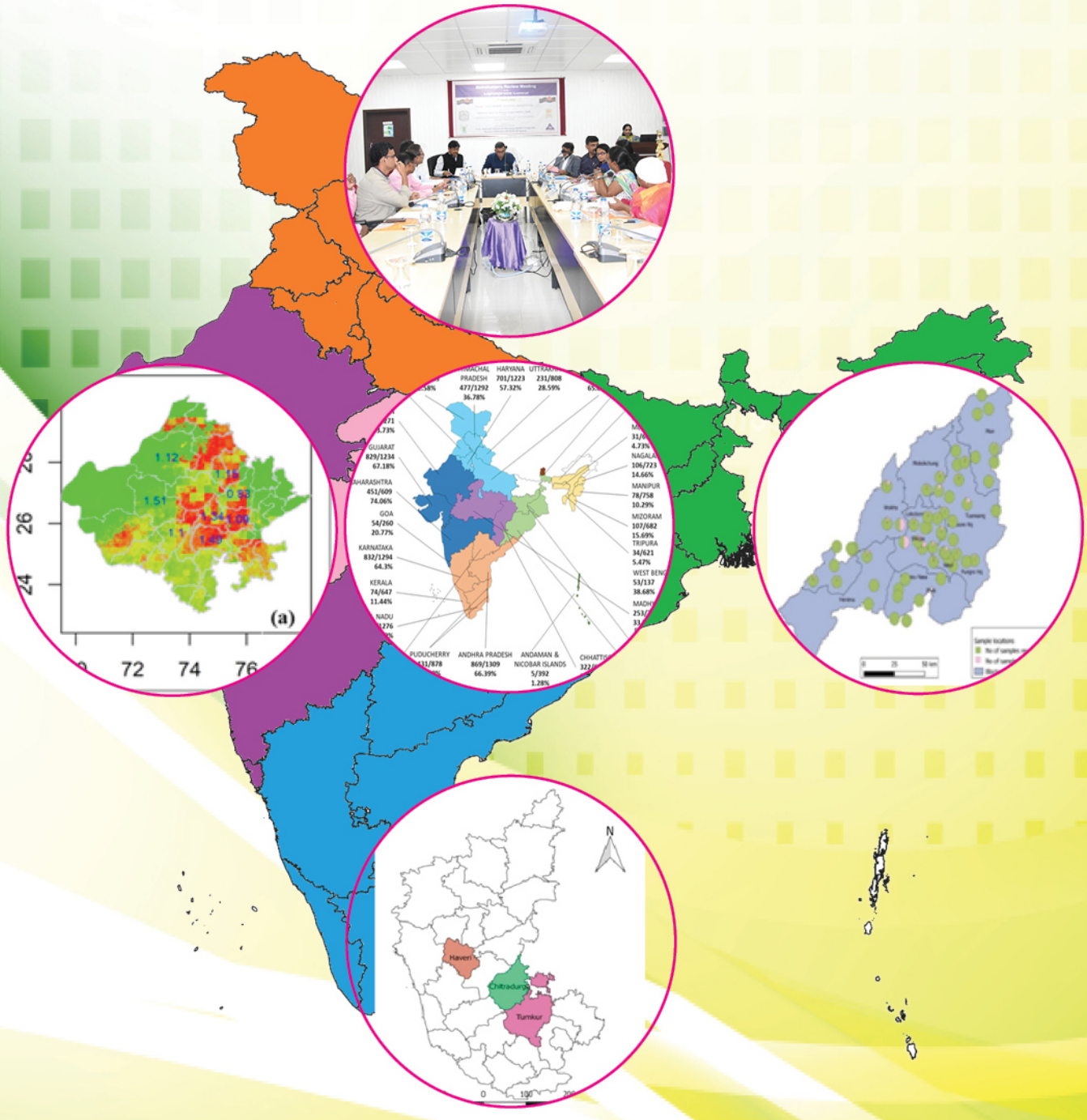

ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (ICAR–NIVEDI)

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