



2012

Scientific Developments and Technical Challenges in the Progressive Control of FMD in South Asia

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Scientific Developments and Technical Challenges in the Progressive Control of FMD in South Asia

Summary

The Conference was jointly organized by the Indian Council of Agricultural Research (ICAR), Department of Animal Husbandry, Dairying and Fisheries (DADF) and Food and Agriculture Organization of the United Nations (FAO), under the broad umbrella of FAO-OIE Global Framework for the Progressive Control of Transboundary Animal Diseases (GFTADs). The South Asia GFTADs has recognized three priority diseases: FMD, PPR and HPAI. The Scientific Conference was attended by 600 partners from across the world, and senior officials of ICAR, FAO, Vice Chancellors of State Agricultural Universities, Directors of Animal Husbandry Departments of State Governments, representatives of industry and veterinary professionals participated in the Conference. The review of scientific developments and technical outcomes of this conference will feed into the upcoming 2nd Global FMD conference jointly organised by FAO and OIE to be held in Thailand in June 2012.

The position of the FAO, OIE and the Ministry of Agriculture and Food Processing, Government of India, was provided at the Opening of the Conference. FMD impacts the rural and national economies of SAARC countries at every level, affecting local livelihoods, food security and international trade; effective national veterinary services working towards regional goals and a common vision are key elements for both regional and global progress; and keeping in view the huge economic losses caused by FMD in India, the Government of India has embarked on a long term national control programme for FMD, from 2003, which by 2011 was extended to 221 districts, and is expected to expand to most of the country in the 12th five year plan (2013-17).

Scientific and technical progress in South Asia will play a vital role in bringing forward the promise of effective control of FMD in both India and South Asia, and investment in this sector was urged by the Conference, as a important part of realising the global strategy for control of FMD.

CONFERENCE OUTCOMES

Considerations and recommendations

Considering that:

1. Livestock, particularly cattle, buffaloes and small ruminants have a great importance to food security, nutrition and livelihoods in South Asia, and that FMD has a wide distribution and has a high impact at household and national levels;
2. Most South Asian countries are at common risk from the closely related FMDV serotypes in Pool 2 that circulate and evolve continuously within the region, and which necessitate a regional approach to selection and use of vaccines against the epidemic strains;
3. National programmes against FMD are at risk from emergent threats from within the region and beyond, requiring close and continuous channels of communication;
4. National and regional capacity is being strengthened to improve the feasibility and impact of FMD control programmes;
5. SAARC member states under the FAO/OIE GF-TADS umbrella, have identified FMD as one of the priority diseases for the sub-region, and that FAO has established a Regional Support Unit in Kathmandu in collaboration with SAARC Secretariat to manage TADs control in the sub-region;
6. Under the Regional Support Unit, SAARC member states have developed mechanisms to improve regional cooperation and collaboration through establishment of the epidemiology centre, networks of laboratories, and epidemiology and surveillance, and supporting regular CVO meetings in the region;
7. FAO, with OIE, has developed the Progressive Control Pathway for FMD (PCP-FMD) to assist countries to develop sustainable, feasible FMD control programmes;
8. That in the recent (July 2011) Meeting of the Regional Epidemiology and Surveillance network recommended the PCP be used to develop national programmes in each SAARC country as part of a Regional Roadmap towards FMD control;
9. The rapid development of research capacity in South Asia, and the potential of the research being conducted by institutions in South Asia for reducing the cost and complexity, and increasing the effectiveness, of control programmes;
10. The SAARC member states have developed a common vision for the progressive control of FMD, and a 2020 Roadmap for FMD control;
11. The Government of India has embarked on a large-scale country-wide control programme through vaccination, and its potential impact on the regional FMD situation;

12. FAO and OIE are developing a Global Strategy for FMD Control, to be presented at the Second Global FMD Conference in June 2012 in Thailand, which foresees a strengthening of national efforts for progressive control, and greater regional co-ordination and backstopping, and greater political commitment from countries and international donor community;
13. The Progressive Control of FMD is a regional public good, and that the PCP-FMD may assist countries to develop, in parallel, progressive control plans for other high impact, transboundary animal diseases.

The Conference therefore recommends that:

1. SAARC member countries commit to develop their national strategies, and to strengthen the national capacity to identify and optimize control measures that rapidly provide benefits to stakeholders, based on a thorough assessment of the socio-economic impacts of FMD, and on the sustainability, the benefits and feasibility of control programmes;
2. Communication and public awareness efforts be strengthened to describe the importance of FMD based on socio-economic impact data, and incentives for FMD control at country level are clearly defined to promote greater 'buy in' and ownership of the national control programmes;
3. National FMD control programmes be used as an opportunity and entry point for implementing control of other high impact infectious diseases;
4. Countries commit to the regional approach to controlling FMD, and continue to engage with the Regional Support Unit (RSU) to improve co-ordination, communication and improve the regional capacity to monitor progress and address technical constraints;
5. An official regional coordination mechanism specific for FMD control be established under the existing RSU to provide a more dedicated support to include harmonization of control measures that would include development of national and regional strategies, defining regional policies on vaccines, diagnostics, animal movement, establishment of a regional data base and mechanism for disease information sharing;
6. There be continued investment in capacity in the veterinary services in the region to develop, manage and monitor programs for the progressive control of transboundary animal diseases, and making use of the PVS Tool of the OIE and the PCP-FMD to assist in identification of necessary capacities;
7. Investment in research be scaled up at national and regional levels, to address the priorities in the agenda for FMD research identified at this Conference, and in particular to bring forward the development of vaccines with a longer duration of immunity, greater stability, and increased cross-protection against emerging lineages, that can increase the cost-effectiveness of control programmes;
8. That the countries of the region and the international community take note of the potential of new technical developments, and regional co-ordinated actions, and recognize the need

for sustained effort on both these fronts to bring forward the benefits of FMD control at all levels;

9. Development of a regional FMD epidemiology and surveillance capacity to support research in improving understanding of the ecology and genetic evolution, and better definition of the infection and transmission dynamics of FMD viruses, designing control programmes and conducting applied research relevant to regional and national FMD control programmes;
10. Vaccination programmes are based on comprehensive assessment that is holistic, cross-sector and multi-disciplinary, and accompanied by rigorous and independent assessment of vaccine quality, by routine use of post-vaccination monitoring (PVM) programmes that are appropriate to the PCP stage, and evaluation processes that address the concerns of major stakeholders on the impact of programmes;
11. That through a public/private sector partnership, biological companies/vaccine manufacturers and the governments increase the production capacity of high quality vaccines and diagnostics to meet the demand of the region;
12. There be further development of nationally and regionally validated diagnostic tests that can be performed without high bio-containment, as part of the process of improving the use of FMD typing and post-vaccination monitoring as tools to improve national and local management of FMD control;
13. FAO and OIE, and international donor community, provide support to countries to embark upon sustainable national FMD control programmes within a regional co-ordinated approach (Roadmap).

