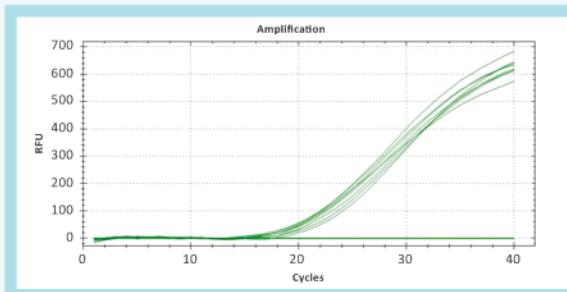
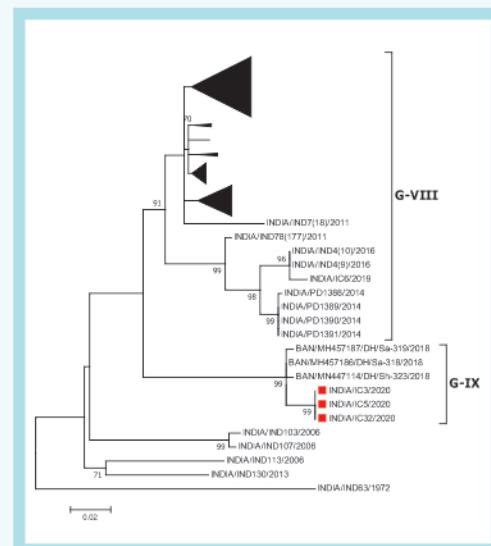


ANNUAL REPORT 2020



ICAR-Directorate of Foot and Mouth Disease
Mukteswar 263 138
Nainital, Uttarakhand, India

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CONTENTS

S. No.	Title	Page No.
	About ICAR-DFMD	1
1.0	Executive Summary	4
2.0	Research Achievements	7
	2.1 Disease Monitoring and Surveillance	7
	2.2 Development and Improvement of Diagnostics	18
	2.3 Characterization of Pathogens and Epidemiology	20
	2.4 Production and Standardization of Biological	24
	2.5 Extension intervention in Livestock Production System	24
3.0	Awards and Recognition	27
4.0	Publications	28
5.0	Research Projects	30
6.0	Education and training including human resource development	32
7.0	Conferences, workshops, seminars, summer / winter schools, short courses, trainings, etc. participated & convened	33
8.0	Revenue Generation	36
9.0	Empowerment of Women and mainstreaming gender issues	37
10.0	Pandemic COVID-19 crisis: Timely diagnostic service rendered by ICAR-DFMD	38
11.0	Miscellaneous activities, Distinguished visitors	39
12.0	Various Committees	42
13.0	Staff Position	44

PREFACE



Foot and Mouth Disease (FMD) is well known economically devastating infectious disease of cloven hoofed livestock. The disease is endemic in India with the circulation of three FMDV serotypes (O, A and Asia1) and several genetic groups. The FMDV serotype C has not been recorded since 1995 in spite of continued surveillance. FMDV serotypes SAT 1, 2 & 3 were never recorded in the country. ICAR-DFMD, Mukteswar serves as National Referral Laboratory for FMD and also recognised as FAO Reference Centre for FMD. A nationwide network of 27 FMD regional and collaborating centres in different states and a central FMD laboratory at Mukteswar were involved in FMD surveillance and diagnosis under AICRP mode. The AICRP scheme was initiated in 1968 and concluded by 31st March 2020. In order to keep the FMD surveillance activities alive, the state FMD centres are now supported by Department of Animal Husbandry & Dairying (DAHD) through National Animal Disease Control Programme (NADCP) since 1st April 2020. The network of these centres also helps the institute to execute various programmes under NEH, SCSP and TSP schemes, which gives strength to FMD control.

The serotyping of the clinical materials collected from the suspected outbreaks/cases is conducted by the Network laboratories using sandwich ELISA and clinical samples are referred subsequently to ICAR-DFMD for complete characterization of virus isolates. Molecular epidemiological analysis based on P1/1D gene sequence and studies of antigenic relationship of the virus from field outbreak with the vaccine strains to monitor antigenic variation, if any, occurring in the field is carried out regularly. Under NADCP, the institute and state FMD laboratories have tested about 1.2 lakhs serum samples and the analysed results were communicated to DAHD, GoI. For the first time, ICAR-DFMD participated in vaccine QC testing and completed testing of 3 batches of FMD vaccines. The institute has been providing all the technical/laboratory and diagnostic support to the FMD Control Program being run by DAHD, GoI since 2003-04.

I am happy to share that ICAR-DFMD is a member of the Global FAO/OIE Network of FMD Reference Laboratories comprising ten other FMD laboratories in the world. The institute also functions as the “FAO Reference Center for FMD” and “SAARC Regional Leading Diagnostic Laboratory for FMD”. The institute is also now a member of GFRA (Global FMD Research Alliance).

I express deep sense of gratitude to Dr T. Mohapatra, Hon'ble Secretary, DARE & DG, ICAR; Shri B. Pradhan, AS&FA, DARE; Shri Sanjay Singh, Addl. Secretary (DARE) & Secretary, ICAR; Dr B N Tripathi, DDG (AS), ICAR, Acting Directors Dr R.K. Singh, Dr B P Misra and Dr Ashok Kumar, ADG (AH), ICAR for providing all the necessary support & guidance in steering the Institute. Also, the help and support extended by Dr Jyoti Misri, Principal Scientist (AH), Dr Vineet Bhasin, Principal Scientist (AGB) and Dr Ranjan Gupta, Principal Scientist (ANP) is duly acknowledged. Untiring effort of a small group of young scientists in achieving new milestones at this institute is praiseworthy. I place on record my appreciation for Administration, Audit & Accounts, Technical, and Skilled support staff of the ICAR-DFMD for their excellent assistance in achieving the targets.

(R.P. Singh)
Director, ICAR-DFMD

About ICAR-DFMD

Genesis

ICAR-Directorate of Foot and Mouth Disease (FMD), the premier institute for FMD in the country, was established as an All India Coordinated Research Project (AICRP) for FMD in 1968. During about five decades of its existence the scope of the project has been expanded progressively and several milestones were achieved. The AICRP for epidemiological studies on FMD was upgraded to the Project Directorate on FMD in July 2000 and then renamed as Directorate of FMD since 2015-16 with 27 Regional and Collaborating centres covering all the major regions of the country. With the announcement of NADCP in 2019, the AICRP on FMD was concluded with effect from 31st March 2020. Since then, the state FMD laboratories are being operated through funding from DAHD, GoI under NADCP. The centres are also supported by funding under TSP, SCSP and NEH from ICAR, and knowledge and technical input from ICAR-DFMD. The Directorate has developed scientific expertise in conventional as well as in cutting edge areas, in the field of FMD diagnosis, epidemiology and research. The mandate of the institute is to carry out research on the epidemiology of FMD in the country and develop technologies to control the disease with ultimate goal of eradication. It is also entrusted with the duty of providing technical support and scientific input/information to the planners and strategy making agencies in planning control of FMD in the country and the SAARC region. The new addition to the institute is the International Centre for FMD(ICFMD) at Bhubaneswar that encompasses both BSL-2 and BSL-3Ag high containment laboratories.

Important milestones

- 1929-Research on FMD was initiated in India.
- 1943-Vaccination of Indian cattle against FMD funded by ICAR.

1968-All India Co-ordinated Research Project (AICRP) for FMD virus typing

1971-AICRP for Epidemiological studies on Foot-and-Mouth Disease

2000-Upgraded to Project Directorate on FMD.

2007-Constituent Laboratory of OIE/FAO FMD Reference Laboratories Network

2008-PD-FMD became “FAO Reference Centre for FMD for South Asia”

2009-Member Laboratory of Global FMD Research Alliance (GFRA)

2009-Foundation stone laid for ICFMD, Bhubaneswar

2010-SAARC Regional Leading Diagnostic laboratory of FAO

2015-Institute upgraded to ICAR-Directorate of FMD (ICAR-DFMD)

2017-Inauguration of International Centre for FMD (ICFMD), Bhubaneswar

2021-ICAR-DFMD became “FAO Reference Centre for FMD”

Vision, Mission, Objectives and Technical Programme:

Vision:

India free from Foot and Mouth Disease.

Mission:

Active epidemiological surveillance through regularly monitoring antigenic and genomic make up of Foot and Mouth Disease virus strains responsible for disease incidences, to provide training in diagnosis and epidemiology, and to develop technologies for making country free from FMD.

Mandate:

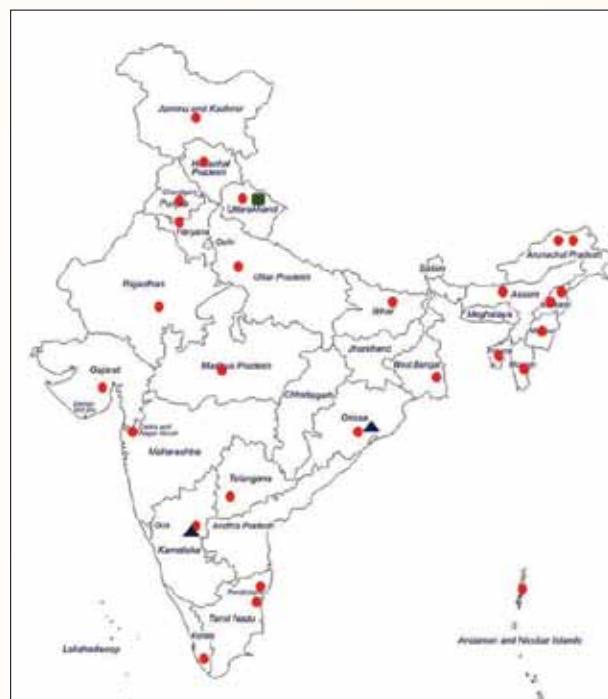
- Surveillance, epidemiology through systematic monitoring of antigenicity and genomic make of FMD virus strains
 - Repository and capacity development

Objectives:

- To conduct systematic epidemiological and molecular epidemiological studies on Foot-and-Mouth Disease (FMD), and also to study carrier status of the infection and latency of the virus.
 - Antigenic and molecular characterization and cataloguing of FMD virus strains isolated from incidences, and monitoring suitability of the vaccine strains in use along with maintenance of National Repository of FMD Virus.
 - Production, standardization and supply of diagnostic reagents for FMD virus serotyping and post-vaccinal seroconversion. Maintenance and supply of most appropriate vaccine strain to the FMD vaccine manufacturers.
 - Development of newer diagnostic techniques using cutting-edge technologies in molecular biology.
 - To act as FAO Referral Centre for FMD.
 - With proforma details to facilitate and ensure their uniform application.
 - To organize skill orientation programme for the scientific staff of the project for keeping them abreast with the latest knowledge and expertise from time to time through short-term training courses
 - Participation in FMD Control Programme with vital contribution in monitoring pre and post vaccinal antibody response for assessment at individual and herd immunity level.
 - National FMD Serosurveillance
 - International collaborations in the areas of interest.

Technical Programme:

1. Active and passive surveillance of FMD in the country in network mode
 2. To carryout antigenic and molecular characterization of field isolates.
 3. To study molecular epidemiology of FMD in India.
 4. Confirmatory diagnosis and expert advice.
 5. To carryout vaccine matching exercise for monitoring of appropriateness of in-use vaccine strains.
 6. Maintenance of National Repository of FMD virus isolates.

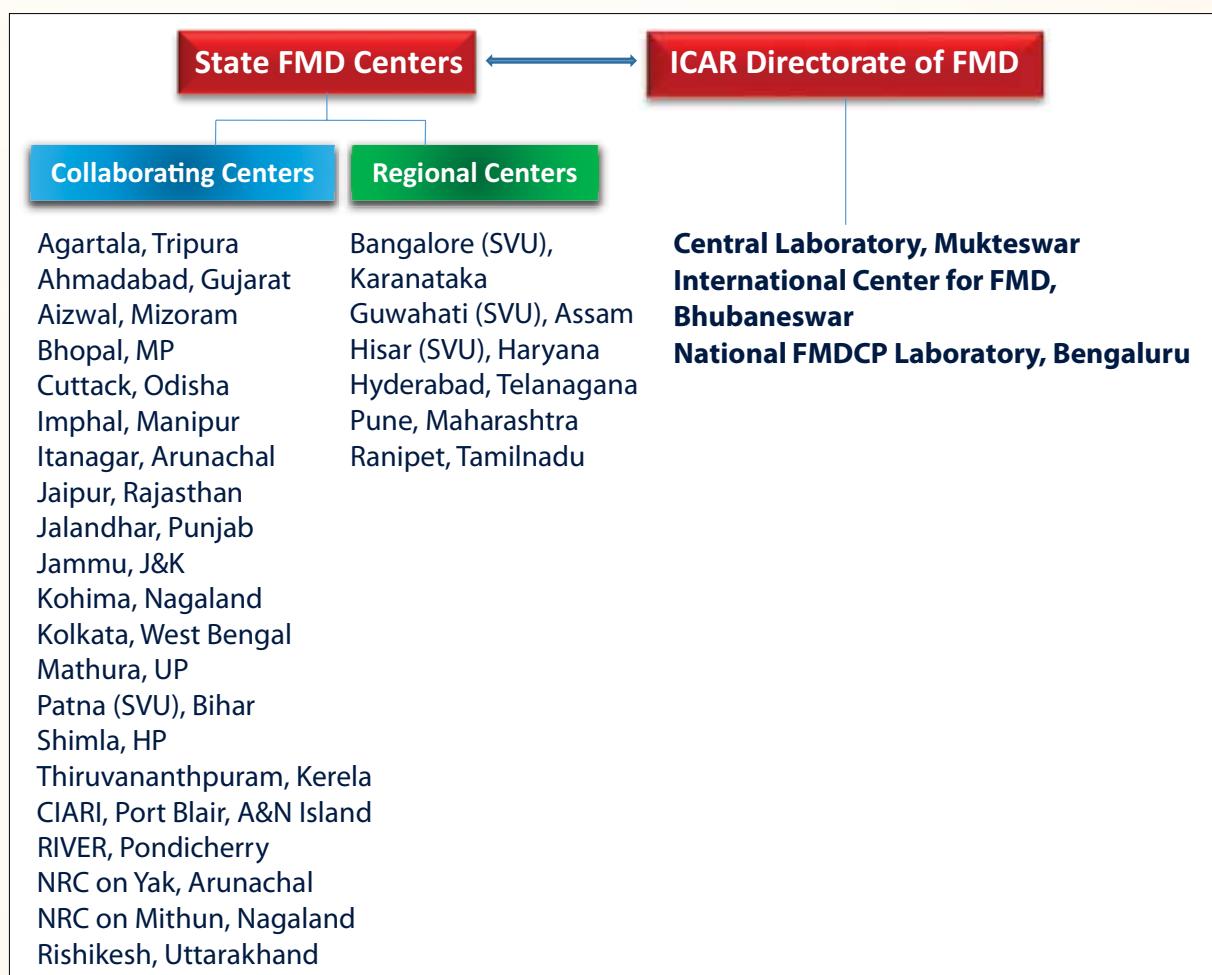


Location of ICAR-DFMD laboratories (Green square and blue triangle) and State FMD centres (filled red)

Scientific Staff Positions and Vacancy

Name of discipline	Scientist		Senior Scientist		Principal Scientist	
	Sanctioned	In position	Sanctioned	In position	Sanctioned	In position
Agricultural Bioinformatics	1	-	-	-	-	-
Animal Biochemistry	1	1	1	-	-	-
Animal Biotechnology	2	2	-	-	-	-
Animal Physiology	1	1	-	-	-	-
Animal Genetics & Breeding	1	1	-	-	-	-
Veterinary Microbiology	8	2	2	1	2	-
Veterinary Pathology	2	2	1	1	-	-

Organizational Setup



1.0

Executive Summary

- During the period under report, the institute operated with 11 scientists, 2 technical personnel and 3 administrative and account workers. For the fiscal year 2020-21, the overall budget allocation was ₹1063.00 lakhs, with a total expenditure of Rs 828.73 lakhs. The institute generated revenue of ₹24.46 lakhs between January-December, 2020.
- Following the conclusion of AICRP on FMD by ICAR with effect from 31st March 2020, the 27 FMD centers at states were funded through DAHD-NADCP scheme & NEH, TSP, SCSP schemes of ICAR. The centers were actively involved in seromonitoring, surveillance and outbreak investigation.
- Using sandwich ELISA and multiplex PCR, 215 clinical samples were analysed for serotype identification in 46 FMD outbreaks. During 2020, all three FMD virus serotypes were documented, with serotype O leading the outbreak scenario. Overall, the disease incidences have decreased across the country, with only 9 states reporting FMD.
- As part of the NADCP, 28,284 bovine serum samples from around the country were analyzed using the r3AB3 NSP-ELISA (DIVA) to determine the prevalence of NSP-antibody (NSP-Ab) positive animals. Overall seropositivity was found in 16.2% of the samples tested, which is lower than the previous year's average of 20.8%. In addition, 4930 serum samples from small ruminants were also screened.
- During 2020, a total of 90,154 serum samples were examined using Solid Phase Competitive ELISA (SPCE) under NADCP to assess the efficiency of immunization, and the results were communicated to DAHD. Due to a variety of factors, only one round of vaccination was carried out in 2020. There was a decrease in protective antibody titres. In addition, 3158 serum samples received from various Breeding Bull stations and surrounding villages were also tested to assess the protection level.
- For the quality control (QC) testing of FMD vaccines to be utilized for the vaccination under NADCP, ICAR-DFMD carried out QC testing of three batches of vaccines.
- For pan-serotype identification of FMD virus in India, a SYBR green-based FMDV-3Dpol specific one-step real-time RT-PCR (rRT-PCR) test was developed. This test can be used in conjunction with the existing FMDV serotype distinguishing assay as a companion diagnostic test.
- A new serological assay (IgM I-ELISA) has been developed to detect anti-FMD IgM antibodies specific for FMDV 2B NSP. This test can be used to detect persistently infected animals.
- The effectiveness of disinfectants and cleansers against FMDV was thoroughly investigated. In BHK 21 cell line, a 0.1 percent citric acid solution successfully inhibited FMDV serotype O infectivity after 5 minutes of exposure.
- The serotype O FMD virus's VP3 protein was produced in a prokaryotic system and is being studied for affinity purification and use as an antigen for immunoassays in FMD seromonitoring.
- The capsid coding region (P1/VP1) sequences of 13 FMD viral strains were inferred and added to the sequencing database of Indian FMD viruses (10 serotype O and 3 serotype A). In serotype O, the exclusive dominance of the O/ME-SA/Ind2001e lineage was discovered, as was the advent of G-IX in serotype Asia1.