REPORT OF THE CONFERENCE

Opening Session

The Conference was jointly organized by the Indian Council of Agricultural Research (ICAR), Department of Animal Husbandry, Dairying and Fisheries (DADF) and Food and Agriculture Organization of the United Nations (FAO) and attended by the 600 partners from across the world. Senior officials of ICAR, FAO, Vice Chancellors of State Agricultural Universities, Directors of Animal Husbandry Departments of State Governments, representatives of industry and veterinary professionals were present in the conference. The Scientific programme of the Conference is given in **Annex 1**.

Dr Juan Lubroth, Chief Veterinary Officer (CVO), FAO-Rome welcomed the two ministers, dignitaries and participants. He thanked ICAR for the partnership in organizing such an event in India and said the review of scientific developments and technical outcomes of this conference will feed into the upcoming 2nd global FMD conference jointly organised by FAO and OIE and to be held in Thailand this June. FMD is not a rich country's problem, the impact of FMD in local level impacts local livelihoods, food security and trade embargo. This international conference is being organized under the broad umbrella of FAO-OIE Global framework for the progressive control of transboundary animal diseases (GFTADs) and South Asia GFTADs has recognized three priority diseases which are FMD, PPR and HPAI. He further stressed that a long term road map of FMD control is required for the countries and we can build on the success and the experience of rinderpest eradication.

Dr Joseph Domenech, World Organization for Animal Health (OIE) Representative from France, mentioned that OIE is happy to support the conference. The socio-economic importance of FMD is huge in the intensive production systems and can hamper income generation. The first international conference of FMD was organised in Paraguay in 2009. The FAO-OIE and GFTADs are organizing the 2nd FMD conference in Bangkok in June this year. The regional goals and common vision are key elements for developing a global strategy. OIE strongly advocates for prevention and control against highly pathogenic emerging diseases.

Mr Rudhra Gangadharan, Secretary, DADF, Ministry of Agriculture and Food Processing said the organization of the conference was being discussed since December 2009 and that this conference is extremely important to India as the incidence of FMD, in terms of trade and commerce is huge. He continued saying "we have already eradicated rinderpest and in next few years we plan to control FMD to a large extent. It is something which requires united efforts to control the disease. We will be most willing to help any neighbouring country towards controlling FMD. We are grateful to FAO for having thought to organise this conference in India".

Dr S. Ayyappan, Secretary and Director General, ICAR gave an elaborative view of FMD control programme in India. He referred to all the key institutions like IVRI and PD-FMD at Mukteswar. PD-FMD is a FAO recognized laboratory and a new BSL-3 facility is coming up in Bhubaneswar, Odisha state. It is with these strengths and expertise that India has to control FMD. He mentioned that the experiences gained so far should be shared in this conference. "The challenge is huge and every time we talk of milk production the first thing said is FMD" he added. He

mentioned about mobile vaccination units, in line with polio vaccination, planned to cater to the needs of animals on move within the country and across the border and stressed that the ideas and inputs of the conference would feed to 12th five-year plan of India.

Mr Harish Rawat, Union Minister of State for Agriculture and Food Processing Industries was the chief guest. He mentioned that Indian economy is largely dependent on agriculture and livestock activities and their livestock population is the highest in the world. Production from animal Husbandry is the main source of income for marginal and poor farmers. Livestock promises numerous avenues for profit and income generation as well as socio-economic development. Once considered a subsidiary activity it has now become a serious business. Animal Husbandry, diary and fisheries play a major role in national economy in addition to providing essential nutrition and dietary protein. Prevalence of FMD after rinderpest is adversely affecting the performance of livestock development plans apart from affecting livestock related exports. The Indian government passed a law “The prevention and control of infectious and contagious diseases of animals Act, 2009” for the prevention, control and eradication of infectious and contagious diseases affecting animals. Keeping in mind the huge economic losses caused by FMD in the country the government started national control programme for FMD in 2003 in 58 districts. In 2010-11 the programme was extended to 221 districts. It is fully funded by the Government of India and continues in the 12th five year plan (2013-17). He stressed that India is determined to control FMD and hopes to increase productivity of livestock sector through this initiative. Mr Rawat released the souvenir and abstract book of the conference.

Dr K M L Pathak, Deputy Director General (Animal Sciences), ICAR started the proceedings and spoke about the background of organizing the conference in India. On behalf of Organizing Committee, Dr Gaya Prasad extended vote of thanks to the dignitaries and other eminent persons present at the function.

SESSIONS

1-2 Global and regional status of FMD

(Chairman: Dr Subhash Morzaria, FAO; Co-Chair: Professor. David Paton, Institute for Animal Health, Pirbright UK; Rapporteur: Dr Arvind Kumar)

The Session was structured to provide information on the activities, direction and needs of the various FMD reference laboratories in East, Southeast and South Asia, West Eurasia and the World Reference Laboratory.

Professor David Paton presented the activities of the Global System OIE/FAO FMD Reference Laboratories Network. The Network, which has 12 members (UK, Thailand, China, Russia, India, Botswana, Kenya, Brazil, Argentina, Republic of South Africa, the USA and Belgium) aims to understand global virus distribution and provide vaccine recommendations, and to improve the quality of laboratory testing carried out by international and national reference laboratories. The key activities of the Network include collection of sera and viruses and their characterization. In 2010, 38 countries submitted over 2300 samples from all over the world, and the conjectured global status of FMD was derived from their analysis. The main outputs of these activities were detailed analysis of the various virus isolates including serotyping, genetic characterization, strain identification, understanding the possible source of the viruses, and the results of the vaccine matching by serology and animal experiments. Some of the key activities of the network had been on harmonization of vaccine matching tests for the network laboratories and vaccine matching technology training workshop. The workplan for 2012 was also described as including a comprehensive review of vaccine matching, vaccination and assessing herd immunity, training and reagent needs. The network has an important role in the Global FMD Control programme and can offer regional focus, knowledge and experience, training and coordination. The need for increased and dedicated funding for the network was expressed as workload from high number of field samples had increased, and demand for training, proficiency testing and accreditation was high. The speaker emphasized that the network was the engine room of the Global Control Initiative.