- The institute provided the state FMD centers with three main test kits (3AB3 indirect DIVA ELISA for 48,480 samples, Solid Phase Competitive ELISA (SPCE) for 92,600 samples, and Sandwich ELISA for 500 samples).
- Several extension and training program were organized under SCSP/TSP scheme
- The DFMD's COVID testing team in Bhubaneswar has analysed 67,905 samples using RT-PCR to detect the nCoV-2 genome in swabs. In addition, two Mukteswar scientists were involved in COVID testing.

हिन्दी सारांश

- विवरण अधीन अवधि के दौरान संस्थान ने 11 वैज्ञानिकों, 2 तकनीकी कर्मियों और 3 प्रशासनिक तथा लेखा कर्मियों के साथ काम किया। वित्तीय वर्ष 2020– 21 के लिए कुल बजट आबंटन रु 1063.00 लाख था, जिसमें कुल व्यय रु 828.73 लाख किया गया। संस्थान ने जनवरी–दिसंबर, 2020 के दौरान रु 24.46 लाख का राजस्व भी अर्जित किया।
- 31 मार्च, 2020 से आई.सी.ए.आर द्वारा खुरपका मुँहपका रोग पर ए.आई.सी.आर. पी. के निष्कर्ष के बाद, राज्यों के 27 खुरपका मुँहपका रोग केंद्रों को पशुपालन और डेयरी विभाग केन्द्र सरकार –राष्ट्रीय पशु रोग नियंत्रण कार्यक्रम योजना के माध्यम से वित पोषित किया गया। यह केंद्र सक्रिय रूप से सिरो निगरानी, सिरोनिरीक्षण तथा प्रकोप जांच के कार्यों में शामिल थे।
- इस दौरान सैंडविच एलिसा तथा मल्टीप्लेक्स पी.सी.आर.का उपयोग करते हुए, 46 खुरपका मुँहपका रोग प्रकोपों में सीरोटाइप पहचान के लिए 215 नैदानिक नमूनों का विश्लेषण किया गया। वर्ष 2020 के दौरान, सभी तीन–सीरोटाइप (सीरोटाइप ओ, सीरोटाइप ए तथा सीरोटाइप एशिया –1) खुरपका मुँहपका रोग विषाणुओं का दस्तावेजीकरण किया गया, जिसमें सीरोटाइप ओ प्रकोप परिदृश्य का नेतृत्व कर रहा था। कुल भिलाकर देश भर में बीमारी की घटनाओं में कमी आयी है। केवल 9 राज्यों ने खुरपका मुँहपका रोग की सूचना दी है।
- राष्ट्रीय पशुरोग नियंत्रण कार्यक्रम के हिस्से के रूप में, एन.एस.पी. एंटीबॉडी पॉजिटिव जानवरों के प्रसार को निर्धारित करने के लिए देश भर से 28284 गोजातीय सीरम नमूनों का विश्लेषण आर3 एबी एन.एस.पी.

—एलिसा (डिवा) का उपयोग करके किया गया। कुल भिलाकर परीक्षण किए गए नमूनों से 16.2% नमूनों में सरोपोसिटिविटी पाई गई, जो पिछले वर्ष के औसत 20.8% से कम है इसके अलावा, छोटे जुगाली करने वाले जानवरों के 4930 सीरम नमूनों की भी जांच की गई।

- वर्ष 2020 के दौरान, टीकाकरण की दक्षता का आंकलन करने के लिए राष्ट्रीय रोग नियंत्रण कार्यक्रम के तहत सॉलिड फेज कम्पिटिटिव एलिसा (एस.पी. सी.ई.) का उपयोग करके कुल 90730 सीरम नमूनों की जांच की गई और प्राप्त परिणाम पशुपालन और डेयरी विभाग केन्द्र सरकार को सूचित किया गया। विभिन्न कारकों के कारण 2020 में टीकाकरण का केवल एक दौर ही किया गया था। इसके कारण सुरक्षात्मक एंटीबॉडी टाइटर में कमी आयी। इसके अलावा विभिन्न ब्रीडिंग साड़ परिसर और आस–पास के गाँव से प्राप्त 3158 सीरम नमूनों का भी परीक्षण किया ताकि इन जानवरों में सुरक्षा स्तर का आंकलन किया जा सके।
- राष्ट्रीय पशुरोग नियंत्रण कार्यक्रम के तहत टीकाकरण के लिए उपयोग किए जाने वाले खुरपका मुँहपका टीकों के गुणवत्ता नियंत्रण परीक्षण के लिए इस संस्थान ने टीकों के तीन बैंचों का परीक्षण किया।
- भारत में खुरपका मुँहपका विषाणु की पैन–सीरोटाइप पहचान के लिए एक एस.वाई.बी.आर.ग्रीन आधारित एफ.एम.डी.वी.–3 डीपोल विशिष्ट वन–स्टेप रियल टाइम आर.टी.पी.सी.आर परीक्षण विकसित किया गया। इसका उपयोग एक नैदानिक परीक्षण के रूप में मौजूदा एफ एम डी विषाणु सीरोटाइप विशिष्ट परख के साथ संयोजन के रूप में किया जा सकता है।
- खुरपका मुँहपका विषाणु 2बी एन.एस.पी. के लिए विशिष्ट एफ.एम.डी. आई.जी. एम.एंटीबॉडी का पता लगाने के लिए एक नया सीरोलॉजिकल परख (आई.जी.एम.आई–एलिसा) विकसित किया गया है। इस परीक्षण का उपयोग लगातार संक्रमित जानवरों का पता लगाने के लिए किया जा सकता है।
- खुरपका–मुँहपका विषाणु के खिलाफ विषाणु–नाशक और निस्संक्रामक द्रव्य तथा रसायनों की प्रभावशीलता की पूरी तरह से जांच की गई। बी.एच.के 21 सेल लाइन में, 0.1% साइट्रिक एसिड ने 5 मिनट के अनावरण के बाद खुरपका–मुँहपका विषाणु सीरोटाइप ओ संक्रामकता को सफलतापूर्वक रोक दिया।



- सीरोटाइप ओ विषाणु का वी पी-3 प्रोटीन एक प्रोकैरियोटिक प्रणाली में तैयार किया गया था और एफिनिटी शुद्धीकरण के लिए अध्ययन किया जा रहा है एवम् यह प्रोटीन खुरपका—मुँहपका के सेरोमोनिटोरिंग के लिए एंटीजन के रूप में उपयोग किया जा सकता है। अतः इससे सम्बन्धित अध्ययन किया जा रहा है।
- 13 खुरपका—मुँहपका विषाणुओं के कैप्सिड कोडिंग क्षेत्र (PI/VPI) अनुक्रमों का अनुमान लगाया गया और भारतीय खुरपका—मुँहपका विषाणु (10 सीरोटाइप ओ और 3 सीरोटाइप ए) को अनुक्रमण डेटाबेस में जोड़ा गया। सीरोटाइप ओ में, ओ /एमई-एसए/इंड 2001ई वंश के क्लेड प्रभुत्व की खोज की गई और सीरोटाइप एशिया 1 में जी-आईएक्स का प्रादुर्भाव था।
- संस्थान ने राज्य के खुरपका मुँहपका केंद्रों को तीन मुख्य परीक्षण किट (48840 नमूनों के लिए 3 ए बी 3 अप्रत्यक्ष डिवा एलिसाए 92600 नमूनों के लिए ठोस चरण प्रतिस्पर्धी (एस.पी.सी.ई) और 500 नमूनों के लिए सेंडविच एलिसा) प्रदान किया।
- एस.सी.एस.पी./टी.एस.पी. योजना के तहत कई विस्तार और प्रशिक्षण कार्यक्रम आयोजित किए गए।
- भुवनेश्वर में इस संस्थान के COVID परीक्षण टीम ने स्वैब में कोरोना विषाणु जीनोम का पता लगाने के लिए आर टी-पी सी आर का उपयोग करके 67905 नमूनों का विश्लेषण किया है। इसके अलावा, दो मुक्तेश्वर केन्द्र के वैज्ञानिक कोरोना विषाणु परिक्षण में शामिल थे।

2.1 Disease Monitoring and Surveillance

2.1.1 Epidemiological scenario during 2020

During the year 2020, a total of 46 FMD outbreaks were confirmed in India. (Table 1). A total of 215 clinical materials collected from 46 outbreaks were tested using antigen differentiating sandwich ELISA and multiplex PCR. The test revealed serotype O in 94 samples, A in 28 samples, Asia1 in 9 samples, and further 84 samples were FMDV negative (Table 2). Out of 46 confirmed FMD outbreaks, serotype O was accountable for 38, and serotype A and Asia1 caused 6 and 2 outbreaks, respectively. In the northern and central regions, no FMD was found, while the number of outbreaks in the western region was on the decline. In the southern and north-eastern regions, there has been an increase in FMD outbreaks compared to the previous year (Table 3). The serotype O continued to be most predominant one and was responsible for 82.6% of the total outbreaks recorded during 2020 (Table 4). After a period of three years, serotype A was recorded in the state of Maharashtra in 2019, and in Assam and Meghalaya in 2020. The serotype Asia1 was not recorded in any of the states in 2019 and this year 2 serotype Asia1 outbreaks were recorded in the state of Tamilnadu. Earlier, outbreaks of serotype Asia1 were observed in West Bengal and Assam in 2018. December saw the highest number of cases of FMD, followed by April and February (Fig 1).

Table 1. FMD outbreaks recorded and diagnosed during 2020 and virus serotype(s) involved

State/UT	Number of FMD outbreaks	FMD Serotypes		
		O	A	Asia1
Southern Region				
Karnataka	13	13	-	-
Kerala	10	10	-	-
Tamilnadu	02	-	-	02
Total	25	23	-	02
Western Region				
Maharashtra	02	02	-	-
Total	02	02	-	-
Eastern Region				
Odisha	01	01	-	-
West Bengal	04	04	-	-
Total	05	05	-	-
North Eastern Region				
Assam	03	-	03	-
Meghalaya	03	-	03	-
Manipur	08	08	-	-
Total	14	08	06	-
Grand Total	46	38	06	02

Table 2. Number of clinical samples tested during 2020 and virus serotype(s) involved

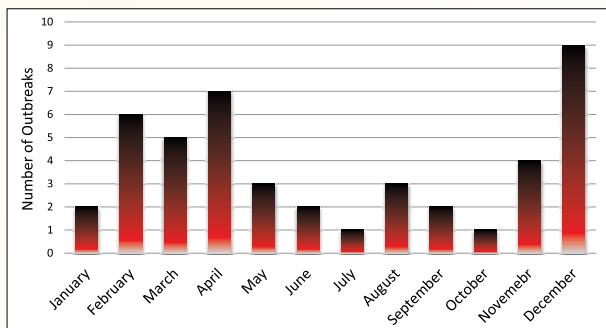
State/UT	Number of Clinical material tested	FMD Serotypes		
		O	A	Asia1
Karnataka	72	32	-	-
Kerala	40	21	-	-
Tamilnadu	26	-	-	09
Odisha	05	05	-	-
West Bengal	11	11	-	-
Assam	18	-	16	-
Meghalaya	12	-	12	-
Maharashtra	05	04	-	-
Manipur	26	21	-	-
Total	215	94	28	09

Table 3. Number of confirmed FMD incidences in different geographical regions during the last six years.

Year	South	North	Central	West	East	North East	Total
2015-16	89	18	26	23	44	52	252
2016-17	49	11	05	06	22	57	150
2017-18	101	17	-	10	-	21	149
2018 (Apr-Dec)	207	26	04	15	78	21	351
2019	16	11	01	13	05	06	52
2020	25	00	00	02	05	14	46

Table 4. Year wise outbreaks/incidences of FMD and virus serotypes involved during last six years.

Year	No. of confirmed outbreaks	O	A	Asia1
2015-16	252	244	06	02
2016-17	150	150	00	0
2017-18	149	146	00	03
2018 (Apr-Dec)	351	347	00	04
2019	52	51	01	00
2020	46	38	06	02


Fig 1. Month-wise FMD incidence during the year 2020

Southern Region

The southern region, which includes five states (Tamilnadu, Karnataka, Telangana, Andhra Pradesh and Kerala) and two UTs (Puducherry and the Andaman and Nicobar Islands), has roughly 21% of the country's FMD susceptible livestock. The region has no international borders, and the state of Karnataka has been identified as an FMD hyperendemic area. In the year 2020, no FMD outbreaks were reported in Andhra Pradesh, Telangana, Puducherry, or the A&N Islands. FMDCP has been operating in the southern peninsular region since 2000.

Tamilnadu: Two outbreaks due to serotype Asia1 was recorded in the state in the month

of January and March in Chennai and Salem, respectively. There was no mortality and morbidity also very negligible. The animals in the outbreak herd were last vaccinated in September, 2019

Karnataka: Thirteen FMD outbreaks were reported in the state. All of them were caused by serotype O. The outbreaks were recorded all through the year in the months of February (n=04), March (n=02), May (n=02), June (n=01), July (n=01), August (n=01), November (n=01) and December (n=01). Four outbreaks each were recorded in the districts of Bengaluru rural and Ramanagara followed by three in Chikballapur, and one each in Kolar and Bengaluru Urban. The disease was observed only in cattle with a morbidity rate of 1.4%. Mortality rate was found to very negligible (0.03%). Animals were last vaccinated during the month of October and November 2019.

Kerala: Ten FMD outbreaks were recorded in the state and all of those were caused by FMDV serotype O. Maximum outbreaks were reported in the month of December (n=05) followed by November (n=02), August (n=01) and September (n=01). In five outbreaks which were recorded in the months of November, August and September,

the affected animals were unvaccinated. The animals which were affected in the month of December were last vaccinated in June 2020. The disease was recorded in the districts of Thrissur (n=03), Wayanad (n=02), Idukki (n=01), Kozhikode (n=01), Kannur (n=01), Palakkad (n=01) and Kollam (n=01). The disease was recorded in cattle and buffalo. The mortality and morbidity rates were very low at 0.069% and 0.037 %, respectively.

Central Region

Central region comprises of two states (Madhya Pradesh and Chhattisgarh) and about 10% of the FMD susceptible livestock of the country. The region shares no international border. The entire central region is covered under FMDCP. There was no outbreak in the state of Madhya Pradesh during the period.

Western Region

Western region comprises of three states (Maharashtra, Rajasthan and Gujarat) and about 22% of the FMD susceptible livestock of the country. The region shares international border with Pakistan. All the three states in the western region are covered under FMDCP since the year 2010-11. During the year 2020, outbreaks of FMD were not reported from the states of Gujarat and Rajasthan

Maharashtra: Two FMD outbreaks were recorded in the state in the district of Ahamadnagar and Aurangabad. The outbreaks that was recorded in the month of February and April were caused by FMDV serotype O. There was no mortality and morbidity rate was estimated to be 0.33%

Northern Region

Northern region comprises of five states and two UTs (Haryana, Punjab, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Jammu & Kashmir and Ladakh) and about 19% of the FMD susceptible livestock of the country. The region shares international border with Pakistan, Afghanistan, Nepal and China. The entire states of Haryana, Punjab, Himachal Pradesh, Uttarakhand and Uttar Pradesh are covered under FMDCP. There were no recorded outbreaks in the region during the period.

Eastern Region

Eastern region comprises of four states (West Bengal, Odisha, Bihar and Jharkhand) and about 22% of the FMD susceptible livestock of the country. This region shares international border with Bangladesh and Nepal. The entire region is covered under FMDCP since 2017. During the period, there are no FMD outbreaks recorded in Bihar

West Bengal: Four FMD outbreaks were recorded in the state in the districts of PaschimMedinipur (n=02), Murshidabad (n=01) and South 24 Parganas (n=01). Two outbreaks were recorded in the month of December and one each in October and November. In all the four instances, bovines were affected with an overall morbidity rate of 2.39%. No mortality was observed. Vaccination history of the affected animals were not known.

Odisha: One FMD outbreak due to serotype O was recorded in the district of Sundergarh in the month of December. The morbidity rate was observed to be 12.77% and there was no mortality. The animals in the outbreak area were last vaccinated in February 2020.

North Eastern Region

North eastern region comprises of seven states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura) and about 6% of the FMD susceptible livestock of the country. This region shares international border with China, Myanmar, Bangladesh and Bhutan. No FMD was reported during the period in the state of Mizoram.