The South Asia activities were presented by Dr Pattnaik. FMD is considered to be one of the most important infectious diseases of livestock in South Asia where there are over 600 million susceptible animals mainly cattle, buffalo, sheep, goats and pigs. The region is heavily dependent on livestock products for its food security. Within the South Asia region, six countries (Afghanistan, Bangladesh, Bhutan, India, Nepal and Pakistan), have three different serotypes of FMD virus circulating, of which serotype O is responsible for the majority of the outbreaks followed by serotypes Asia 1 and A. Maldives is free from FMD and Sri Lanka has only serotype O present. The strengths and various activities of the reference laboratory were described including laboratory competency in sero-diagnosis of FMDV, two-dimensional micro-neutralization and LPB-ELISA for vaccine matching, multiplex PCR and molecular typing for identification of lineage and sub-lineages, molecular epidemiology and virus evolution, complete genome sequence analysis to monitor recombination(s), generation of recombinant antigen and recombinant antibody, immunology, bioinformatics, and research and development in diagnostics and vaccines. He also described in detail the FMD situation in India, and showed that outbreaks occur throughout the year, with maximum numbers towards the end of the monsoon and post monsoon seasons. The vaccine matching exercise showed that all vaccine strains have maintained their appropriateness. He summarized the data on molecular epidemiology of the viruses in India, showing that the 'Ind2001'

strains of serotype O has spread to majority of states in Northern, Eastern, North-Eastern and Southern India. Next to 'Ind2001' lineage, Pan Asia II was responsible for sporadic outbreaks/cases in West Bengal, Arunachal Pradesh and Maharashtra. There were cases of FMD in cattle in Punjab caused by PanAsia I lineage. In case of serotype A, there was exclusive dominance of genotype 18 (VII), but grouped both in the non-deletion and the VP359-deletion sub-lineages. The Asia 1 field isolates were grouped with lineage C reiterating the supremacy of this lineage since 2005. He described briefly the FMD control programme in India and showed evidence of declining disease incidence over the last eight years. The challenges faced in improving the disease control in India included political will and lack of grass roots initiatives, limited investment from private sector, inadequate collaboration with global disease control partners, and weak recognition of the importance of livestock sector. He mentioned a regional South Asia approach to disease control, and a zonal approach with regular vaccination with good quality vaccines and sero-monitoring. He further suggested the establishment of SAARC FMD Control Commission to implement, monitor and evaluate the control program. The RLDL-FMD laboratory could offer training on FMD diagnosis, proficiency testing, supply of diagnostic kits, setting of FMD laboratory and referral diagnostic service in support of a regional approach.

The Southeast Asia presentation was made by Dr Thongtha of the OIE Regional Reference Laboratory (RRL) based in Pakchong, Thailand. This laboratory, which was originally a national FMD laboratory, was recently refurbished and upgraded to have a BSL3 containment laboratory, and was upgraded to the OIE RRL status for Southeast Asia. The laboratory has a range of technical capacity that includes FMD diagnosis by ELISA typing, virus isolation, LP ELISA, NS test and PCR; strain differentiation for vaccine selection and vaccine matching, molecular epidemiology, and production of diagnostic reagents. In addition, the RRL acts as a training centre and technology transfer centre in the region, establishes quality control system, provides proficiency testing and inter-laboratory comparison for national FMD laboratories of the ASEAN member states and promotes collaborative research work among various research institutions and international organizations such as OIE, FAO, WRL, AAHL and JICA. In 2011 the RRL received over 130 tissue samples and 9000 serum samples for analysis. The key research activities have been on development and production of defined FMD ELISA reagent kits, molecular epidemiology of FMD viruses isolated in Thailand and other Southeast Asian countries during 2010-2012, development of RT PCR method for the diagnosis of FMD virus, determining the disease status of FMD in elephants using sero-monitoring, and the studies on FMD status in sheep and goats in Thailand. The RRL is part of several FMD laboratory networks that includes 9 national laboratories, 8 regional laboratories and 8 other laboratories at a global level outside the Southeast Asia region. The RRL also maintains a continuing education programme for its staff through active participation in international training and conferences.

The presentation from China was made by Dr Jijin of the Lanzhou Veterinary Research Institute, which is also the OIE/China national FMD reference laboratory (CNFMDR.L), and covered a brief description of the CNFMDR.L, the national FMD situation, the currently used diagnostic techniques and the surveillance programme. The CNFMDR.L was established in 1958 and was recognized as an OIE reference laboratory in 2011. The laboratory represents one of the most important centres in China for FMD diagnosis, research and consulting services. The laboratory has the state of the art facilities to conduct molecular analysis, whole genome sequencing, generation of diagnostic reagents and vaccine matching capacity. The studies on virus isolation and surveillance have shown that from 2005 onwards, a total of 81 FMD outbreaks were detected of which 46 were of serotype Asia 1, the virus being of South Asia topotype, Group V, which closely resembled the

virus isolated in India in 1980s. Since 2009, there have been no outbreaks of FMD due to serotype Asia 1, and a number of outbreaks due to serotype A were detected; the virus sequences show close similarity to viruses isolated in Myanmar, Thailand and Laos. Since early 2012, no outbreaks of disease due to serotype A have been reported. The current threat of FMD is considered to be derived from serotype O, Mya-98 and PanAsia strains. The former strain affects mainly pigs, while the latter mainly affects cattle. The sequence data show that the virus has resemblance to a number of viruses isolated from outbreaks in Southeast Asia. The epidemiological studies show that the animal movement between Provinces in China is the main mode of transmission and spread of the disease. Thus for both O and A serotypes, sequence data implicate FMD endemic parts of mainland Southeast Asia as the source of FMD viruses that have caused recent outbreaks in East Asia. *In vitro* vaccine matching data from WRL indicates that currently available vaccine strains (A/May/97 and O/Manisa) should protect against representative isolates from these two serotypes. Separate information on the FMD situation in Hong Kong and Taiwan was also provided. Since joining the OIE SEACFMD Campaign, the PR China will participate actively in the PCP for FMD control, and has become part of the SEACFMD 2020 Roadmap.

The West Eurasia presentation was made by Dr Aktas, from the FAO Sub-regional Office based in Ankara, Turkey, and included the description of the disease situation in the region, including Afghanistan and Pakistan, and the plans for the implementation of the West Eurasia FMD Control Roadmap – 2020 using the PCP approach. He also presented the PCP assessment of various countries (Turkey, Iran, Pakistan, Afghanistan, Azerbaijan, Armenia, Georgia, Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan and Kazakhstan, Syria and Iraq) in 2010, and the expected progression to 2020. The West Eurasia maintains an independent pool (Pool 3) of related FMD viruses of serotypes A, Asia 1 and O. Occasional incursions of FMDV from other virus pools have been reported. Epidemics of the disease in the region often occur across several countries, and recently type A(Iran-05) and type O (PanAsia-2) have extended from Pakistan/Afghanistan to Turkey and with incursions into Central Asia and as far as Israel and Libya. The current situation in Turkey showed that there is high prevalence of FMD viruses (type O, A and Asia 1) in live animal markets and the serotype Asia 1 infection cannot be protected by the current vaccines. Most of the countries in the region use vaccination to control the disease and have the desire to adopt a regional approach to FMD control. Recently, through an FAO-convened meeting of the 14 regional countries, a long term (2020) FMD control strategy was developed using the PCP approach (designed by FMD in collaboration with OIE). The region has also FMD laboratory network (WELNET) that supports regional communication, data and information sharing and training. Early reporting in the region is still a major challenge.

After the presentation there was a general discussion on all the five presentations made in the Session. The key issues discussed were as follows:

- The question was raised whether there was a need to develop a common facility to select appropriate vaccine strains for India and other SAARC member countries, in addition to the global vaccine matching system. It was generally agreed that this will not be necessary, particularly for India, as the animal movement was unidirectional, with most animals moving out of India and not into India;
- While the disappearance of the serotype C of the FMD virus was noted in South Asia, it was also agreed by the participants that there was as yet no scientific explanation for this phenomenon;

- It was suggested that the frequent change of vaccine strain in Eurasia was due to quality of vaccines used such as the amount of PD₅₀ in the vaccine, and/or the inadequate vaccine matching facility. It was clarified that the vaccine strains were selected based on the advice by the World Reference Laboratory. It was also recommended that the issues related to vaccine matching could be discussed further in the vaccines session 1-4;
- The issue of disease reporting and action plan following outbreak of disease in PR China was raised. The participants were informed that the FMD situation in China was determined through an active surveillance programme and vaccination was a standard policy for the control of the disease. However, no clear indication was given as to the coverage of animals in vaccination programme in China;
- In India, vaccination was being deployed to increase the herd immunity and progressively control disease through a zonal approach and better management of animal movement;
- Other issues raised were the suitability of R2/75 type O strain for control of FMD in Turkey;
- The development of various diagnostic tests and generation of diagnostic reagents by the PD-FMD was acknowledged, and their importance in FMD control in South Asia was recognized. However, the cost of these diagnostics was still unaffordable to many countries in the region, and the question raised was whether PF-FMD could supply diagnostics to the region. The PD-FMD was willing to provide training and diagnostics on an *ad hoc* basis, but who should bear the cost of the diagnostics for those countries who could not afford needed to be discussed and determined;
- Diagnosis of FMD in elephants was also raised and whether the current tests used in Thailand were applicable.

The following issues were raised for possible recommendations from this Session:

- There should be a harmonization of diagnostic tests in the region for better comparison of data generated in different countries in the region;
- Greater emphasis should be placed to develop regional approach to control programme in South Asia;
- Due to rapid evolution of the FMD viruses in the field, there should be emphasis on early diagnosis, and vaccine strain matching;
- All countries should have vaccine strain matching facility in the region;
- The countries in the region are urged to share disease information and encouraged to be transparent about disease reporting.

1-3 FMD immunology and vaccines: Scientific progress and potential impacts on control options

(Chair: Dr Luis Rodríguez; Co-Chair: Dr R. Venkataramanan (in place of B. Pattnaik); Rapporteur: Dr Madhu Hosamani)

The Keynote lecture was given by Dr Bryan Charleston, IAH, Pirbright, UK, and followed by the following presentations:

1. The early pathogenesis of FMD and the implications for control measures (Luis Rodríguez, ARS, USDA, USA);
2. Novel FMD vaccine research in China (Dr Zhang Qiang, Lanzhou, VRI, PR China);
3. FMD vaccines R&D in India (Dr R. Venkataramanan, IVRI, Bangalore).

Dr Charleston presented emerging concepts in immunology for developing improved diagnostics/vaccines for FMD. Three key events including rapid induction of CD4 T-cell independent immune responses, persistence of antigen in the lymphoid tissues and presence of co-stimulatory molecules which are important to induce strong immunity to FMD. In order to address the limitations of the current vaccines, with regards to cost and stability, IAH has established a proof-of-principle for developing non-infectious, capsid-stabilized antigens expressed in insect cells. These vaccines are highly stable at higher temperature and acidic environment and can be manufactured at low cost without requirement of high containment facility.

A query was made concerning this novel understanding on the capsid stabilization to improving the duration of immunity studies which can be extended to conventional vaccine. Dr Charleston replied that such work in infectious clones is not successful so far, as mutations affected the infectivity. It was discussed that further improvements in vaccine efficiency (longevity of immunity) can be made possible through enhancing the T-cell responses to drive T-dependant B cells responses, formation of germinal centres and persistence of antigen.

Dr Rodríguez presented the work on early pathogenesis of FMD and its implication for disease control. PIADC has developed Adenovirus based vaccine for FMD which induces early immunity. The centre has also developed L-gene deletion mutant virus which has potential use as attenuated candidate strain. Such vaccines are expected to provide longer duration of protective immunity as is the case with live vaccines.

A discussion concerned the duration of immunity in adenovirus based vaccine.

Dr Qiang presented the recent developments in FMD vaccine research in China. It was discussed that a number of approaches have been made to develop effective vaccines. However, monovalent inactivated vaccine is currently in use. Among the vaccines in use are peptide vaccines, baculo-expressed empty capsids, recombinant capripox vaccines. The efficacy of each of these vaccines was not discussed.

Dr Venkataramanan presented the initiatives taken up by IVRI Bangalore to improve the vaccine efficacy through use of novel adjuvants based on inactivated antigens. The studies have been ongoing to determine the duration of immunity with these vaccine. It was emphasized that thermostability and improving the duration of immunity are the key objectives in the search of effective vaccines. The centre has also been involved with developing adenovirus based FMD vaccine in collaboration with PIADC, USA. It was pointed out that production of good quality inactivated

vaccine is feasible but at it is always associated with higher cost. Currently, use of trivalent vaccine is being continued by the government in the on-going PCP, although the use of monovalent type O vaccine is being deliberated at various forums. There is uniformity in the country for the selection of vaccine strains and process of vaccine manufacture

Summary of the Chairman: Knowledge on immunology and pathogenesis of FMD over the years has resulted in development of the vaccines we have today. New understanding of immunology and disease pathogenesis is necessary to improve the next generation of vaccines that will be central to global control of FMD.

1-4 Status of the conventional FMD vaccines: efficacy and potential for improved performance

(Chair: Dr D Paton; Co-chair: Dr R. Venkataramanan; Rapporteur: Dr R. Sharma)

Six presentations were made in this session on the status of the conventional FMD vaccines, their efficacy and potential for improved performance. The key issues identified and discussed were:

1. Demand and supply of vaccines;
2. Safety, potency and efficacy of vaccines;
3. Strain selection and vaccine matching;
4. Independent testing of vaccine quality;
5. Targeted use of vaccines in limited supply for optimal effect;

The Chairmen drew the following conclusions and recommendations:

1. Independent centralized organisation(s) are needed for monitoring the quality of vaccines for SAARC region countries. Assessment should be based on compliance with OIE standards, with examination of a chain of technical evidence provided by manufacturers, inspections and spot checks on vaccine quality. An independent organisation acting at a global level could also be considered;
2. Vaccine strain selection should aim for immunodominant strains with a broad spectrum of cross-reactivity that will provide long term use against a wide range of strains and not just the latest outbreaks;
3. Vaccines with potency greater than or equal to 6 PD₅₀ offer advantages in terms of breadth of protection and duration of immunity but these advantages have to be balanced against the need to maximise the number of doses and minimize costs;
4. In order to reduce costs, the policy of partial transfer of technology might be considered, such as the external supply of vaccine antigen for local formulation;
5. Field indicators should be used to help evaluate the success of vaccine programmes, including measures of post-vaccination immunity and studies of vaccine efficacy based on reduction in FMD infection and disease;
6. Sharing of vaccine matching reagents and data should be encouraged;

7. Further research is justified to build on progress made in developing and introducing alternative vaccine selection methods and to improve understanding of which epitopes contribute to protection;
8. Vaccines with a minimum of NSP contamination will be needed when countries approach freedom and need to substantiate such claims; this technology therefore needs to be put in place;
9. New standards of FMD vaccine potency testing in pigs may be adopted;

2-1 Progressive control of FMD: Science and practice in endemic countries

(Chair: Dr Juan Lubroth, FAO; Co-Chair: Dr Mohinder Oberoi; Rapporteur: Dr Aniket Sanyal)

The session had three oral presentations covering West Eurasia, South Asia and South East Asia regions. Dr Keith Sumption delivered the keynote presentation covering the principles of FAO/OIE progressive control pathway (PCP) for FMD and the experiences gained from West Eurasian countries. The West Eurasian roadmap comprises of 14 countries participating in PCP since 2008. The roadmap is the first regional approach bringing together endemic countries affected by common FMD gene pool 3. He further informed that OIE has adopted a system for endorsing country control programmes for those which have reached PCP stage 3.