Assam: Three outbreaks of FMD were recorded in the state during the period. Serotype A accounted for all the outbreaks. The disease was recorded only in cattle in the months of May, August and December. The outbreaks were recorded in the districts of Kamrup, Kamru and Darang. The animals were last vaccinated 4-6 months before the outbreaks. Higher morbidity (33.11%) was observed with low mortality (0.66%)

Meghalaya: Three outbreaks of FMD caused by serotype A was recorded in cattle during the period. The outbreaks were recorded in Ribhoi district in



the months of February (n=01) and March (n=02). No mortality was observed with a morbidity rate of 18.34%. In two instances, the affected animals were vaccinated about 3 months before the outbreak.

Manipur: Eight outbreaks due to serotype O were recorded in the state. Maximum of six outbreaks occurred in the month of April and one each in January and June. Two outbreaks each were recorded in Imphal West, Senapati and Bishnupur, and one outbreak each was reported from Churachandpur and Thoubal districts. The morbidity rate and mortality rate was observed to be 6.1% and 0.18%, respectively.

2.1.2 FMD Serosurveillance under NADCP

In India, vaccination with inactivated vaccine is the primary mode of FMD control. There is challenge to identify the infected animals among the vaccinated animals for appropriate implementation of the control programme. Differentiation of these two categories of animals is important during serological surveys to detect evidence of infection, as a follow up to ring vaccination in FMD free countries and for import/ export serology. During active viral replication following FMD virus infection, arrays of nonstructural proteins (NSPs) are produced that elicit anti-NSP antibodies, which is not the case in animals which are vaccinated against FMD with inactivated virus vaccine. Use of DIVA assay is essential in identification of potential disease free zones (DFZs) with vaccination in India.

For 3AB3-NSP based sero-surveillance activity, 200 bovine serum samples (animals 6 months- 18 months of age) per annum were collected at random from various districts of India. The sample size (n=200)/district has been calculated arbitrarily. However, the experts of the OIE FMD Mission to India suggested that a two-stage sampling strategy with a minimum design prevalence of 1% between the first-stage level (village) and 5% between the villages should be followed for NSP sero-surveillance. A new sampling design following two-stage sampling strategy was developed jointly by ICAR-NIVEDI and ICAR-DFMD. For NSP sero-surveillance, the study design usually focuses on younger animals (6-18 months age) since repeated

vaccination even with good quality vaccine can generate positive signal in NSP ELISA that may provide false positive NSP reactors.

During the year 2020, a total of 28,284 bovine serum samples collected at random from various parts of the country were tested using r3AB3 NSP-ELISA for assessing NSP-antibody (NSP-Ab) response, which is an underlying indicator of FMD virus exposure regardless of vaccination status. The test revealed overall seropositivity (DIVA positive) in ~ 16.2% samples or animals (Table 5). Till date, a total of 5,28,359 random serum samples from bovine have been analyzed by DIVA. Higher NSP antibody prevalence was observed in the states of West Bengal, Odisha and Mizoram. Though majority of the states showed reduction in NSP antibody prevalence compared to last year, increase in NSP prevalence was observed in the state of West Bengal and Odisha. In general, over the year though there has been a fluctuation in number of outbreaks, a decline in NSP antibody prevalence was observed in the country (Fig 2). In addition, samples were also tested for checking sero-negative status and also from outbreaks to check NSP antibody prevalence (Table 6) from samples referred to ICAR-DFMD.

Table 5. DIVA Positivity/ Reactivity during the year 2020 in Bovine of India

State/UT	Number of samples tested during 2020	Number positive in 2020	% positive in 2020	%positive in previous year (2019)
Telangana	334	02	0.59	3.4
A&N Islands	200	7	3.5	0.46
Madhya Pradesh	3120	422	13.5	14.6
Gujarat	1977	253	12.80	38.0
Maharashtra	9417	2008	21.32	26.8
Odisha	2144	636	29.66	27.5
West Bengal	540	195	36.11	31.6
Haryana	3930	173	4.4	7.3
Punjab	4282	447	10.43	-
Jammu &Kashmir	1080	174	16.11	16.2
Mizoram	1260	266	21.11	-
Total	28284	4583	16.2	20.8

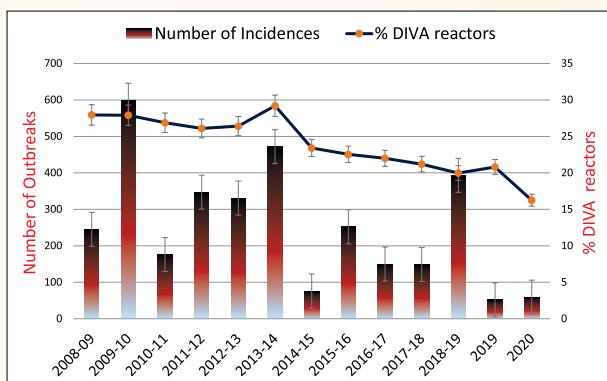


Fig 2. DIVA Positivity/ Reactivity over the years in Bovine of India and number of FMD outbreaks

Table 6. NSP ELISA testing of samples referred from outbreaks and for screening against FMDV

Place of sampling	Month of sampling	Origin of sample	No. of samples tested	Positive for NSP-antibodies
PGRIAS, Kattupakkam, Tamilnadu	January 2020	Outbreak	22	17
C.C.S. National Institute of Animal Health, Baghpat, Uttar Pradesh	January 2020	Sero-negative screening	81	12
Chhindwara, Mandla, Seoni and Hoshangabad, Madhya Pradesh	January 2020	Random	80	4
Jalda, Sundargarh, Odisha	December 2020	Outbreak	15	8

FMD Serosurveillance in small ruminants

Continued serosurveillance for FMD in small ruminants is essential to understand their role in the epidemiology of FMD and to extend support to FMD control decisions, particularly regarding vaccination. During the period serum samples of small ruminants from the states of Odisha and Telangana were tested. Higher NSP antibody prevalence was observed in both the states indicating past exposure of those species to FMD (Table 7).

Table 7. NSP ELISA testing of samples referred from small ruminants

State of sample collection	Species	Total samples tested in 3AB-NSP-ELISA	Number of positive	% positive
Telangana	Sheep	1074	151	14.1
	Goat	576	117	20.3
	Total	1650	268	16.2
Odisha	Sheep	324	25	7.7
	Goat	491	91	18.5
	Total	815	116	14.2
Total		4930	768	15.6

2.1.3 FMD Seromonitoring under NADCP

A bi-annual vaccination based FMD Control Programme (FMDCP) was started by the Government of India in 2004, initially covering 54 districts in the country. This involves 6 monthly FMD vaccinations, with an inactivated trivalent FMD vaccine, of all cattle and buffaloes for protection against FMD. The scheme was progressively expanded to cover the entire country by 2018-19. In 2019, Hon'ble Prime Minister launched National Animal Disease Control Programme (NADCP), a flagship scheme in September, 2019 for control of FMD and Brucellosis by vaccinating 100% cattle, buffalo, sheep, goat and pig population for FMD and 100% bovine female calves of 4-8 months of age for brucellosis. The overall aim of the NADCP is to control FMD by 2025 with vaccination and its eventual eradication by 2030. This will result in increased domestic production and ultimately in increased exports of milk and livestock products. NADCP for FMD and Brucellosis is a Central Sector Scheme where 100% of funds shall be provided by the Central Government to the States / UTs.

Under FMDCP, 200 pre and post vaccination samples were collected from each district following a simple random sampling technique. The whole process of sample collection (pre-vaccination and post-vaccination sampling) was repeated again during each round of vaccination through randomized calculator. In India, the above post-vaccination sampling strategy has been designed to determine the efficacy of both vaccine and vaccination programme. However, the experts of



Table 8. State wise number of samples tested and percentage of animals showing protective titre against FMD virus serotypes O, A and Asia1 (NADCP-1)

Name of State/UT	Total No of samples		Serotype O Number (% Protected)		Serotype A Number (% Protected)		Serotype Asia1 Number (% Protected)	
	pre	post	pre	post	pre	post	pre	post
Andhra Pradesh	2119	2116	191 (9.1)	618(29.2)	119 (5.6)	504 (23.8)	196 (9.3)	576 (27.2)
Arunachal Pradesh	186		5 (2.7)		26 (14.0)		2 (1.1)	
Assam	1989	1401	184 (9.6)	224(16.0)	39(2.0)	96 (6.9)	26 (1.3)	87 (6.2)
Chhattisgarh	2152	2011	366 (17.0)	716(36.5)	234 (10.9)	461 (22.9)	248 (11.5)	457 (22.7)
Goa	735	735	251 (34.2)	361(49.1)	203 (27.6)	318 (43.3)	253 (34.4)	314 (42.7)
Gujarat	2223	2223	418 (18.8)	982(44.2)	364 (16.4)	942(42.4)	447 (20.1)	1033 (46.5)
Haryana	2267	2271	549 (24.2)	1345(59.2)	545 (24.0)	1380(60.8)	643 (28.4)	1448 (63.8)
Himachal Pradesh	625	1028	19 (3.0)	87 (8.5)	23 (3.7)	75 (7.3)	9 (1.4)	44 (4.28)
Jharkhand	1506	492	135 (9.0)	143 (29.1)	51(3.4)	65(13.2)	71(4.7)	82(1.7)
Karnataka	2300	2303	376(16.4)	1042(45.3)	284(12.4)	766(33.3)	304(13.2)	865(37.6)
Kerala	660	796	217(32.9)	562(70.6)	173(26.2)	501(62.9)	219(33.2)	552(69.4)
Maharashtra	4346	4359	761(17.5)	1581(36.3)	627(14.4)	1285(29.5)	705(16.2)	1410(32.4)
Mizoram	838	838	88(10.5)	255(30.4)	75(9.0)	222(26.5)	91(10.9)	241(28.8)
Manipur	807	807	78(9.7)	370(45.9)	57(7.1)	329(40.8)	58(7.2)	297(36.8)
Madhya Pradesh	4589	4589	458(10.0)	1304(28.42)	397(8.7)	983(21.4)	428(9.3)	1108(24.1)
Odisha	2262	2262	287(12.7)	814(36.0)	198(8.75)	464(20.5)	166(7.3)	402(17.8)
Punjab	2145	-	244(11.4)	-	408(19.0)	-	390(18.2)	-
Sikkim	921	390	21(2.3)	103(26.4)	35(3.8)	65(16.7)	22(2.4)	84(21.5)
Tamilnadu	2246	2246	832(37.0)	1578(70.3)	618(27.5)	1366(60.8)	625(27.8)	1388(61.8)
Telangana	2210	2210	458(20.7)	1157(52.4)	321(14.5)	1085(49.1)	453(20.5)	1215(55.0)
Uttar Pradesh	7468	5975	738(9.9)	1714(28.7)	559(7.5)	1086(18.2)	642(8.6)	1323(22.1)
Uttarakhand	1320	1291	55(4.2)	314(24.3)	50(3.8)	226(17.5)	39(3.0)	298(23.1)
A&N Island	328	516	65(19.8)	203(39.3)	32(9.8)	180(34.9)	80(24.4)	234(45.4)
Delhi	200	191	79(39.5)	155(81.2)	95(47.5)	143(74.9)	81(40.5)	148(77.5)
Jammu Kashmir	1525	1137	265(17.4)	416(36.6)	141(9.3)	268(23.6)	157(10.3)	220(19.4)
Total	47967	42187	7140(14.9)	16044(38.0)	5674(11.8)	12810(30.4)	6355(13.3)	13826(32)

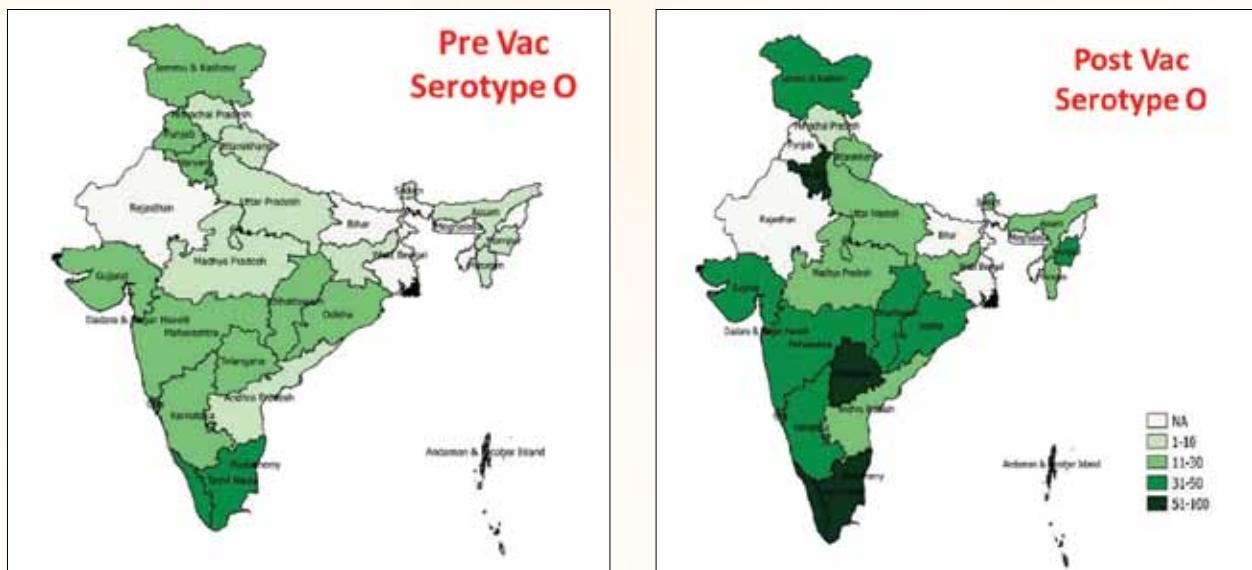


Fig 3: Map depicting Percent protective titer in pre-vaccination and post vaccination serum samples against FMD virus serotype O

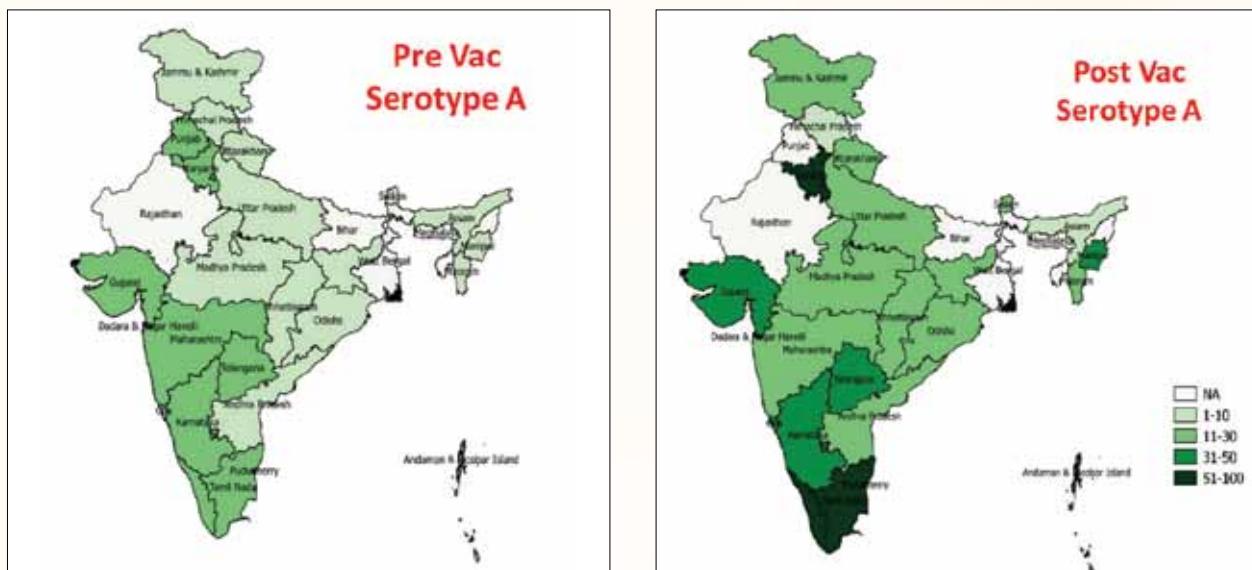


Fig 4. Map depicting Percent protective titer in pre-vaccination and post vaccination serum samples against FMD virus serotype A

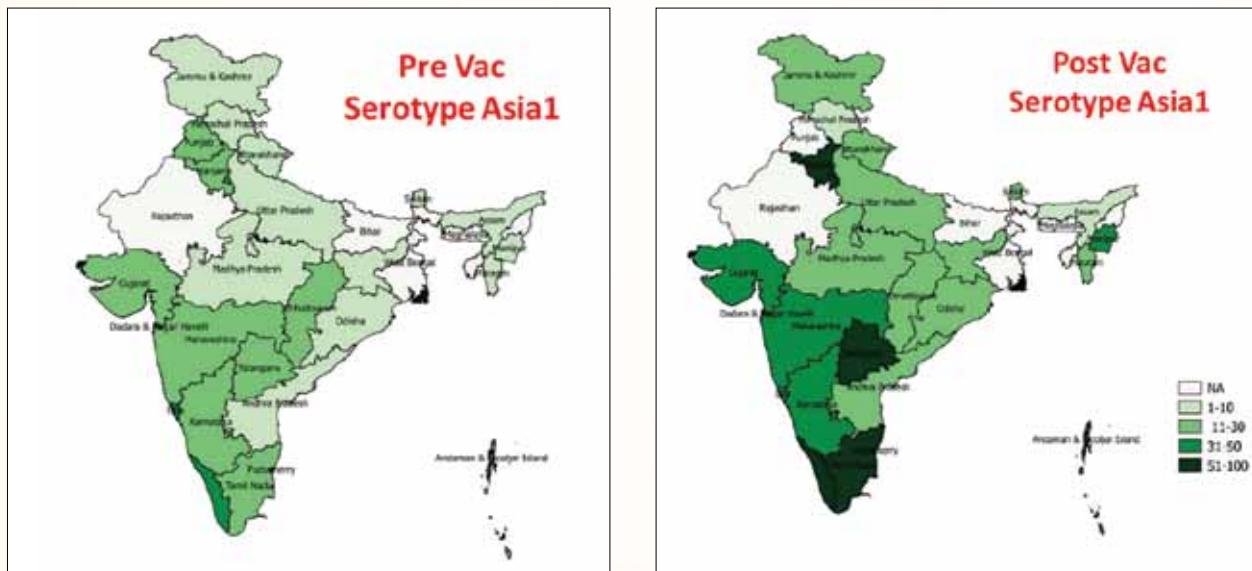


Fig 5. Map depicting Percent protective titer in pre-vaccination and post vaccination serum samples against FMD virus serotype Asia1



the OIE FMD Mission to India felt to change the sampling strategy in order to provide a clear picture of the population/herd immunity. Considering the recommendations, ICAR-NIVEDI in collaboration with ICAR-DFMD developed a new post-vaccination sero-monitoring sampling strategy which has been followed under NADCP. Under new sampling scheme, meta-data related to age of the animal, species, sex, location are being collected. The samples are collected from three different age groups of animals viz 6-12 months, 13-24 months and >24 months at a ratio of 5:4:1 as per OIE guidelines.