The second presentation was made from South Asia region by Dr Mohinder Oberoi. The countries share FMD gene pool 2 viruses and a regional approach is the only solution to its control. India is much advanced in the PCP with a national control programme among the South Asian countries and has vaccine production capacity. Genetic and vaccine matching data analysis indicates that the vaccine being produced in India would be the most suitable for the South Asian countries. He further explained the activities undertaken during the last one year towards PCP-FMD in the sub region, especially identification of the regional leading diagnostic laboratory in India, trainings on harmonization of testing protocols and reagents, initiation of proficiency testing of the national laboratories. The establishment of a regional support unit and the assistance provided to other countries was also highlighted. The SAARC countries have developed a PCP-FMD roadmap for SAARC countries which was distributed at the conference.

Dr Ronello Abila presented the ongoing FMD control campaign since 1997 in South East Asia popularly known as SEAFMD. In 2010 China joined the campaign thus renaming it as SEACFMD. A SEAFMD roadmap 2020 was launched in 2007 focusing at progressive zoning approach to ensure effective use of limited resources. The strategy was expanded to reduce the overall FMD prevalence by targeting hotspots and critical nodes along animal movement pathways and maintenance of FMD free countries and zones. To strengthen the foundation to effectively control FMD, SEACFMD Epidemiology Network and Laboratory Network were established to provide technical support to enhance member states capacity for effective surveillance and diagnosis.

At the end of the presentations the floor was opened for a Panel discussion focusing on “managing the challenge of huge populations and high risk Husbandry and trade; bringing in experience from elsewhere, and regional issues”. The discussion points are summarized as under:

- i. India is far ahead in PCP-FMD in South Asia however limited availability of vaccine in the country and the region is a problem. Assistance from FAO/World Bank can help in making available FMD vaccine by investing in scaling up the production capacity;
- ii. Disease control programmes should be taken in totality; hence actions other than vaccination should be taken into consideration;
- iii. Vaccination programme should go along with proper epidemiological analysis in a geographic region that includes serological, clinical and virological monitoring to determine vaccine efficacy;
- iv. There is need to address the monitoring and evaluation system so that timely corrective actions can be implemented where required;
- v. Making available a good quality vaccine at reasonable cost is the responsibility of government;
- vi. Involvement of private sector in aspects of disease control compliance and policies (vaccine delivery, contingency planning, compensation strategy, compliance etc.) are required;
- vii. Regional networking will be an important tool in risk management of transboundary spread of FMD.

2-2 FMD Control initiatives in SAARC Member States

(Chair: Mr Tenzin Dendup; Co-chaired: Dr Muhammad Afzal; Rapporteur: Dr Pasang Tshering)

Six countries from the SAARC Members States (Afghanistan, Bangladesh, Bhutan, India, Nepal and Pakistan) representatives made the country presentations on the control measures and PCP-FMD initiatives taken in the respective countries. Dr Mohibula Halini, Director General of Department of Livestock and Animal Health of Afghanistan; Dr Ainul Haque, Department of Livestock, Bangladesh; Dr Kinzang Dukpa, National Center for Animal Health, DoL, Bhutan; Dr R. Venkataraman, IVRI, Bangalore, India; Dr Vijay Chandra Jha, FMD and TADs laboratory, Nepal; and Dr Qurban Ali, National Veterinary Laboratory, Pakistan were the respective presenters. Mr Tenzin Dendup, Director General, Department of Livestock, Bhutan chaired the session and co-chaired by Dr Muhammad Afzal, FMD project, Pakistan.

The presentations mainly captured the veterinary setup, animal population, livestock production systems, epidemiological scenario of FMD, the existing strategic approaches and policies and also the constraints and issues related to implementation of FMD control programmes in the respective countries.

Some of the issues and concerns raised were:

1. Since all countries in the region are embarking on PCP-FMD approach for controlling the disease, two serious gaps should be expeditiously addressed in the control plans; i) the shortage of vaccine availability, and ii) gap in the delivery of vaccines including cold chain maintenance;
2. Mass awareness campaign should be carried out as in the Polio eradication programme;
3. In India all the FMD vaccine manufacturers have to use the strains approved by the Government and which are selected by vaccine matching;
4. Maintaining the cold chain during the vaccine supply is inbuilt in the system and vaccines are supplied safely up to the District HQ level. At the district level, the States are provided with funds to establish vaccine storage facilities;
5. India has declared itself as having reached Stage 3 of the PCP-FMD pathway; however as of now it does not have any document to prove the status. Some monitoring and surveillance system is in place and in future the country would comply with providing evidences;
6. The role of small ruminants in the epidemiology and transmission of FMD has not been fully understood.

The Chair then summarized the session. He stated that South Asia is very much a livestock dependant population and most common production system is small holdings. Livestock production is a livelihood for majority of the population and very much an issue of poverty alleviation and therefore, controlling diseases such as FMD is a public goods issue and the States have a responsibility to control the disease.

He also stated there is expertise and experience available within the region which should be shared amongst the countries and utilized for the regional approach to controlling the disease. Cross border animal movement is being considered as an issue in the transmission of the disease for which bilateral agreements to control movement or share disease information should be encouraged. Vaccine availability (at affordable price) and vaccine quality is being raised by all the countries as being a significant constraint in our control programme. So, there is the need to look for a regional approach to address the situation. Involvement of and support of international organizations alike FAO, World Bank, EC and OIE is very much solicited in this arena.

Most activities in the area of disease control are currently done in isolation by the Member States and the need for a regional approach for a more effective and sustainable control programme is very critical.

2-3 Working Groups: parallel sessions

Five working groups were formed, each group comprising international and regional participants. *Feedback from these groups is given in Annex 2.*

2-4 Epidemiology: emergence and spread of FMDV

The epidemiology of FMD was first presented in a plenary session (Dr McLaws). Emphasis was made that endemic FMD should actually be considered as waves of epidemics. Such epidemics are precipitated by the changing threat from changes to host-pathogen-environment interactions; these factors should be monitored to provide advanced warning and allow increased preparedness. There is a need to constantly monitor risk factors and disease incidence/prevalence with robust data analysis and timely reporting to identify emerging trends. The sensitivity, specificity and predictive values are key to determining the effectiveness of surveillance systems.