Under FMDCP and NADCP, serum samples before vaccination and 21 to 30 days post vaccination are collected by the respective state AH departments and tested by ICAR-DFMD and its state FMD laboratories for estimation of level of serotype specific antibodies. The Liquid Phase Blocking ELISA (LPBE) for monitoring of herd immunity following each round of vaccination was used till the year 2015. Subsequently, a Solid Phase Competitive ELISA (SPCE) in four dilution format was developed for the sero-monitoring activity under FMDCP. The SPCE is suitable for mass serology and is routinely used in World Reference Laboratory (WRL) on FMD, Pirbright, UK. The SPCE was reported to have equal test sensitivity as the LPBE and VNT and a better specificity of reaction than the LPBE. It is easier to use, more robust and specific, and therefore offers an improvement for FMD virus specific antibody detection.

During 2020, a total of 90,154 serum samples (pre-vac: 47,967 and post vac: 42,187) from various states collected under NADCP round 1 were tested to determine the antibody titre against FMD virus serotypes O, A and Asia1 using Solid Phase Competitive ELISA (Table 8). The testing was carried out at National FMD-CP Seromonitoring Laboratory (ICAR-DFMD), Bengaluru and state FMD laboratories. The serum samples were collected as per new sampling frame developed jointly by ICAR-DFMD and ICAR-NIVEDI. The antibody

titre of $\geq 1.8 \log_{10}$ is considered deemed to be protective at herd level. In pre-vaccination samples, the protective titre was found in 14.84, 11.69 and 13.13 percent of animals against serotypes O, A and Asia1, respectively. In post-vaccination samples, the protective titre of $\geq 1.8 \log_{10}$ was found in 37.62, 29.99 and 32.37 percent of animals against serotypes O, A and Asia1, respectively. Good post vaccination titre was observed in the states of Tamilnadu and Kerala, and UT of Delhi. A moderate response was observed in the states of Haryana and Telangana. In the rest of the states, the post vaccinal antibody response was found to be sub optimal.

Trends in antibody response

Compared to previous rounds, the protective antibody titre was found to be declining in both pre and post vaccination serum samples (Fig 6). The decline may be due to several factors including delay in vaccination, improper vaccination, under coverage, sub-optimal vaccine quality, change in sampling plan and change of test system etc. A correction factor need to be worked out for determining the trend of antibody response in real time. As per new plan, samples were collected from three different age groups viz; 6-12 months (Category I), 13-24 months (Category II) and >24 months (Category III) in 5:4:1 ratio. Majority of the samples were from Category I and those group might have received only 1-2 doses of vaccine. As expected poor antibody response was observed in category I animals. Under NADCP, 30 days booster vaccination for primo vaccinated animals is advised. If the procedure is followed strictly, we may expect some boost in immune response in the category I animals in the subsequent rounds. Surprisingly in many states the antibody response in category III animals were also found to be poor (Fig 7). This could be attributed to low-quality vaccines and vaccinations, as well as a compromise in the assay's quality etc. Failure to keep a six-monthly immunisation schedule could be a major factor. The response in general was found to be better in cattle compared to buffalo (Fig 8)

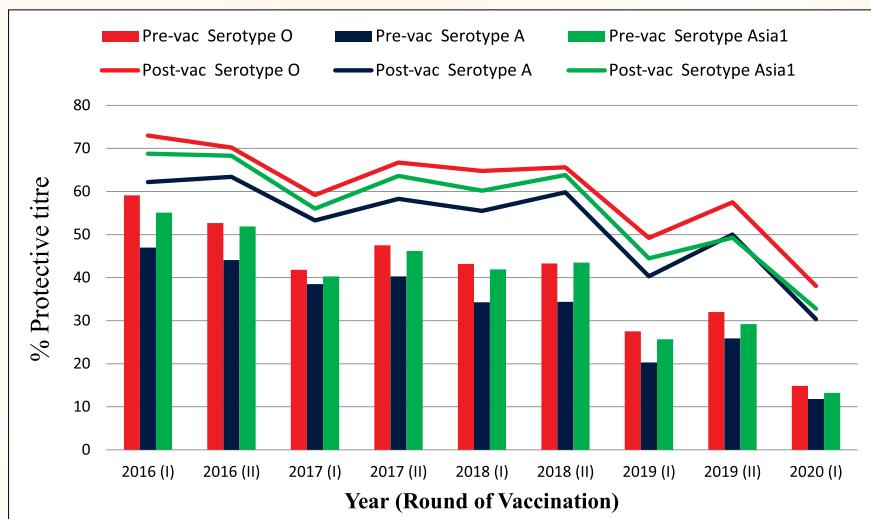


Fig 6. Percent protective antibody titre in pre and post vaccination serum samples over the year using SPCE for different serotypes.

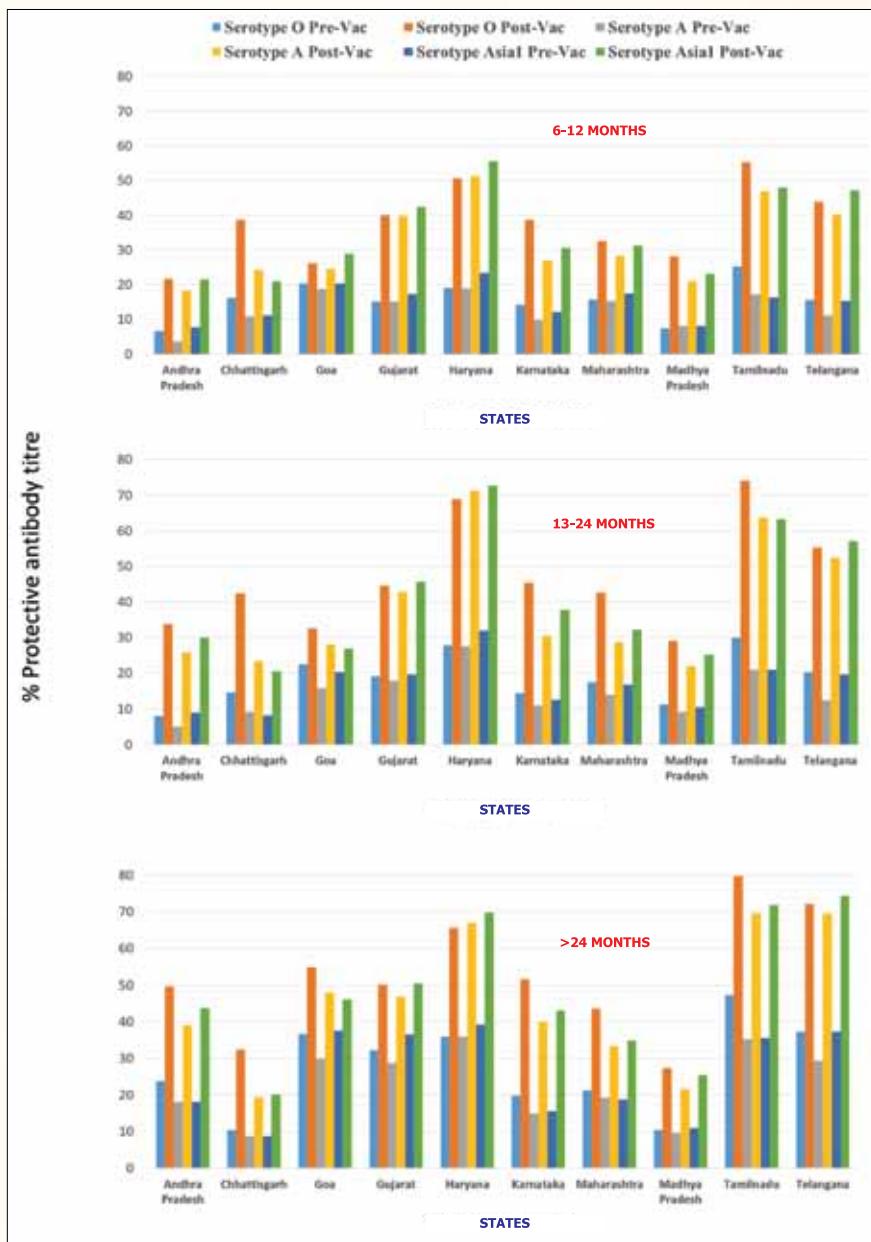


Fig 7. Percent protective antibody titre in pre and post vaccination serum samples in different age groups of animals (NADCP-1), Year 2020

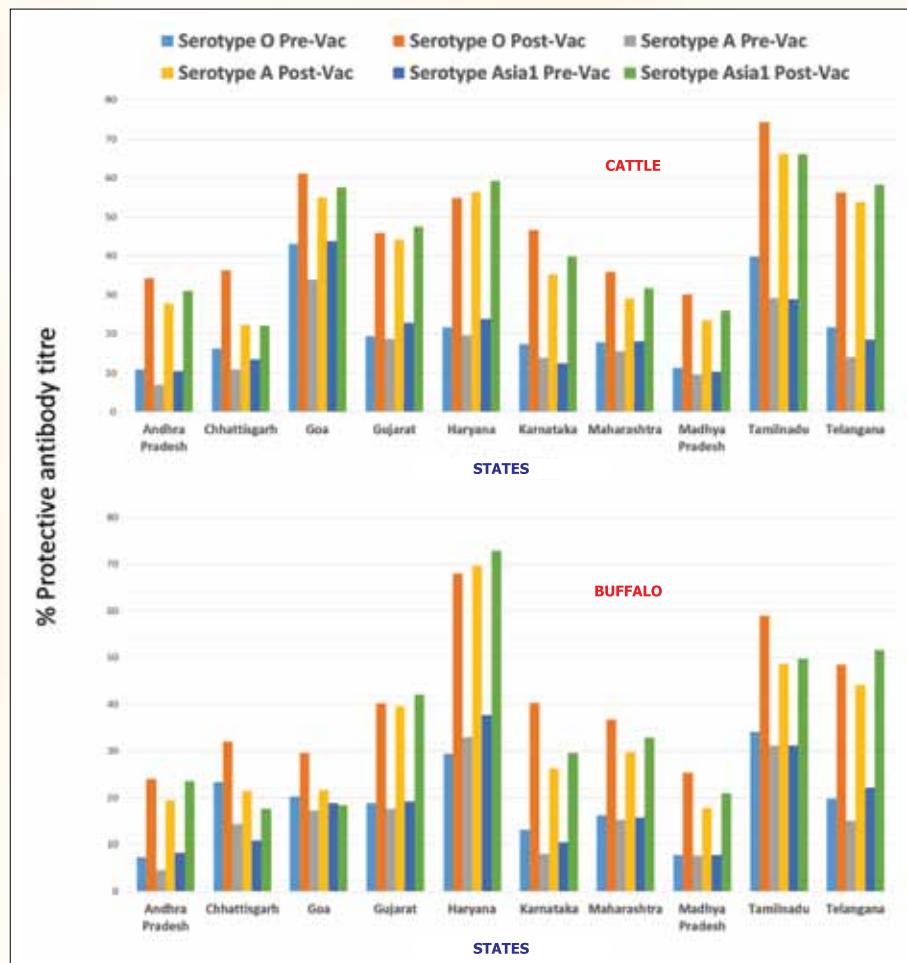


Fig 8 Percent protective antibody titre in pre and post vaccination serum samples in cattle and buffalo (NADCP-1), Year 2020

FMD seromonitoring in organized livestock farms

A total 3158 serum samples received from various Breeding Bull stations and random samples from surrounding villages were tested for protection

level. The antibody titre and post vaccination seroconversion were found to be excellent (>90%) in most of the farms (Table 9). In most of the organized farms, four monthly vaccinations have been practised without fail.

Table 9 Farm wise percent animals showing protective titre against FMD virus serotypes O, A and Asia1

Name of the Farm	Nature of samples tested		Percentage of animals showing antibody titres $\geq 1.8 \log_{10}$ against FMDV					
	Pre vac	Post Vac	Serotype O		Serotype A		Serotype Asia1	
			Pre	Post	Pre	Post	Pre	Post
KLDB, Kulathupuzha, Kerala	43	43	79.1	90.7	62.8	90.7	81.4	90.7
KLDB, Kulathupuzha, Kerala	79	79	73.4	98.7	68.4	91.1	92.4	100.0
KLDB, Kulathupuzha, Kerala	68	68	94.1	100.0	89.7	100.0	98.5	100.0
KLDB, Kulathupuzha, Kerala	119	119	57.1	63.9	54.6	63.0	56.3	64.7
KLDB, Dhoni, Kerala	110	110	91.8	100.0	92.7	96.4	98.2	100.0
KLDB, Dhoni, Kerala	109	109	93.6	96.3	90.8	94.5	93.6	99.1
KLDB, Dhoni, Kerala	106	107	92.5	99.1	83.0	98.1	97.2	98.1

Name of the Farm	Nature of samples tested		Percentage of animals showing antibody titres $\geq 1.8 \log_{10}$ against FMDV					
	Pre vac	Post Vac	Serotype O		Serotype A		Serotype Asia1	
			Pre	Post	Pre	Post	Pre	Post
KLDB, Mattupatty, Kerala	54	54	81.5	96.3	68.5	94.4	92.6	98.1
KLDB, Mattupatty, Kerala	84	84	89.3	95.2	82.1	94.0	91.7	98.8
KLDB, Mattupatty, Kerala	70	71	94.3	95.8	81.4	95.8	90.0	97.2
KLDB, Mattupatty, Kerala	69	68	95.7	100.0	95.7	100.0	98.6	98.5
KLDB, Palakkad, Kerala	109	109	93.6	96.3	90.8	94.5	93.6	99.1
APLDA, Banavasi, AP	91	91	68.1	94.5	63.7	85.7	74.7	86.8
APLDA, Banavasi, AP	90	80	78.9	92.5	77.8	90.0	90.0	95.0
APLDA, Visakhapatnam, AP	60	59	75.0	96.6	68.3	93.2	88.3	96.6
APLDA, Nandyal, AP	56	55	83.9	96.4	87.5	90.9	91.1	100.0
APLDA, Nandyal, AP	42	40	97.6	95.0	92.9	90.0	100.0	100.0
CBF, AnjoraChhattisgarh	25	25	64.0	92.0	40.0	92.0	76.0	96.0
CSS, Bhopal, MP	201	202	69.7	91.6	63.7	88.1	79.6	95.0

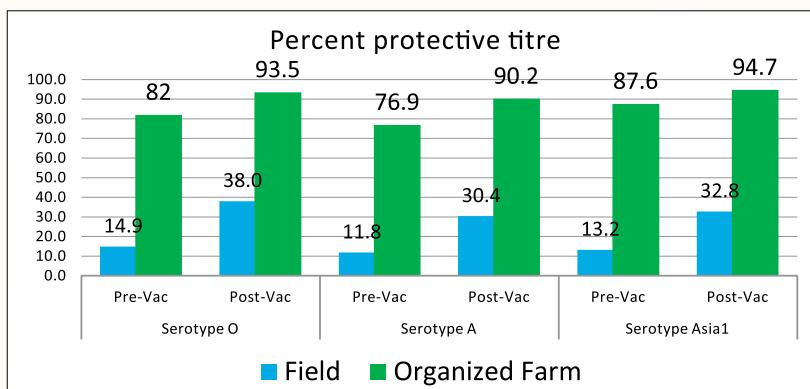


Fig 9 Percent protective antibody titre in pre and post vaccination serum samples from field and organized farms

2.1.4 FMD vaccine quality control testing under NADCP

Under NADCP, for the quality control testing of FMD vaccines to be used for the vaccination, our institute along with ICAR-IVRI and CCS-National Institute of Animal Health, Baghpur have joined hands to participate in the largest ever FMD control programme. The programme was initiated with first batch of vaccine testing at CCBF, Chiplima on 03.07.2020 using Jersey and crossbred calves during the COVID-19 crisis. For each individual batch, the experimental calves were first screened for sero-negative status with respect to FMD antibody. A group of 20 FMD sero-negative calves were selected for each batch of testing consisting of non-vaccinated

control (02), safety testing (02) and potency test (16). From potency test group, the pre vaccination (0 day) as well as 28 days post vaccination serum collected and was evaluated for serotype specific FMD antibody titer using VNT for potency. For purity testing, a booster was administered to 8 calves in the potency group at 28 days post primo vaccination and animals were sampled at 28 days post booster (56 days post primovaccination) and tested using 3AB3NSP ELISA for NSP antibody purity. During the year 2020, three coded batches of FMD vaccines (BS/05/A02X/2020; BS/025 B02X/2020 and BS/056 C07X/2020) have been tested at different farms such as CCBF, Chiplima, CCBF Sunabeda and Junagadh Agricultural University farm and reports were communicated. Under each batch the safety, sterility, purity and potency tests were conducted as per the standard operative procedure laid down by DAHD.