2-5 FMD Epidemiology: risk-based approaches to FMD control

Four further papers were presented on FMD epidemiology focusing on specific issues: The importance of post vaccination monitoring was advocated (Dr Metwally). It was highlighted that though vaccination plays a key role in FMD control it alone cannot control the disease. Post vaccination monitoring (PVM) is essential as some outbreaks occur even in vaccinated animals. Approaches were presented for post vaccination monitoring. Pilot studies in selected endemic areas of the world are to be conducted to develop a universal PVM scheme.

Studies were presented on persistent FMD infection in Asian Buffalo (Dr Verin and Dr Parida). The first study presented results indicating persistence as long as 20 months; it was indicated that the role of Asian buffalo in transmission was unclear as these were host adapted viruses. The second study demonstrated that carrier animal typically did not excrete virus in mucosal secretions, though stress might precipitate excretion. Further studies were recommended.

A risk based strategy for the control of emerging strains of FMD virus was presented (Dr Dukpa). The spatial temporal pattern of the disease in Bhutan was described using gene sequencing information.

Presentations were also made by conference sponsors: Seppic, Brilliant, Biovet, and Indian Immunologicals on their products and vaccine manufacturing facilities.

3-1 Socio-economic impacts of FMD management: Who benefits, who is willing to pay?

The morning session begins with two presentations on socio-economic impacts of FMD in the south Asian countries. Prof Mo Salman from the Colorado State University (USA) chaired the session assisted by Dr Ramesh Chand. Mr Prakash Nayak was the rapporteur of the session.

The 1st presentation (Dr Ferrari, FAO) addressed FMD and its effect on milk yield and its economic impact on small and medium livestock holders in Pakistan. He shared findings of a regional project that is operating in Afghanistan, Pakistan, Tajikistan, Turkmenistan and Uzbekistan since 2004. In this study a total of 72 milking cows and 125 milking buffaloes with clinical FMD were sampled from Punjab, Sindh and Islamabad Capital Territory. The study aimed at estimating the economic losses experienced by livestock keepers due to loss in milk production (other costs such as treatment costs or more long terms effects were not considered in the present study). The sampled population was followed up for approximately 70 days.

Milk production in both cattle and buffaloes rapidly drops as animals develop clinical signs and in the 60 days following the onset of the disease there is an estimated loss in milk production of 307.65 kg (56.38% of the 60 days potential production) and 284.39 Kg (53.21% of the potential 60 days production) in cattle and buffalo respectively.

It was thought that the total value of milk loss (expressed in US dollars) was 33.454 USD against an estimated overall cost of 3.529 USD to vaccinate all the animals belonging to the livestock keepers enrolled in this study. The ratio between the economic loss and the cost to prevention of FMD disease was estimated as 9.48.

The 2nd presentation was on the economic impact of Foot-and-Mouth disease in India (Dr Ganesh Kumar). The data presented compared districts covered by the FMD national vaccination program and districts still not covered by the national program. The variables studied were: (i) loss due to milk yield reduction; (ii) loss due to draught power reduction; (iii) loss due to treatment costs; (iv) loss due to mortality. Indirect losses were not quantified.

The direct economic losses in the districts, covered by the vaccination program (CP districts) were estimated in 41.483 Rs/farm compared to 63.768 Rs/farm in those districts not covered by the vaccination program (non-CP districts).

Despite the vaccination program in CP districts farmers report that FMD outbreaks still persist. It was projected that the state of Andhra Pradesh would stand to lose Rs. 1147 crores only on account of direct impacts if there is no vaccination program against FMD. Similarly, the country would incur a total of direct loss of Rs. 15.575 crores.

Remarks:

Dr Mo Salman raised some points for both presentations. (i) OIE manual should be referred to while defining “impact” in socio-economic studies related to livestock sector; (ii) The impact of FMD on human wellbeing and it could be addressed to policy makers for commitment building for FMD control.

Dr Ramesh Chand, the co-chair, while appreciating both papers with full of information, pointed out that the situation of south Asia is not fully understood and not yet quantifiable. He highlighted that there are lots of commonality between India and Pakistan. He added that it is not the cost of vaccination but rather the “cost of transaction cost” that prohibit farmers to get benefit of vaccination programme.

3-2 Diagnostics and laboratory services: Widening access of practitioners and vet services to quality services

(Chair: Dr S. Metwally; Co-chair: L. Krishna; Rapporteur: D. Hemadri)

Changing concept of FMD diagnostics: from central to local was presented by Dr Sanyal-PDFMD. There is a need for screening and confirmatory diagnostic assays for immediate response and providing epidemiological data. Several challenges faced in collection of samples, preservation, storage and shipping. New generation tests are available allowing rapid and definitive diagnosis. Needs for molecular Point-of-care test (POC) with satisfactory performance characteristics to minimize the time required for confirmation. PDFMD provides diagnostic services and reagents nationally and to member countries of SAARC.

FMD diagnostics: current developments and application in the context of FMD control in endemic countries was presented by Dr Wilna Vosloo-AAHL. The specific need for diagnostic assays changes as countries move along the PCP stages; from serological screening (stages 1-2) to full identification and characterization of virus isolates (stages 3-4). Fit for purpose, quality control and validation criteria were discussed as main pillars for development and deployment of diagnostic assays. POC assays may play a role in advancing through PCP stages if the test is affordable and validated. It was emphasized that good laboratory diagnostics will only be meaningful when there are sufficient resources with submission of samples and act upon results.

The development and validation of next generation diagnostic assays were presented by professor Paton-IAH and the work was done in collaboration with IZS-Brescia. Analytical and diagnostic validation of antigen ELISA (monoclonal-based) for serotypes A, Asia 1, C and O was completed and the conversion of in-house MAbs based SPCE-ELISA into “ready to use” ELISA kits is near completion. Pan-specific, SAT2-specific and Asia1-specific lateral flow device was launched. New antigen detection ELISA for Eurasian FMD is ready for launch. Eurasian serotype-specific Ab ELISAs under final validation. SAT-specific Ab/Ag ELISAs are under development.

This was followed by the **Working Group 2 Report- on Regional lab network services:**

The concept of having FMD lab networking is relatively new to the SAARC member countries. It was emphasized that countries have variable capacities in diagnostics and surveillance with a majority of labs only geared to conduct serological testing. The main concern is the current funding source for operating diagnostic labs is through national or regional projects/donor which affects sustainability. The current needs to improve diagnostics across the SAARC are bench and field training, validated kits and accessibility of diagnostic reagents, training on samples collection and shipping, proficiency tests, monitoring of lab capacities and identifying requirements for operation.

The working group proposes multi-donor support system or introduction of matching grant based assistance to maintain lab capacity and to invest on research in diagnostics and epidemiology.

3-3 Animal production systems, marketing and biosecurity: the elephant in the room for control?

This session consisted of two presentations and an ensuing panel discussion. The first presentation reviewed the structure and trends of India's livestock sector while the second presentation provided an overview of Pakistan's large dairy colonies. Both presentations focused on the implications of the prevalent livestock production systems for FMD control.

With more than 300 million large ruminants (cattle and buffalo) and more than 200 million small ruminants (sheep and goats) India is home to the largest domesticated ruminant populations worldwide, while, at the national scale, the population of domestic pigs, around 10 million, is insignificant. This huge livestock population is distributed over some 120 million agricultural households, the majority of which operate on less than 2 ha and own less than 5 tropical livestock units. The main output / services of the large ruminant systems are milk, draught power and manure while meat is the major product stemming from small ruminants.

Marketing and processing of livestock products is predominantly carried out by informal small-scale actors. It is estimated that annually around 40 million tons of milk, i.e. around half of the marketed milk in India, is handled by the 'traditional' sector (as opposed to 'cooperative' and 'private' sector). With respect to the provision of meat, between 70 and 80 million small ruminants are slaughtered each year, much of this activity taking place in some 25,000 unregistered slaughterhouses (versus around 4,000 registered slaughterhouses). Meat and offal (app. 800,000 tonnes) is handled by many small-scale intermediaries through customary networks with little or no sanitary control.

Changes in the livestock sector comprise a decline in the use of draught power, replacement of 'non-descript' cattle by crossbreds and buffalo for milk production, the establishment of larger-scale specialized dairy operations and over-proportional growth of the formal dairy sector and vigorous growth of the goat population relative to sheep. Despite the relatively rapid transformation of the livestock sector, small-scale informal actors will continue to constitute the vast majority of stakeholders to consider in animal disease control programmes. Providing the right incentives to the latter issues to comply with disease control measures will be one of the major determinants of success in the control of contagious livestock diseases.

In Pakistan dairy colonies play an important role in the provision of milk to large urban centres. These dairy colonies are located around all major cities, the largest at Landhi in Karachi (LCC) having more than 350,000 animals. Dairy herd size in the colonies is between 50 and 500 female adults, the vast majority thereof being buffaloes. Once dry, animals are usually taken to slaughter and replaced by freshly calved females. Calves are not raised and all inputs, including green fodder, are purchased.

The high turnover of animals in the dairy colonies (10 to 12%) poses special challenges to the control of FMD and field studies have indicated that dairy colonies serve as hotspots for FMD virus

circulation. Slaughterhouse surveys revealed almost 98% of animals to possess NSP antibodies while RT-PCR on oral swabs showed the presence of FMD virus in 19.2% of clinically healthy animals in LCC. FMD virus detection in oral swabs from animals from dairy colonies was nearly twice that from animals sampled in live animal markets. Twenty-seven of 39 naïve buffaloes entering LCC became NSP positive in the first month of introduction.

An approach being tested for the control of FMD in dairy colonies consists of rigorous vaccination of animals and new entrants with a trivalent vaccine (O Pan-Asia 2, A Iran 05 and Asia 1 Shamir) complemented by sero-monitoring of a population sub-sample for vaccination coverage and infection dynamics.

The presentations were followed by a lively panel discussion revolving around two main issues: (i) whether and how to distribute the cost of FMD control over the diverse stakeholders involved and (ii) which species other than large ruminants to include in FMD vaccination programmes. No consensus emerged on either of the issues. Some participants argued that in the context of South Asia, where smallholder livestock keepers dominate, government should bear the cost of FMD control while others were of the view that some private sector actors should be requested to financially contribute to FMD control efforts as they are among the principal beneficiaries. It was remarked that some smallholders were actually willing to pay for vaccination of their animals against FMD once they were convinced that vaccination actually conferred protection while erroneous perceptions about the effect of vaccination act as disincentive. With regard to species coverage, it was argued that the objective of the vaccination programme would dictate the species to be included and that the objective is likely to evolve as control progresses. At early stages of FMD control, protection of the dairy industry might be the overriding motive while as the number of outbreaks falls, elimination of virus circulation might become the main goal so as to avoid recurring vaccination cost.

3-4 Science serving future control: Under-resourced or under-used? The potential and use of recent scientific developments and products for improved control of FMD in endemic countries

(Chair: Dr Juan Lubroth; Co-Chair: Dr Gaya Prasad; Rapporteur: Dr Jyoti Misri.)

Dr Joseph Domenech from the World Organization for Animal Health (OIE) opened the session with a presentation on “The role of the OIE in transforming science into practice and policy making”. He explained how the OIE incorporates scientific progress into practice through the publication of standards, guidelines and recommendations, which in turn are translated into tools, methods, strategies and regulations. He then described the history and structure of the OIE, and how its mandate has expanded from limiting the spread of diseases to “Improve animal health, veterinary public health, animal welfare, and consolidate the animal’s role worldwide”. He summarised some of the challenges that they face, such as globalisation and decreased funding for the veterinary services. He closed by describing OIE’s work in relation to FMD, particularly the development of a global strategy, and the upcoming global conference in Thailand in June 2012, both in collaboration with FAO.

The second presentation was given by Dr Mo Salman from Colorado State University “Putting it together: The potential role of modelling to explore the impact of FMD”. In this presentation, Dr Salman emphasized that available data should be analysed to provide useful information to guide disease control. He described how simulation models may be useful in animal health, particularly in contingency planning for outbreaks of diseases such as FMD. He stressed that models have limitations and must be used by persons understanding the assumptions integral to the model and with the best data available. Disease spread models could be very useful to assess the efficacy of alternative control strategies in FMD- endemic countries; this is an area with great potential for future development.

The final presentation was “Global Foot and Mouth Disease Research Alliance (GFRA): current actions and future perspective”, given by Dr Francois Maree, of the Onderstepoort Veterinary Institute, Agricultural Research Council, S. Africa. The mission of the GFRA is to establish and sustain global research partnerships to generate scientific knowledge and discover the tools to successfully prevent, control and eradicate FMD. Since the GFRA was established in 2003 with five member institutions, it has held four open meetings and has expanded to include 35 institutional members on 5 continents. The 5th scientific meeting of the GFRA will be held in S. Africa in April 2012; the meeting goal is: “To share the latest knowledge on FMD virus ecology, to improve vaccine efficacy and vaccine matching within the GFRA”.

Closure & acknowledgments

The authors would like to acknowledge the free and frank discussion by all participants.

The participants expressed their appreciation for the wonderful support and assistance provided by ICAR and DADF, and the excellent results of their close work together with the EuFMD Secretariat, particularly Enrique Antón and Nadia Rumich, the FAO ECTAD office (New Delhi), the FAO Representation in India and FAO staff in Rome.

ANNEXES

Annex 1: Scientific programme



Scientific Developments and Technical Challenges in the Progressive Control of FMD in South Asia

Feb 13- 15, 2012 in New Delhi, India.

Principle Themes:

- The potential of current FMD research for the development of improved vaccines with properties that could reduce cost and achieve greater impact of vaccination programmes.
- The importance of a comprehensive assessment of FMD epidemiology and the impact of control measures in the design of improved FMD control programmes;
- Science and the monitoring and evaluation of Regionally Co-ordinated FMD programmes
- The growing FMD scientific output from Eurasia, which has the potential to create new options and greater levels of control if public policy makes good use of the best science.