2.1.5 Evaluation of efficacy of disinfectants and cleaners against FMDV

In order to study the virucidal efficacy of disinfectants, the in silico analysis of citric acid

and the capsid protein of FMD virus serotype O were carried out by molecular docking. It showed the non-covalent interaction at residues Pro 190, Lys135, and Arg189 of VP1 capsid protein at its antigenic loop. The method of studying virucidal effect of different disinfectants was optimized in BHK 21 cell line. The virus was incubated with 0.1 % citric acid solution (pH-2.1) for 1, 2, and 5 minutes at 25 °C temperature. Following incubation, the treated mixtures were neutralized with sodium bicarbonate (final concentration 1.8%) for adjusting the pH. The infectivity titers of FMDV in virus solution and treated mixtures were determined by the 50% tissue culture infective doses (TCID₅₀) at 30 hrs post infection. The infectivity titer of the stock virus was 6.98 log 10 TCID₅₀/ml. The citric acid solution (0.1%) reduced the infectivity of FMDV serotype O by 1.36, 1.84, and 3.0 log₁₀ TCID₅₀/ml within 1, 2, and 5 minutes of exposure, respectively. In conclusion, the citric acid solution of 0.1 % effectively reduced the infectivity of FMDV serotype O in 5 min exposure in BHK 21 cell line.

2.2 Development and Improvement of Diagnostics

Development of sensitive diagnostics and refinement of existing diagnostic tests is important mandate of the institute. During the reported period two diagnostic tests were developed. A SYBR green-based one-step real-time RT-PCR for serotype-independent detection of FMDV circulating in India has been developed and validated with archival clinical samples and cell-culture isolates. An alternative serological assay (IgM I-ELISA) has been developed which can detect the anti-FMD IgM antibody specific to 2B NSP of FMDV and can be applied for identification of persistently infected animals.

2.2.1 One-step SYBR green-based rRT-PCR assay for detection of FMDV

Rapid, sensitive and reliable laboratory detection of FMDV infection is essential for containing and controlling virus infection in any geographical area. A SYBR green-based FMDV-3Dpol specific one-step real-time RT-PCR (rRT-PCR) assay was developed for the pan-serotype detection of FMD

virus in India. The limit of detection of FMDV RNA by the SYBR green based rRT-PCR was 10⁻² TCID₅₀/50µl, which is 10-times more sensitive than the traditional agarose gel electrophoresis-based RT-multiplex PCR (RT-mPCR). The standard curve exhibited a linear range across 8-log₁₀ units of viral-RNA dilution (Fig 10a-10b). The reproducibility and specificity of this assay was reasonably high suggesting that the 3Dpol specific SYBR-green rRT-PCR could detect FMDV genome specifically and with little run-to-run variation. The new 3Dpol specific SYBR-green rRT-PCR assay was evaluated alongside the established RT-mPCR using the archived FMDV isolates and clinical field-samples from suspected FMD outbreaks. A perfect concordance was observed between the new rRT-PCR and traditional RT-mPCR on viral RNA in the archived FMDV cell culture isolates tested. Furthermore, 16% more FMDV-suspected clinical samples were detected positive through the 3Dpol specific SYBR-green rRT-PCR as compared to the traditional RT-mPCR. Therefore, the SYBR green-based 3Dpol specific one step rRT-PCR could be considered as a valuable assay with higher diagnostic sensitivity to complement the routine assays that are being used for FMD virus diagnosis in India.

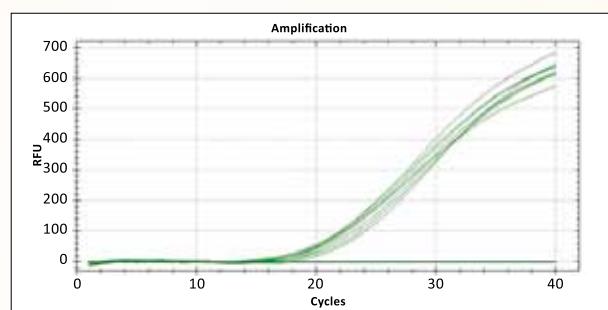


Fig 10a: A representative amplification plot in 3Dpol based SYBR-green RT-qPCR

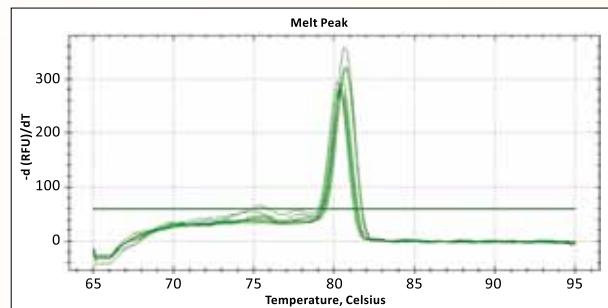


Fig. 10b: A representative melt-curve plot in 3Dpol based SYBR-green RT-qPCR.

2.2.2 Detection of FMDV carrier bovine through 2B-NSP based IgM-ELISA

FMDV infected cattle and buffalo typically clear the generalized infection within 10-15 days due to appearance of neutralizing antibodies. However, approximately 50% of FMD-recovered ruminants become FMD carriers (persistently infected animals), defined as animals from which FMDV can be detected in oro-pharyngeal fluid (OPF) at more than 28 days post-infection.

FMDV persistently-infected animals may be considered a risk for transmitting the disease to the naïve-susceptible animals, which might be a reason for implementation of trade restriction on livestock and livestock products from the FMD endemic countries. Furthermore, the presence of FMD-carrier state jeopardizes the declaration or recovery of FMD-free status. Therefore, FMD-carrier animals must be identified through detection of FMDV genome and/or live virus in the OPF. However, it is not feasible to test the OPF samples while screening a large animal population for detection of carrier state. Therefore, an alternative serological assay (IgM I-ELISA) has been developed which can detect the anti-FMD IgM antibody

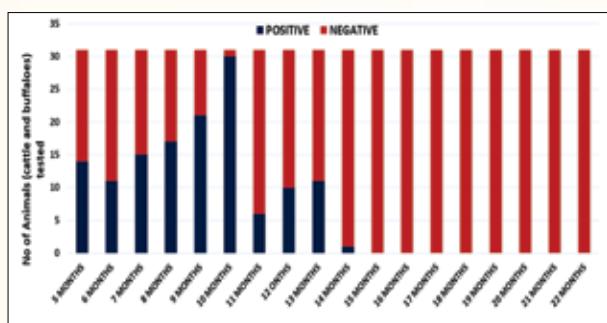


Fig 11a: Kinetics of the detection of FMDV-persistently infected animals (n=31) by RT-mPCR based genome detection assay.

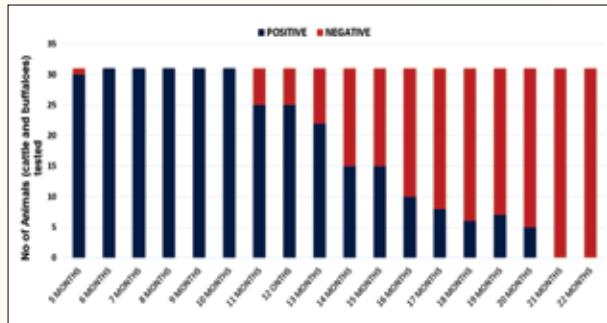


Fig 11b: Kinetics of the detection of FMDV-persistently infected animals (n=31) by IgM-ELISA based serological assay.

specific to 2B NSP of FMDV. The concentration/dilution of different assay parameters like antigen concentration, serum and anti-species conjugate dilution were determined to be 150 ng/well, 1:40 and 1:8000 respectively, after optimization through checkerboard titration. Percentage of positivity (PP) values from 507 archival serum samples were analysed through receiver-operating curve (ROC) curve, where the cut-off point was found to be 48 PP and the diagnostic sensitivity and specificity at this cut-off was found to be 97.98% and 96.67%, respectively (Fig 11a-11b). The kinetics of IgM antibody was determined using serum samples collected sequentially up to 22 months post-infection and the longevity of IgM response was found up to 10-21 months post-infection.

2.2.3 Expression of VP3 of FMDV serotype O in prokaryotic system

The VP3 protein of current Indian vaccine strain (IND/R2/1975) for serotype O FMD virus was expressed as a histidine-tagged recombinant protein in a prokaryotic host. The VP3 gene was amplified by reverse transcription PCR using custom-designed primers and cloned into the pET28a (+) expression vector. The orientation and reading frame of the recombinant expression construct was confirmed by restriction enzyme digestion and sequence analysis. The recombinant VP3 (~35kDa) was expressed in the soluble fraction of *E. coli* BL 21 (DE3) pLysS host after induction with 1mM IPTG. An evident specific reactivity for recombinant VP3 was observed against anti-His tag monoclonal antibody and serotype O specific bovine vaccinal serum in western blot (Fig 12a and Fig 12b). The results indicate the desired expression of recombinant protein with in-frame histidine tag,

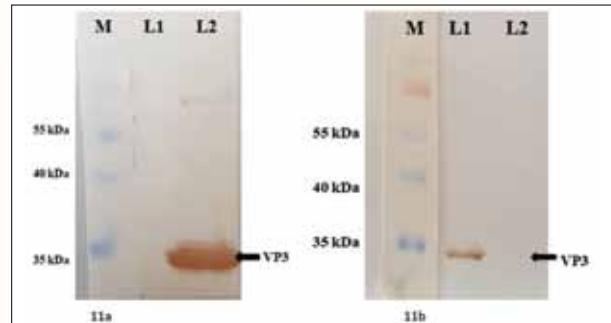


Fig 12: Reactivity of expressed VP3 with (a) FMDV specific monoclonal antibody and (b) polyclonal serum

maintaining the viable antigenic nature of VP3. Further, this recombinant protein is being explored for affinity purification and to use as an antigen for immunoassays in sero-monitoring of FMD.

2.3 Characterization of Pathogens and Epidemiology

2.3.1 Molecular Epidemiology of FMDV Serotype O

Globally, eleven geographically restricted topotypes namely Europe-South America (EURO-SA), Middle East-South Asia (ME-SA), South East Asia (SEA), Cathay, Indonesia (ISA) 1, ISA-2, East Africa (EA)-1, EA-2, EA-3, EA-4, and West Africa (WA) have been identified. To date, all the FMDV serotype O strains characterized in India belong to the ME-SA topotype. Within the ME-SA topotype, several genetic groups (lineages/sub-lineages) of the virus with more than 5% nucleotide divergence at 1D region have been identified in India. The Indian vaccine strain (INDR2/1975) belongs to the lineage Branch B. Historically, lineages O/ME-SA/Ind2001 and O/ME-SA/PanAsia are the predominant genetic groups circulating in India. Both O/ME-SA/PanAsia and O/ME-SA/Ind2001 strains have also established as the most dominant lineages within ME-SA topotype in South Asia.

The O/ME-SA/Ind2001 lineage since its first report in the year 2001 has diversified into at least five sub-lineages (Ind2001a, b, c, d and e) since then. The phylogenetic comparison of serotype O isolates with representative strains revealed emergence of sub-lineage O/ME-SA/Ind2001e during the year 2015 in India. The emerging lineage O/ME-SA/Ind2001e was responsible for sporadic incidences during 2015-2017, before causing outbreaks in epidemic proportion during the year 2018. The O/ME-SA/Ind2001d lineage played a predominant role in causing FMD outbreaks in the country since its emergence in 2008. With the emergence of lineage O/ME-SA/Ind2001e, decline in circulation of O/ME-SA/Ind2001d lineage has been observed. Both the lineages co-circulated for three years during 2015-2017 before eventual replacement of O/ME-SA/Ind2001d from the field during 2018. Emergence of a novel cluster during the year 2018 designated

here as O/ME-SA/2018 lineage was documented earlier. The lineage showed considerable genetic divergence from both O/ME-SA/Ind2001 and O/ME-SA/PanAsia lineages.

During the year 2020, a total of ten FMD virus serotype O field isolates were sequence determined and subjected to phylogenetic analysis. Out of ten isolates, four were sampled during the year 2018 from the state of Karnataka. Rest of the six isolates were collected during 2020 from the states of Kerala, Odisha and Maharashtra. Among the four isolates collected from the state of Karnataka, three belonged to O/ME-SA/Ind2001e sub-lineage, and one clustered within O/ME-SA/2018 cluster which shows the complexity of virus circulation in the state. All the three isolates collected from Kerala during 2020 clustered with O/ME-SA/Ind2001e sub-lineage and had 100% sequence similarity among themselves. Similarly, two isolates sampled from Odisha had 100% sequence identities and grouped within O/ME-SA/Ind2001e sub-lineage. A lone isolate from the state of Maharashtra grouped within O/ME-SA/2018 cluster. Compared to the year 2019, no significant difference was observed in terms of change of epidemiological scenario which is characterized by the absence of O/ME-SA/Ind2001d sub-lineage, and dominance of O/ME-SA/Ind2001e sub-lineage and the presence of O/ME-SA/2018 cluster (Fig 13).

2.3.2 Molecular Epidemiology of FMDV Serotype A

Serotype A virus population is genetically and antigenically most heterogeneous in nature among the three serotypes prevalent in India. Molecular phylogeny has established circulation of four genotypes (2, 10, 16 and 18) showing more than 15% nucleotide (nt) divergence among them at 1D region of serotype A so far in India. Since 2001, genotype 18 has been exclusively responsible for all the field outbreaks and has outcompeted all other genotypes. Within the currently circulating genotype 18, a divergent and unique lineage emerged in late part of 2002, which showed an amino acid (aa) deletion at 59th position of VP3 (VP3⁵⁹-deletion group) and dominated the field outbreak scenario in 2002-03. Ever since then sporadic outbreaks due to this

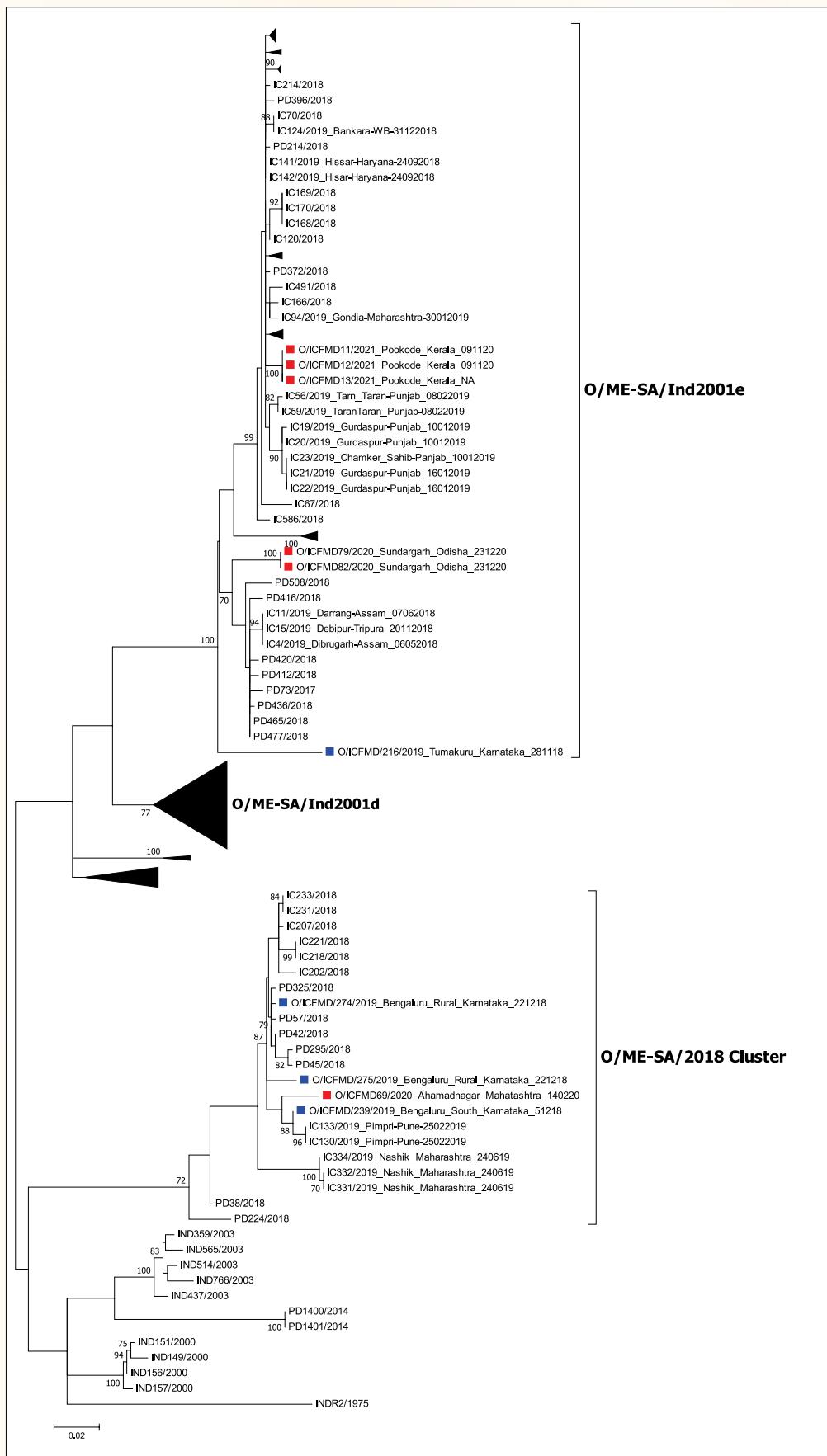


Fig 13: Maximum Likelihood phylogenetic tree at VP1 coding region of Indian serotype O FMD virus isolates during 2020. The analysis showed dominance O/ME-SA/Ind2001e sub-lineage in India during the period.

lineage has been identified. During the year 2019, FMD outbreak due to serotype A was recorded in Satara district of Maharashtra state in January and three samples were collected. Phylogenetic analysis ML method revealed clustering of both the isolates within Genotype 18 (Fig 14) but distantly from both deletion and non-deletion lineages. Examination of VP3 region revealed the presence of 59th amino acid. There is a possibility of emergence of new lineage with Genotype 18. The newly emerging group has been designated here as G-18/non-deletion/2019 lineage. During the year 2020, no isolates of serotype A were characterized for phylogenetic analysis.

2.3.3 Molecular Epidemiology of FMDV Serotype Asia1

Previous studies on 1D/VP1 gene based phylogeny demarcated Indian serotype Asia1 field

isolates in to three major lineages namely B, C and D. Lineage B which include currently used serotype Asia1 vaccine strain, IND63/1972, was last recorded in the year 2000. The isolates of lineage D emerged late in 2001 and dominated the period between 2002 and 2004. The lineage C dominated the Asia1 field outbreaks between 1998 and 2002, although disappeared between year 2001 and 2004, and re-emerged as the predominating lineage from 2005 onwards (sub-lineage CII). FMD virus serotype Asia1 collected since 2004 are classified in nine different genetic groups (G I-IX) globally. On global scale, isolates collected from India during 2001-2004 (termed earlier as lineage D) clustered within Group III. Isolates collected after 2005 from India, (termed earlier sub-lineage CII) and clustered with in Group VIII.

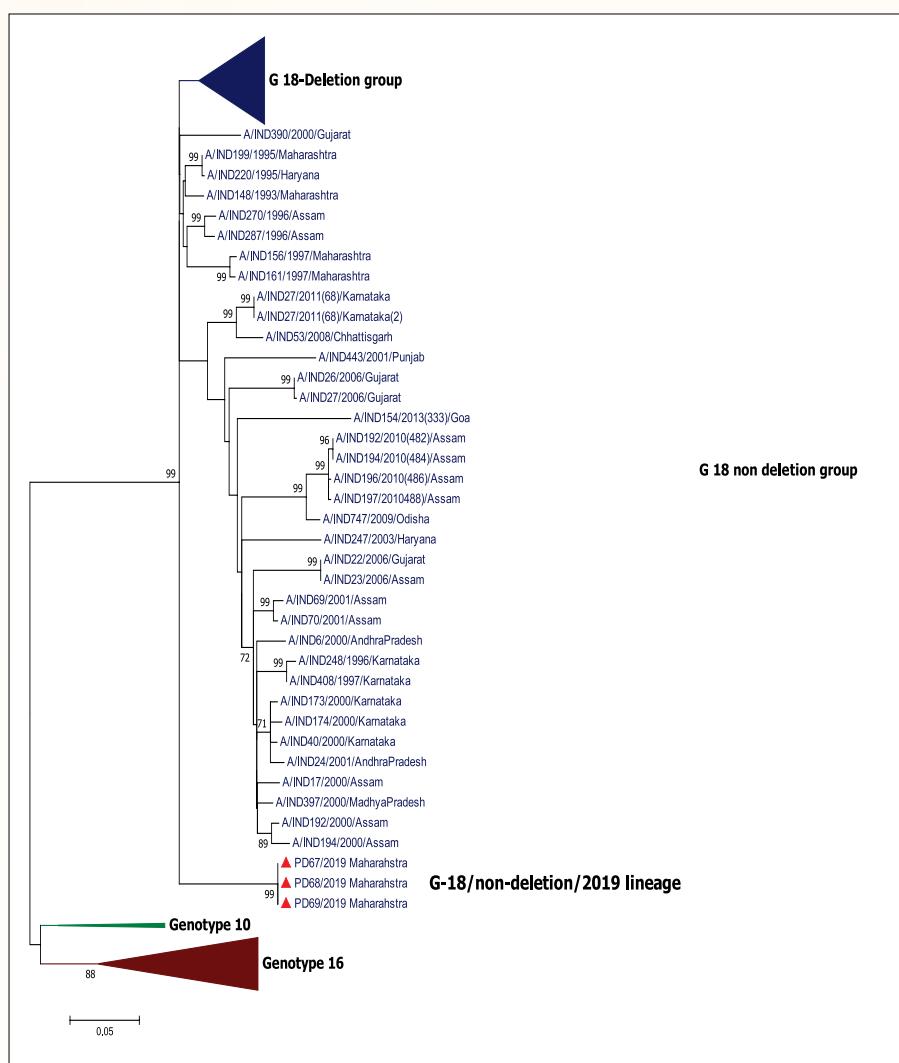


Fig 14: Maximum Likelihood phylogenetic tree at VP1 coding region of Indian serotype A FMD virus isolates during 2019. The analysis showed emergence of new genetic cluster.

Three isolates collected during 2020 from India clustered within G-IX (BD-18) whose emergence has been described recently in January, 2018 in Bangladesh. The outbreak due to FMD virus Asia1/G-IX was recorded in an organized farm in the state of Tamilnadu during the month of January 2020 (Fig 15). The animals in the farm have been vaccinated regularly twice in a year and the last vaccination was carried out in the month of September 2019. During the FMD outbreak in the farm both the cross-bred cattle and buffalo were affected with mild oral, foot and teat lesion. All the clinically affected animals were recovered in two weeks' time. The farm consists of separate units of sheep, goat and pig, however, none of them were infected clinically during that outbreak. Although the farm is fenced, entering of animals (either vaccinated or unvaccinated) from

the nearby villages and mingling with the farm animals during grazing did happen at times.

The Indian G-IX isolates showed 1.5% mean nucleotide divergence of VP1 from their counterpart strains from Bangladesh. It may be interpreted that either there is a possible incursion of virus from Bangladesh or in-situ evolution of virus within India from the topologically neighbouring prevalent Asia1/G-VIII virus. However, it is difficult to establish the origin of G-IX in the absence of any temporally intermediate epidemiological links between 2018 and 2020, and the only sequence resolved during 2019 clustered in Asia1/G-VIII. The Asia1/G-IX apparently shares recent common ancestry with Asia1/G-VIII, and as suggested earlier key founder events in the transmission pathway of G-VIII might have triggered the emergence of G-IX.

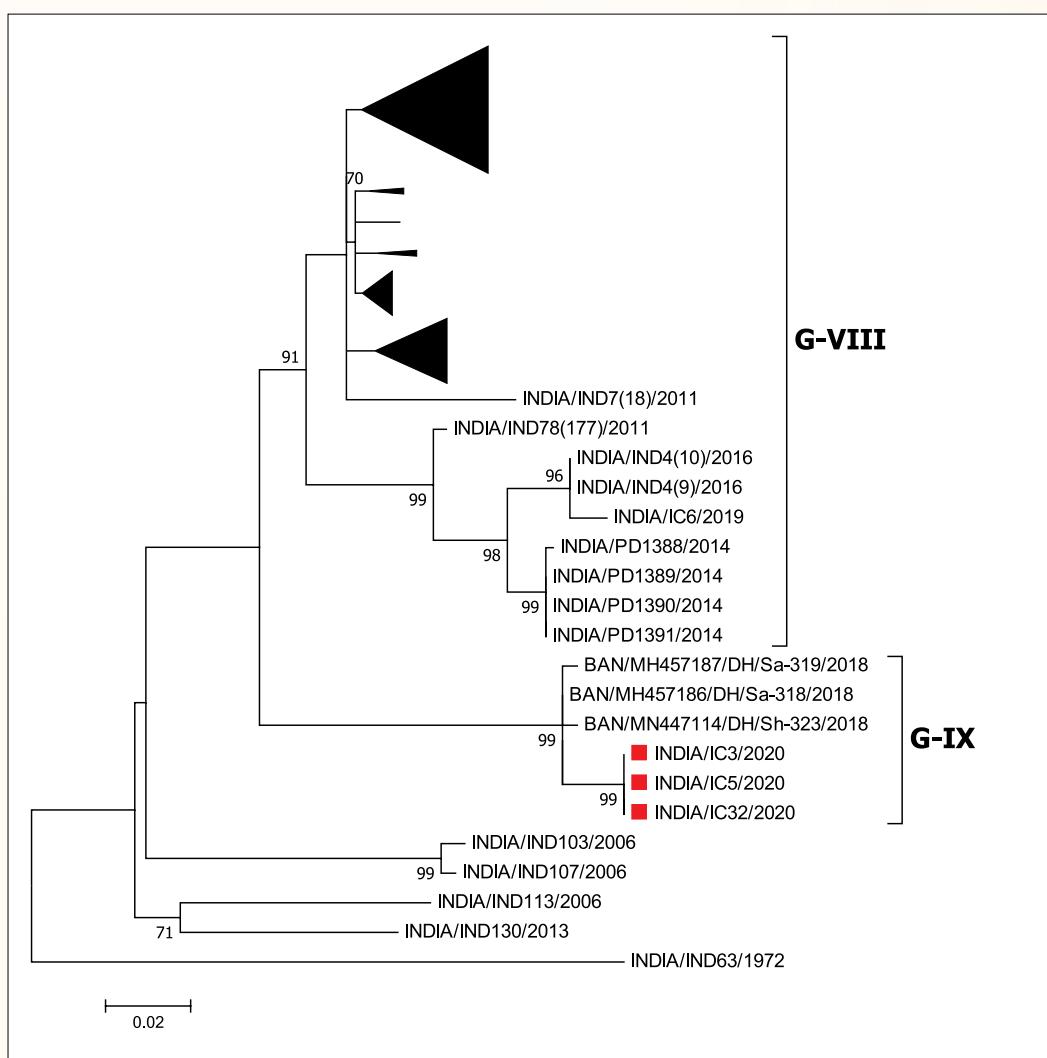


Fig 15: Maximum Likelihood phylogenetic tree at VP1 coding region of Indian serotype Asia1 FMD virus isolates during 2020. The analysis showed emergence of G-IX



2.4 Production and Standardization of Biologicals

ICAR-DFMD supplied 3AB3 indirect DIVA ELISA and Solid Phase Competitive ELISA (SPCE) kits to carry out seromonitoring and serosurveillance,

and Sandwich ELISA kit for serotyping to the state FMD centres. The details of supplies made are given below. Besides supply, the diagnostic kits were also used at ICAR-DFMD laboratories at Bhubaneswar, Mukteswar and Bengaluru for seromonitoring and serosurveillance under NADCP.

Table 10: Diagnostic kits supplied during 2020 for number of samples

Institute/Organization	3AB3 indirect DIVA ELISA kit (Number of samples)	Solid Phase Competitive ELISA kit (Number of samples)	Serotyping ELISA kit (Number of samples)
FMD centre, Telangana	13500	5000	100
FMD centre, Tamilnadu			200
FMD centre, Kerala		9900	
FMD centre, Punjab	5040	4500	200
FMD centre, Odisha	1440	11500	
FMD centre, Maharashtra	5040	8000	
FMD centre, Gujarat	2520	4000	
FMD centre, Haryana	5040	8000	
FMD centre, Uttarakhand		3000	
FMD centre, Nagaland		3500	
FMD centre, Himachal Pradesh		1000	
FMD centre, Jammu & Kashmir		3000	
FMD centre, Assam		4500	
FMD centre, Manipur		3500	
FMD centre, Mizoram		3000	
FMD centre, A&N Island		3200	
FMD centre, Madhya Pradesh	3600	17000	
VBRI, Andhra Pradesh	10500		
C.C.S.NIAH, Baghpat, Uttar Pradesh	450		
I.V.R.I., Bengaluru, Karnataka	450		
Brilliant BioPharma Pvt. Ltd., Hyderabad	900		
Total (Number of samples)	48,480	92,600	500

2.5 Extension intervention in Livestock Production System

Tribal Sub-Plan (TSP) activities

Tribal Sub Plan (TSP) programme was implemented at one aspirational district of Uttarakhand covering Tharu tribes. The operational area included two villages namely Khaunda Khera and Sunkharikala villages of Sitarganj block, U. S. Nagar. The programme was implemented by

conducting baseline survey cum sensitization programme, animal health camp, skilled development programme and demonstration. In addition, the need based critical inputs for livestock health management were distributed among tribal families. The inputs included mineral supplements, anthelmintics, disinfectants and hand sanitizers. During this period, a total 130 tribal families benefited through various interventions. Details of the activity are summarized in Table 11.

Table 11: Activities under Tribal Sub-Plan (TSP)

S No	Description of activity	Venue	Beneficiaries (Number)
1	Baseline survey cum sensitization programme and distribution of disinfectants	KaundhaKhera, Sitarganj, US Nagar	34
2	Demonstration of mineral and vitamin supplementation to dairy animals	Sunkharikala village, Sitarganj, US Nagar	10
3.	Organization of animal health camp [treatment of cattle (n=34), buffalo (n=15), goat (n=7), poultry (n=120) and dog(n=1)]	Sunkharikala village, Sitarganj, US Nagar	27
4.	Distribution of anthelmintics for cattle, buffalo and goat	Kaundha Khera, Sitarganj, US Nagar	27
5.	Technical guidance provided through mobile advisory service	Sunkharikala village, Kaundha Khera, Sitarganj, US Nagar	10
6.	Organization of skilled development programme related to livestock health management	Sunkharikala village, Sitarganj, US Nagar	22

Distribution of disinfectant among schedule tribe's families at KhaundhaKhera village by ICAR-DFMD



Input distribution under TSP by state FMD centres



Scheduled Caste Sub- Plan (SCSP) activities

The ICAR-DFMD Mukteswar identified three villages of Kumaon hill region for conducting various interventions during this year. The operational area included two villages (Darmoli and Pangari)of Nainital districts and one village (Okhalisirodha) of Bageswar district. Trainings, kisangosthi, animal health camps and method demonstration were organized under the SCSP programme. Besides, inputs related to livestock production like balanced cattle feed, acaricides, disinfectants etc were distributed among SC families. The details of interventions are summarized in Table 12.



Table 12: Activities under Schedule Caste Sub-Plan (SCSP)

S. No	Programme/ Activities	Venue	Beneficiaries (Numbers)
1	Baseline survey of Pangrari village under SCSP	Pangrari, Distt. Nainital	33
2	Organization of Animal Health Camp (two nos) [Animals treated, cattle (n=133), buffalo (n=11), goat (n=166), dog (n=1) and pony (n=1)	Pokhari and Darmoli villages, Distt. Nainital	60
3	Distribution of balanced ration for dairy animals	Darmoli, Pitohli, Distt. Nainital	129
4	Method Demonstrations a) procedure of animal shed disinfection b) application of cleaners and virucide agents during FMD infection c) procedure of temperature recording of goat	Pokhari, Darmoli, Pitohli villages, Distt. Nainital	62
5	Distribution of disinfection among SC families	Okhalisirodha, Distt-Bageswar and Pitohli village, Distt- Nainital	76
6	Celebration of KishanDiwas	Pitohli, Distt. Nainital	22
7	Organization of trainings	Darmoli and Pokhari village	48

Distribution of disinfectant among Schedule caste families at Darmoli village by ICAR-DFMD



FMD awareness programs by different state FMD centres



3.1 National/International Awards

1. Best presentation: Biswal J K, Subramaniam S, Ranjan R, Pattnaik B, Singh, R K (2019). Genetic basis of the antigenic variation of the FMD virus during persistent infection in naturally infected cattle and buffalo. XXXIII Annual convention of IAVMI. National conference on challenges and threats of microbes to animals and humans during February 6-7, 2020 at IVRI, Izatnagar, UP.
2. Prof. P.K. Uppal promising young scientist award in infectious diseases to Dr Jitendra Kumar Biswal during XXXIII Annual convention of IAVMI. National conference on challenges and threats of microbes to animals and humans during February 6-7, 2020 at IVRI, Izatnagar, UP.
3. Best Hindi article Award for Pasudhan Prakas (NBAGR-2020) to Dr Nihar R Sahoo
4. Ram Singh Memorial National Animal Welfare Award 2020 cited as "National Excellence Award" awarded to Dr Rajeev Ranjan in recognition of significance contribution for Prevention of Cruelty to Animal and Enhancement of Animal Welfare by PashudhanPraharee. RNI No.: JHAHIN/2012/46453. ISSN : 2319 - 6971 (PRINT).
5. Dr Smrutirekha Mallick awarded with "IFBA Certified Professional"- Professional Certification in Biorisk Management (IFBA Certified Professional, ID Number: YAI033164) provided by "International Federation of Biosafety Associations (IFBA), 102-2460 Lancaster Road Ottawa, Ontario, Canada, K1B 4S5" on June 24, 2019.
6. Dr C. Jana, Pr Scientist received 1st best oral presentation award at 38th Annual Convention of Indian Society for Veterinary Medicine and National Symposium on "Advancement in Veterinary Medicine in Mitigating Challenges to Animal Health" held during 5th -7th February, 2020
7. Second best oral presentation:Khulape SA, Jana C, Dahiya SS, Sahoo AP and Singh RK (2020). "In-silico antigenic heterogeneity analysis for capsid protein VP1 of serotype Asia1 Foot and Mouth disease virus". International Web-Conference on "New Trends in Agriculture, Environmental & Biological Sciences for Inclusive Development (NTAEBSID-2020)" Agro Environmental Development Society (AEDS), India held during 21-22 June, 2020

3.2 Editor/Associate Editor of Research Journals

1. Dr Nihar R Sahoo-Associate Editor of BMC Research Notes (Springer Nature)

4.1 Research Publications

Research articles

Foreign journal

1. Bertram M.R., Palinski R.M., Pauszek S.J., Hartwig E.J., Smoliga G.R., Biswal J.K., Ranjan R., Subramaniam S., Mohapatra J.K., Das B., Fish I.H., Pattnaik B., Rodriguez L.L. and Arzt J. (2020). Genome Sequences of Seven Foot-and-Mouth Disease Virus Isolates Reveal Diversity in the O/ME-SA/Ind2001 Lineage in India between 1997 and 2009. *Microbiology Resource Announcements*, 9 (16) e00287-20
2. Subramaniam S., Biswal J.K., Mohapatra J.K., Khulape S.A., Madhanmohan M. and Singh R.K. (2020). Emergence of foot-and-mouth disease virus serotype Asia1 group IX in India. *Archives of Virology*, 165(11): 2619-2625. NAAS Score: 8.24 JCR Impact Factor: 2.243
3. Dahiya S.S., Subramaniam S., Biswal J.K., Das B., Prusty B.R., Ali S.Z., Khulape S.A., Mohapatra J.K. and Singh R.K. (2020). Genetic characterization of foot-and-mouth disease virus serotype O isolates collected during 2014-2018 revealed dominance of O/ME-SA/Ind2001e and the emergence of a novel lineage in India. *Transboundary and Emerging Diseases*, doi: 10.1111/tbed.13954. NAAS Score: 10.19 JCR Impact Factor: 4.188

Technical papers / review articles / full invited papers in conferences / training, etc

1. Ranjan R, Biswal J.K., Subramaniam S. and Singh R.K. (2020). Diagnostic Paradigms in Strategizing Foot-and-Mouth Disease Control and Eradication. *Zonal Conference IAVP ZONAL CONFERENCE-2020 and NATIONAL SYMPOSIUM On "Recent advances*

in diagnostic pathology for emerging and re-emerging diseases in livestock, poultry under farming conditions and wildlife" Organized by IAVP Jharkhand Chapter; Department of Veterinary Pathology, RVC, BAU, Kanke, Ranchi 6, IAVP Central Zone and East Zone; NAHEP-CAST Programme, BAU, from Feb 22-24, 2020.

2. Dr Ranjan R delivered an e-lecture under NAHEP_IG Project on August 07, 2020 at 3.30 PM by Zoom Cloud Platform on the topic entitled "*Subclinical Infection of Foot and Mouth Disease in Cattle and Buffalo*" organized by Director Research, Office of the Director Research, Bihar Animal Sciences University, BVC campus, Patna-800014, Bihar. Invitation No.: 05/NAHEP/BASU/2020/1437 dated 27.07.2020.
3. Dr C Jana delivered a lecture on 'FMD status in hill and its preventive measures' in an Inter-institutional training on preventive health care practice in livestock at hilly region' under DST NMSHE project (ICAR-IVRI Mukteswar) at Sunkhiya village Nainital.

Abstracts / papers presented in conferences / symposia

1. Biswal J.K., Subramaniam S., Ranjan R., Pattnaik B. and Singh R.K. (2020). Genetic basis of the antigenic variation of Foot-and-Mouth Disease virus during virus persistence in naturally infected cattle and buffalo. *XXXIII Annual Convention of Indian Association of Veterinary Microbiologists and Specialists in infectious diseases and National conference on "Challenges and threats of microbes to animals and humans"* organized by ICAR-Indian Veterinary Research Institute, Izatnagar-243122, Bareilly, UP during February 6-7, 2020. Pp.104

- 2 Khulape S.A., Jana C., Dahiya S.S., Sahoo A.P. and Singh R.K. (2020). In-silico antigenic heterogeneity analysis for capsid protein VP1 of serotype Asia1 Foot and Mouth disease virus. *International Web-Conference on “New Trends in Agriculture, Environmental & Biological Sciences for Inclusive Development (NTAEBSID-2020)”* Organized by Agro Environmental Development Society (AEDS), India held during 21-22 June, 2020. Pp-109
- 3 Khulape S.A., Biswal J.K., Jana C., Kumar M, Mohapatra J.K, Singh R.K. and Mishra B.P. (2020). Foot and Mouth Disease sero-surveillance at buffer area of Reserve Forests in Uttarakhand. *WILDCON2020 (Online International Conference)* organized by Wildlife research and Training Centre, Gorewada Rescue Centre Nagpur in association of Indian Zoos and Wildlife Veterinarians, Bareilly held during 18th -20th December, 2020. Pp-231
- 4 Jana C., Khulape S.A., and Subramaniam S. (2020). Evaluation of the virucidal efficacy of citric acid against Foot-and-mouth disease

virus in BHK21 cell line, in 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’, organized jointly by Department of Veterinary Pathology, NVC, Maharashtra Animal and Fishery Sciences University, Nagpur- 440006, India and Indian Association of Veterinary Pathologists and Indian College of Veterinary Pathologists during 26-29th December, 2020.Pp 99-100

Popular articles

- 1 Ranjan R., Biswal J.K. and Gupta M.K. (2020) Examination of milk: A new approach of handling Bovine Mastitis. *PashudhanPrahare*. September 26, 2020. <https://www.pashudhanpraharee.com/examination-of-milk-a-new-approach-of-handling-bovine-mastitis/#comment-4604>.
- 2 Sahoo N.R. (2020) Odishare Ghusuri Palan. *Prani Bikas Dhara*. 2020 (04): 20-22

5.0

Research Projects

Table 14: List of research projects carried out during 2020

S.No.	Title of the Project	Name of the PI & Associates	Duration	Funding
1.	Foot-and-mouth disease virus surveillance at the wildlife-livestock interface	Ranjan R (PI) Biswal JK	2019-21	Institute
2.	Development, standardization and quality control of biosecurity procedures at BSL3+Ag laboratory of International Centre for Foot-and-mouth disease virus	Ranjan R (PI) Biswal JK	2019-22	Institute
3.	Development of DIVA-compatible live-attenuated vaccine candidate strain for FMDV serotype O	Biswal JK(PI) Saravanan S Ranjan R	2019-21	Institute
4.	Development and in vitro characterization of thermostable vaccine candidates for FMDV serotypes Asia1 and A	Biswal JK(PI) Saravanan S Khulape SA	2019-21	Institute
5.	Heterologous expression of FMDV genome regions and proteins	Khulape SA(PI) Jana C Biswal JK Ranjan R	2019-21	Institute
6.	Study of vaccine induced antibody response in livestock in organized herd	Rout M(PI) Mohapatra JK	2019-21	Institute
7.	Generation of monoclonal antibodies against recombinant FMDV polyprotein 3AB and their application in immunodiagnosis	Mallick SR(PI) Sahoo AP Biswal JK Ranjan R	2019-21	Institute
8.	Use of calcium phosphate nanoparticles for the generation of thermostable vaccine candidate against FMDV serotype O	Biswal JK(PI)	2020-22	Institute
9.	Host genetic factors affecting FMD vaccine response in calves	Sahoo NR(PI) Mohapatra JK Biswal JK Rout M	2020-22	Institute
10.	Association of Foot and Mouth disease virus vaccine induced immune response with reproductive status and production performance of bovines in organized herd.	Mallick SR(PI) Mohapatra JK	2020-22	Institute
11.	Antigenic and Genetic characterization of foot and mouth disease virus serotype O from India during 2020-21.	Dahiya SS(PI) Saravanan S Mohapatra JK	2020-21	Institute
12.	Antigenic and Genetic characterization of foot and mouth disease virus serotype A from India during 2020-21.	Mohapatra JK(PI) Rout M	2020-21	Institute
13.	Genetic and antigenic characterization of Foot and Mouth Disease virus serotype Asia1 during 2020-21	Biswal JK(PI) Khulape SA	2020-21	Institute

S.No.	Title of the Project	Name of the PI & Associates	Duration	Funding
14.	FMD virus isolation and maintenance of virus repository	Dahiya SS(PI) Rout M Mohapatra JK Khulape SA	2020-21	Institute
15.	Epidemiology of Foot and Mouth Disease in small ruminants and pigs in India during 2020-21.	Rout M(PI) Mohapatra JK Saravanan S	2020-21	Institute
16.	Production, standardization and supply of diagnostic reagents for FMD virus diagnosis and surveillance during 2020-21.	Mohapatra JK(PI) Sahoo AP Khulape SA Dahiya SS Biswal JK Jana C Saravanan S	2020-21	Institute
17.	Seromonitoring of pre and post vaccinal immunity against Foot and Mouth Disease under NADCP (2020-21).	Saravanan S(PI) Sahoo AP Mohapatra JK	2020-21	DAHD-NADCP
18.	Serosurveillance in bovines under NADCP (2020-21).	Mohapatra JK(PI) Saravanan S Rout M Sahoo AP Ranjan R Mallick SR	2020-21	DAHD-NADCP
19.	FMD virus diagnostic service and serotype identification	Mohapatra JK(PI) Biswal JK Dahiya SS Rout M	2020-21	Institute
20.	FMD vaccine quality control under NADCP	Sahoo NR(PI) Mohapatra JK Saravanan S Sahoo AP Rout M Dahiya SS	2020-21	DAHD-NADCP
21.	Surveillance of FMD and vaccine effectiveness study within 20 km radius of ICFMD, Arugul, Bhubaneswar	Rout M(PI) Mohapatra JK Sahoo NR Saravanan S	2020-22	Institute
22.	Production of anti-FMDV Hyper-immune sera in rabbits and guinea pigs for FMD virus diagnosis and seromonitoring	Sahoo AP(PI) Sreenivasa B P Saravanan S Mohapatra JK Khulape SA	2020-21	Institute
23.	Transmission Electron Microscopy as a tool in diagnostic pathology and research for Foot-and-mouth disease virus	Ranjan R(PI)	2020-22	Institute
24.	Evaluation of efficacy of disinfectants and cleaners against Foot and Mouth Disease virus on environmental surfaces	Jana C(PI) Khulape SA Saravanan S	2020-22	Institute
25.	Establishment of Institute Technology Management Unit	Mohapatra JK (PI)	2020-21	ICAR-NAIF

6.0

Education and training including human resource development

ICAR-DFMD at its ICFMD, Bhubaneswar centre organized 2-3 days hands on training programme on 'FMD Serosurveillance using DIVA indirect ELISA' in three batches. A pool of 7 trained personnel from state FMD centres located in different states was created to undertake the task of serosurveillance. The DIVA kit was provided to each centre at the end of the training. ICAR-DFMD will continue to monitor the testing activity and will

be involved in trouble shooting of any issue arising from time to time for active capacity building in the country. Imparted hands on training on 'Solid Phase Competitive ELISA (SPCE)' and sampling strategies and aspects of FMD seromonitoring to a Veterinary officer from Regional FMD centre, Hyderabad, Telangana during 17-03-2021 to 20-03-2021 at National Seromonitoring Laboratory of ICAR-DFMD, Bengaluru (Table 15)

Table 15: Details of training provided during 2020

S. No.	Institute/Organization	No. of persons trained	Period of training	Duration (Days)	Type of training
1.	VBRI, Labbipet, Vijayawada, Andhra Pradesh	2	10.02.2020 to 11.02.2020	2	FMD Serosurveillance using DIVA indirect ELISA
2.	FMD Collaborating Centre, A.D.R.I., Cuttack, Odisha	3	24.02.2020 to 26.02.2020	3	FMD Serosurveillance using DIVA indirect ELISA
3.	FMD Collaborating Centre, Hyderabad, TSVBRI, Telangana	2	01.12.2020 to 03.12.2020	3	FMD Serosurveillance using DIVA indirect ELISA
4.	FMD Collaborating Centre, Hyderabad, TSVBRI, Telangana	1	17-03-2021 to 20-03-2021	4	FMD Serosurveillance using SPCE

Conferences, workshops, seminars, summer /winter schools, short courses, trainings, etc. participated & convened

7.0

7.1 Participation of Scientists

A. Symposium/Seminar

S. No.	Name of Symposium/Seminar	Name of Scientists Attended
International		
1.	Webinar on “A Primer on the WHO Classification of Lymphoma” on 24.07.2020 organized by Bruce H. William, Davis Thompson Foundation	Dr R. Ranjan
2.	Webinar on “Patterns of lung injury” on 31.07.2020 organized by Bruce H. William, Davis Thompson Foundation	Dr R. Ranjan
3.	Virtual Seminar on Chronic hepatitis in animals” on 7th August 2020, organized by Bruce H. William, Davis Thompson Foundation.	Dr R. Ranjan
4.	Webinar on “Hematopathology and field diagnosis of commonly prevalent tick-borne diseases of bovines in India” on August 8, 2020 organized by Carus Laboratory Private Limited.	Dr R. Ranjan
5.	Webinar on Autopsy, Histology, and Pathology of the American Lobster” on 14 th August 2020, organized by Bruce H. William, Davis Thompson Foundation	Dr R. Ranjan
6.	Online international seminar on “Diagnostic Veterinary Pathology” organized by Department of Veterinary Pathology, Madras Veterinary College, Chennai on 12 th September, 2020	Dr R. Ranjan Dr Khulape SA
7.	Virtual 20th Davis-Thompson Diagnostic Pathology Symposium “Global Animal Health and Working in Development” in conjunction with the 63rd Annual AAVLD Annual meeting on 15.10.2020 organized by Davis Thompson Foundation.	Dr R. Ranjan

S No	Name of Symposium/Seminar	Name of Scientists Attended
National		
1.	10 th National Conference on One Health approach to prevent Vector borne Zoonotic diseases of public health importance jointly organized by Millennium India Education Foundation, Safdarjung Hospital, New Delhi and Heart care foundation of India, New Delhi held on 6 th July, 2020.	Dr A.P.Sahoo
2.	Webinar on Microbiome, Immunity and Vaccine organized by IAVMI on August 30, 2020	Dr Saravanan S
3.	Webinar on response of DBT's Autonomous Institutes to COVID-19 (Part -II) on Sept 10 th 2020.	Dr J.K. Biswal
4.	International Webinar held on September 20 th , 2020 organized by Association of Microbiologists of India.	Dr A.P.Sahoo
5.	National Webinar on "Physiological spectrum to augment livestock production under enigmatic COVID-19 scenario" organized by Departmentment of veterinary Physiology, CVSc, AAU, Khanpara, Guwahati, Assam-781022 on 25 th September 2020	Dr S Mallick

S No	Name of Symposium/Seminar	Name of Scientists Attended
6	Webinar on, "AMR Mitigation for Food Safety - ONE HEALTH" on October 30, 2020 organized by Ayurvet Research Foundation, Department of Animal Husbandry and Dairying, Government of India and SVPUAT, Meerut	Dr Saravanan S
7.	National Webinar on "Advancement in Veterinary Diagnosis-A Journey in Veterinary Pathology" on 14.10.2020, organized by Rajasthan University of Veterinary and Animal Sciences, Bikaner and Indian Association of Veterinary Pathologist	Dr R. Ranjan
8.	Online webinar on response of DBT's Autonomous Institutes to COVID-19 (Part -III) on Oct 15 th 2020.	Dr J.K. Biswal
9.	Webinar on Biosafety and Biocontainment Requirements for Biopharma Research and Manufacturing on Oct 15 th 2020.	Dr J.K. Biswal
10.	Webinar on "Mammary gland biology and pathology: A treasure trove of research opportunities for scientists and vets on 19 th Oct 2020.	Dr J.K. Biswal
11.	EHS Webinar 3- Waste Management in Biopharmaceutical Sector: An Integrated Approach organized by National Biopharma Mission on 29.10.2020	Dr R. Ranjan
12.	National Webinar on "Climate Resilient Livestock Production: Opportunities and Threat" organized by ICAR-National Institute of Abiotic Stress Management, Baramati, India on November 03, 2020.	Dr R. Ranjan
13.	National Webinar of IVS on Transboundary and emerging infectious disease: challenges in diagnosis and control" held on November 18 organized by Department of Veterinary Microbiology, College of Veterinary Science, Assam Agricultural University, Assam.	Dr Saravanan S
14.	National webinar on "Metabolic Diseases of Importance in Dairy animals" organized by Department of Veterinary Medicine, PGIVER, Jaipur and INTAS Animal Health	Dr Khulape SA

B. Training/Workshop

S. No.	Name of Training/Workshop	Name of Scientists Attended
International		
1.	Online course on Vaccine, Vaccination and Post Vaccination Monitoring organized by the EuFMD during 26 th February to 8 th April 2020	Dr JK Mohapatra Dr Saravanan S
2.	Online courses "Introduction to Foot-and-Mouth Disease", "What is the Progressive Control Pathway?", "Introduction to Progressive Control Pathway" organized by the European Commission for the Control of Foot-and-Mouth Disease (EuFMD) on April 2020	Dr A.P. Sahoo
3.	Online workshop on Decontamination and hazard: waste management given by Miss Cecelia V Williams, Global Chemical & Biological Security, Sandia National Laboratories, Albuquerque, New Mexico. Organized by Indian Veterinary Association dated on 12.07.2020 through Zoom Cloud Platform with meeting ID: 876 8945 2185.	Dr R. Ranjan
4.	Online course on "Molecular Docking" at portal https://www.udemy.com/ on 24 th December, 2020	Dr Khulape SA
5.	Online course on Parametric Data Analysis" organized by Research Smiths from 28 th to 30 th August, 2020	Dr Khulape SA
6.	OIE/FAO FMD Laboratory network meeting during 1-2 December 2020 through Video Conferencing	Dr J.K. Mohapatra Dr Saravanan S

S. No.	Name of Training/Workshop	Name of Scientists Attended
National		
1.	IV Workshop on ICAR Research Data Repository for Knowledge Management (KRISHI) for Nodal Officers" at New Delhi organized by ICAR-IASRI during 06-07 Feb 2020	Dr R. Ranjan
2.	One day online workshop on "Training Management Information System (TMIS) for HRD Nodal Officers of ICAR" organized by Human Resource Management Unit, ICAR, KAB-II, Pusa, New Delhi-12, on 08 May, 2020	Dr R. Ranjan
3.	COVID-19 RT-PCR training at ICMR- Regional Medical Research Center Bhubaneswar on 5 th May 2020	Dr S Mallick
4.	Online certificate course offered by WHO, on Emerging respiratory viruses, including COVID-19: methods for detection, prevention, response and control. June 7, 2020	Dr R. Ranjan
5.	Online certificate course offered by WHO, on Standard precautions: Waste Management. June 8, 2020	Dr R. Ranjan
6.	Online two-week Faculty development program on "COMPREHENSIVE E-LEARNING TO E-TRAINING MODULE" from 25 th May- 05 th June 2020 organized by Teaching Learning Centre, Ramanujan College, University of Delhi.	Dr Khulape SA
7.	Online one-week Faculty development program on "OPEN-SOURCE TOOLS FOR RESEARCH" from 08 th June- 14 th June 2020 organized by Teaching Learning Centre, Ramanujan College, University of Delhi	Dr Khulape SA
8.	COVID-19 testing training at Virus Research Diagnostic Laboratory (VRDL), Government Medical College, Haldwani on 24 th -25 th June, 2020	Dr Khulape SA
9.	Online National Workshop on "Research Methodology: Concepts & Applications" organized by the Directorate of Students Welfare, MaharanaPratap University of Agriculture and Technology, Udaipur, Rajasthan during 26-27 June, 2020 under Institution Development Plan, National Agricultural Higher Education Project (NAHEP) of Indian Council of Agricultural Research (ICAR), New Delhi.	Dr R. Ranjan
10.	Management Development Program (MDP) on Orientation-cum-Awareness and implementation of ABS Guidelines during 7-10 July, 2020 (Online) organized by NAARM	Dr Saravanan S
11.	Online two-week Faculty development program on "ADVANCED CONCEPTS FOR DEVELOPING MOOCS" from 02 nd - 17 th July 2020 organized by Teaching Learning Centre, Ramanujan College, University of Delhi	Dr Khulape SA
12.	Online course on "GETTING STARTED WITH DATA ANALYSIS ON MICROSOFT EXCEL" organized by Ramanujan College, University of Delhi in collaboration with Mathematical Science Foundationfrom 04 th -17 th August2020	Dr Khulape SA
13.	Delhi Technological University sponsored one-week international e-workshop on bioinformatics held on December 14-18, 2020	Dr Khulape SA
14.	Online Virtual Workshops focusing on Regulatory Approaches for Agricultural and Food/Feed Applications of Animal Biotechnology organized by International Service for the Acquisition of Agri-biotech Applications (ISAAA), USDA in seven sessions (Session I: Sept 8-9, 2020; Session II: Sept 23-24, 2020; Session III: Oct 7- 8, 2020; Session IV: Oct 19-22, 2021; Session V: Nov 4-5, 2020; Session VI: Nov 18-19, 2020; Session VII: Dec 1-3, 2020).	Dr A.P.Sahoo
15.	COVID-19 RT-PCR training at ICMR- Regional Medical Research Center, Bhubaneswar on 6 th May 2020	Dr Mohapatra JK Dr Sahoo NR

7.2 Conferences, workshops, seminars, summer /winter schools, short courses, trainings convened

S No	Name of Conference / workshop / seminar	Date of Start/Close	Number of Participants
1.	28 th Annual Review Meeting (ARM) of All India Coordinated Research Project on Foot and Mouth Disease (Virtual)	06-11-2020	~50

8.0

Revenue Generation

The institute provided testing services for FMD Seromonitoring using SPCE to measure anti-FMDV structural antibody titre to private bull semen station and dairy farms, and also supplied DIVA ELISA Kit to vaccine manufactures. A total of Rs 24,45,877 was generated in the year 2020, with the majority of the money coming from testing services (Rs 23,65,438).

Empowerment of Women and mainstreaming gender issues

The institute observed Mahila Kisan Diwas at Pangari village of Nainital district, Uttarakhand on 15.10.2020. A total of 30 farm women participated in this programme. The theme, objectives of the programme and contribution of women in Indian agriculture were highlighted. Dr C. Jana, Pr. Scientist focused the role of women in livestock farming at hill region. He emphasized the contributions of institute on animal health care and disease management. He also stressed upon wholesome milk production by women at rural areas of hilly region. The Scientist-In-Charge, ICAR-CITH, Mukteswar briefed about

the kitchen garden and cultivation of high value fruit crops at hill region for better house-hold nutrition and family income. Progressive farm women shared her experience in livestock farming at hill region. Queries namely, infertility of livestock, poor milk yield, tick infestation, worm infection, vaccination schedule of cattle and feed management of FMD infected cattle were addressed during interaction with the participants. Extension literature, mask, animal shed disinfectant were distributed among all participants.

Celebration of Mahila Kisan Diwas at Pangari village, Nainital by ICAR-DFMD



Pandemic COVID-19 crisis: Timely diagnostic service rendered by ICAR-DFMD

India is confronting the challenge of pandemic COVID-19 bravely with the help of its COVID warriors. In these unprecedented crisis hours, timely diagnosis of infection is pivotal to the 'test-track-treat' mechanism of containing the disease. It was 16th May 2020 – when the COVID-19 cases in the country were on a surge and death toll was scary in the European countries and the USA. On the request of Government of Odisha and the approval of ICAR and ICMR, RT-PCR testing to detect nCoV-2 genome in swab samples referred from various districts of Odisha commenced in the BSL-3 Containment Laboratory of International Centre for FMD (ICFMD) under ICAR-Directorate of Foot and Mouth Disease (ICAR-DFMD), Arugul, Bhubaneswar. A small group of 8 young scientists under the initiative, guidance, and motivation of Director, ICAR-DFMD joined hands to contribute to this noble cause. Gradually, the testing team got expanded with the active participation of scientists, vets, students from other ICAR Institutes such as ICAR-CIFA, ICAR-NRRI, ICAR-CARI, and ADRI, FARD, Govt. of Odisha, and OUAT. The testing activity at ICFMD was coordinated by Hon'ble Vice

Chancellor, OUAT, Bhubaneswar and supported by the Department of Health & Family Welfare, Govt. of Odisha. The ICFMD COVID testing team has tested 67,905 samples by RT-PCR. Samples from seven districts such as Puri, Gajapati, Khordha, Nayagarh, Boudh, Sonepur and Nuapada were received and tested at ICFMD. Results obtained at ICFMD have shown a perfect concordance (100%) with that generated at the QC testing laboratory ICMR-RMRC, Bhubaneswar that stands in support of the credible quality diagnosis. The Institute's timely contribution towards COVID-19 diagnostic service saw the famous 'PuriRathyatra' conducted safely. ICFMD was one of the four ICAR Institutes involved in COVID testing that responded to the need of the hour.

It is a long drawn battle against COVID-19 and the invisible enemy is yet to surrender. However, the valiant selfless team came forward and worked relentlessly. It's a battle that is being fought on multiple fronts, starting from the policy makers to Anganwadi workers at the grass root level. ICAR-DFMD-ICFMD salutes the indomitable spirit and valor of each and every COVID warrior!



Miscellaneous activities

Distinguished Visitors

11.0

13.1 Swachh Bharat Abhiyan

Swachhata banners were placed at prominent places including entrance gate for public awareness. Swachhata pledge was taken by the staff at all 3 campuses of the institute. Cleaning of office and digitalization of office records was done as a continuous activity. Plantation of saplings was done

by scientists and staff. Removal of waste from campus, sanitization of office premises, cleaning of animal shed area, water storage bodies and internal roads were carried out. Signboards depicting creation of “No plastic Zone”/plastic free campus and activities related to that was undertaken. Composting of canteen kitchen waste was demonstrated and swachhata awareness was created among staff.



13.2 Vigilance Awareness Week -2020

As per the CVC circular No.020/VGL/036/459673, dated 08.09.2020 and ICAR letter No.104-1/2020-Vig-I, dated 13.10.2020, the period from 27th October 2020 to 2nd November 2020 was observed as "Vigilance Awareness Week". The theme of the year was "SATARK BHARAT, SAMRIDDH BHARAT (Vigilant India, Prosperous India)". It commenced with an

integrity pledge administered to all officials and support staff gathered in front of the institute building of ICAR-DFMD-ICFMD on 27th October 2020 at 11.00 AM. The scientists and staff of DFMD, Mukteswar, National Seromonitoring Laboratory, Bengaluru were also informed to observe the vigilance awareness week following COVID-19 guidelines e.g. keeping social distancing and wearing masks during the time. As per the instruction, various competitions were conducted during Vigilance Awareness Week in the institute.



13.3 हिन्दी प्रखराड़ा



Distinguished Visitors

1. Hon'ble Secretary, Fisheries and Animal Resource Development (FARD)Department, Govt. of Odisha visited ICFMD, Bhubaneswar in the month of May 2020
2. Hon'ble Vice-Chancellor, Odisha University of Agriculture and Technology (OUAT), Odisha
3. visited ICFMD, Bhubaneswar on 08.05.2020
4. Sh. Amitabh Kant, CEO, NITI Ayog visited ICAR-DFMD, Mukteswar on 06-12-2020
5. Mr Akhilesh Kumar, GB member of ICAR visited the Institute on 29.11.2020



12.0

Various Committees

14.1 Research Advisory Committee (RAC)

Name & Designation	Role
Dr C. Renuka Prasad, Former Vice Chancellor, KVAFSU, Bidar	Chairman
Dr. Lal Krishnan, Former ADG (AH), ICAR	Member
Dr. S. K. Das, Former Prof. and Head, Department of Microbiology, College of Veterinary Science, Assam	Member
Dr. S.K. Yadav, Former Prof. and Head, Department of Microbiology, DUVASU, Mathur, UP	Member
Dr V A Srinivasan, Former Advisor, NDDB	Member
Dr. Bhaskar Sharma, Former National Professor, ICAR-IVRI, Bareilly, UP	Member
Director, ICAR-DFMD	Member
Dr. Ashok Kumar, ADG (AH), ICAR, KrishiBhavan, New Delhi-110 001	Member
Dr. Sanjeev Gupta S/o ShNand Kumar Gupta, R/o Van Vihar Colony, Ballupur, Dehradun	Member
Shri Tara Dutt Joshi S/O Sh. ManoharDutt Joshi, R/OTiwari Nagar, Bindukhatta,Nainital	Member
Dr. Saravanan, S., Sr. Scientist, ICAR-DFMD	Member Secretary

14.2 Quinquennial Review Team (QRT)

Name & Designation	Role
Dr. S. K. Garg, Former Vice-Chancellor, DUVASU, Mathura, Uttar Pradesh.	Chairman
Dr.K. Kumanan, Former Director of Research, TANUVAS, Chennai	Member
Dr.Mukund R. Gajendragad, Former Scientist Emeritus, ICAR-NIVEDI, Bangalore	Member
Dr. A. Chakraborty, Former Director of Research, AAU, Assam	Member
Dr.Ravindra Sharma, Former Director of Research, LUVAS, Haryana	Member
Dr. R. Somvanshi, Former Scientist Emeritus, ICAR-IVRI, Bareilly	Member
Dr. C. Jana, Pr. Scientist, ICAR-DFMD, Mukteswar	Member Secretary

14.3 Institute Technology Management Committee (ITMC)

Name & Designation	Role
Director, ICAR-DFMD	Chairman
Dr Priyabrata Swain, Pr Scientist, ICAR-CIFA, Bhubneswar	External Member
Dr Saravanan S, Sr Scientist, DFMD	Member
Dr Shyam Singh Dahiya, Scientist, DFMD	Member
Dr J K Mahapatra, Sr Scientist, DFMD	Member Secretary

14.4 Institute Management Committee (IMC)

Name & Designation	Role
Director, ICAR-DFMD	Chairman
Dr. Ashok Kumar, ADG (AH), ICAR, New Delhi-110 001	Member
Dr. S.S. Patil, Principal Scientist, NIVEDI, Bengaluru	Member
Dr. Sai Kumar, Pr. Scientist & I/C PME, IVRI, Izatnagar.	Member
Dr. A. Sanyal, Joint Director, ICAR-IVRI, Bengaluru	Member
Dr. Jyoti Misri, Pr. Scientist, ICAR, New Delhi	Member
Dr. Sanjeev Gupta S/o Shri Nand Kumar Gupta, Van Vihar Colony, Bollupur, Dehradun	Member
Shri Tara Dutt Joshi, S/o Shri ManoharDutt Joshi, Bindukhatta, Nainital	Member
AAO, DFMD	Member Secretary

14.5 Institutional Animals Ethics Committee (IAEC)

Name & Designation	Role
Dr JajatiKeshariMohapatra, Sr. Scientist, ICAR-ICFMD	Biological Scientist (Chairperson)
Dr. Prakash Kumar Sahoo, ICMR-Regional Medical Research Centre, Bhubaneswar	CPSEA Nominee
Shri. Narendra Kumar Parida , The College of Pharmaceutical Sciences, Bhubaneswar	Link Nominee
Dr. S. Parthasarathy Fisheries & Animal Resources Development Dept, Govt of Odisha, Bhubaneswar,	Scientist from outside of the Institute
Shri AmulyaNayak PFA, Jagatsinghpur	Socially aware Nominee
Dr. Aditya Prasad Sahoo, ICAR-DFMD	Scientist from different biological discipline
Dr. Jitendra Kumar Biswal, ICAR-DFMD	Veterinarian
Dr. SmrutirekhaMallick, ICAR-DFMD	Scientist In-charge of Animal House Facility (Member Secretary)
Dr. Rajeev Ranjan, ICAR-DFMD	

14.6 Institutional Biosafety Committee (IBSC)

Name	Position
Director, ICAR-DFMD	Chairman
Dr Biswajit Mishra, Biosafety Officer, Bhubaneswar, Odisha	Biosafety officer
Dr Sandeep Bhatia, Outside Expert, Bhopal, Madhya Pradesh	Outside Expert
Dr SidharthaGiri, Scientific E, ICMR-RMRC, Bhubaneswar	DBT nominee
Dr JajatiKeshariMahapatra, Sr Scientist, DFMD	Internal Member
Dr Jitendra Kumar Biswal, Scientist, DFMD	Internal Member
Dr Shyam Singh Dahiya, Scientist, DFMD	Internal Member
Dr Rajeev Ranjan, Scientist, DFMD	Member Secretary

Staff Position

13.0

S.No.	Name	Designation
1.	Dr Rabindra Prasad Singh	Director (RMP)
Scientific staff		
Veterinary Microbiology		
2.	Dr Jajati K Mohapatra	Senior Scientist
3.	Dr Saravanan Subramaniam	Senior Scientist
4.	Dr Shyam S Dahiya	Scientist (Sr Scale)
Veterinary Pathology		
5.	Dr Chandrakanta Jana	Principal Scientist
6.	Dr Manoranjan Rout	Senior Scientist
7.	Dr Rajeev Ranjan	Scientist (Sr Scale)
Animal Physiology & Biochemistry		
8.	Dr Jitendra K Biswal	Scientist (Sr Scale)
9.	Dr Smrutirekha Mallick	Scientist
Animal Genetics & Biotechnology		
10.	Dr Nihar R Sahoo	Senior Scientist
11.	Dr Aditya P Sahoo	Senior Scientist
12.	Dr Khulape S Ashok	Scientist (Sr Scale)
Technical staff		
13.	Sh. Nayan Sanjeev	T-4 (Lab)
14.	Sh. S.L.Tamta	T-1 (Lab)
Administrative staff		
15.	Sh. Tara Kumar	AAO
16.	Sh. R.N.Sahoo	Assistant
17.	Sh. Ravi Chaudhary	Junior Stenographer

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