Overview

<i>Day-Session</i>	
Day 0 (12 Feb)	Pre-registration
Day 1 (13 Feb)	Science and progress
1-1	Opening
1-2	Global and regional status of FMD
1-3	FMD immunology and vaccines
1-4	Status of the conventional FMD vaccines
	Poster Session
Day 2 (14 Feb)	Science and the progressive control of FMD in Eurasia
2-1	Progressive Control of FMD
2-2	FMD Control initiatives in SAARC Member States
2-3	Working Groups (WG): Parallel Sessions
WG1	South Asia group: PCP progress and the long term vision (Roadmap)
WG2	Regional FMD laboratory network services
WG3	Regional FMD epidemiology; gaps and priorities
WG4	FMD Research in Eurasia; success stories and priorities for investment
2-4	Epidemiology: emergence and spread of FMD
2-5	FMD Epidemiology: risk-based approaches to FMD control
Day 3 (15 Feb)	Big issues, big potentials: science and future impacts
3-1	Socio-economic impacts of FMD management
3-2	Diagnosis and laboratory services
3-3	Animal production systems, marketing and biosecurity
3-4	Science serving future control
3-5	Recommendations and closure

<i>Format. All sessions 90 min</i>	<i>Leadership</i>	<i>Presentations (in italic: Speaker)</i>	<i>Item in book of abstracts (# page in book)</i>	<i>PPTs (on line)</i>
Day 1 Monday (13-02-2012)		Current status and new scientific developments		
1-1 Current status and new scientific developments				
0900 – 1000 1000 - 1015	Opening ceremony <i>Group Photo</i>	Welcoming/Opening remarks Government of India (ICAR, MoA, DADF, NDDB) , FAO, OIE	-	-
Break 1015 – 1045				
1-2 Global and regional status of FMD – Reference center presentations				
1045 - 1230 20 minutes each including 5 minutes discussion	<i>Chair:</i> <i>Subhash Morzaria</i> <i>Co-Chair:</i> <i>David Paton</i> <i>Rapporteur:</i> <i>Arvind Kumar</i>	<ol style="list-style-type: none"> The Global system (OIE/FAO Network): Activities, directions. (<i>David Paton, WRL Pirbright, UK</i>) South Asia: Action plans, future directions and needs. (<i>Branhadev Pattnaik, Mukteswar, India</i>) Southeast Asia: Action plans, future directions and needs. (<i>Panithan Thongtha, Pakchong, Thailand</i>) FMD: Current epidemic situation in China. (<i>He Jijun, Lanzhou VRI, PR China</i>) <p>West Eurasia: Action plans, future directions and needs. (<i>Sinan Aktas FMD Institute Ankara, Turkey</i>)</p>	7 7 9 13 13	1 2 3 4 5
Lunch 1230 -1330				
1-3 FMD Immunology and vaccines: scientific progress and potential impacts on control options				
1330 – 1500 30 min Keynote plus 3 by 15 m talks, plus discussion	<i>Chair:</i> <i>Luis Rodriguez</i> <i>Co-Chair:</i> <i>B. Pattnaik</i> <i>Rapporteur:</i> <i>M. Hosamani</i>	<p>Keynote: Immunology and transmission: new findings which could change FMD control (<i>Bryan Charleston, Pirbright, UK</i>)</p> <ol style="list-style-type: none"> The early pathogenesis of FMD and the implications for control measures (<i>Luis Rodriguez, ARS, USDA, USA</i>) 	17 19	6 7

		2. Novel FMD vaccine research in China (<i>Zhang Qiang, Lanzhou VRI, PR China</i>)	21	8
		3. FMD vaccine R&D in India (<i>Ramamurthy Venkataramanan – IVRI, India</i>)	23	9
Break 1500 - 1530				
1-4 Status of the conventional FMD vaccines: efficacy and potential for improved performance				
1530 - 1715	<i>Chair:</i> <i>David Paton</i>	Keynote: Demand, supply, and the gaps between the best conventional vaccines and the worst on the market; what needs to be done? (<i>Danny Goovaerts, Intervet, Holland</i>)	25	10
20 min Keynote, 5 x 15 minute talks including 3 min discussion after each talk	<i>Co-Chair:</i> <i>Ramamurthy Venkataramanan</i>			
	<i>Rapporteur:</i> <i>Ravindra Sharma</i>	1. Manufacturers' expected contribution to the progressive control of FMD in South Asia. (<i>Philippe Dubourget, Merial, France</i>)	27	11
		2. Common vaccines for Eurasian A, O and Asia-1 – the way to go? (<i>David Paton, Pirbright</i>)	27	12
		3. FMD vaccines and vaccination in India: Production, use, and quality. (<i>Villapanur Alwar Srinivasan, Indian Immunologicals, India</i>)	27	13
		4. FMD vaccines and vaccination in China: Production, use, and quality) (<i>Li Huachun, Yunnan, PR China</i>)	28	14
Session Discussion 10 minutes		5. Current vaccines and their use in the design of vaccination programmes: theory and practice (<i>Chris Bartels, EuFMD, FAO, Italy</i>)	30	15
Poster Session 1715-1830				
1800 -1900	Cultural Programme			
1900 - 2130	Dinner hosted by the Secretary. DARE & DG, ICAR, Government of India.			
Day 2 Tuesday (14-02-2012)		Science and the progressive control of FMD in Eurasia		
2-1 Progressive Control of FMD: science and practice in endemic countries				

0830 - 1000 20 min Keynote, 3 x 15 minute talks plus discussion	<i>Chair:</i> <i>Juan Lubroth</i>	Keynote: FAO/OIE Progressive Control Pathway (PCP) for FMD: Principles, practice and lessons learnt in the West Eurasia FMD Roadmap (<i>Keith Sumption, EuFMD, FAO, Italy</i>)	36	16
	<i>Co-Chair:</i> <i>Mohinder Oberoi</i>		40	17
	<i>Rapporteur:</i> <i>Aniket Sanyal</i>		42	18
	Panel Members (TBD) Chair persons, some speakers and other key resource persons	3. Discussion: Managing the challenge of huge populations and high risk husbandry and trade; Forum bringing in experience from elsewhere, and regional issues	-	-
Break 1015 – 1045				
2-2 FMD control initiatives in SAARC Member States: country presentations				
1030-1230 Followed by discussion	<i>Chair:</i> <i>Tenzin Dhendut</i> <i>Co-Chair:</i> <i>Muhammad Afzal,</i> <i>Rapporteur:</i> <i>Pasang Tshering</i>	1. Afghanistan (<i>TBC</i>)	-	19
		2. Bangladesh (<i>Md. Ainul Haque</i>)	-	20
		3. Bhutan (<i>Kinzang Dupka</i>)	-	21
		4. India (<i>R. Venkataramanam</i>)	-	22
		5. Nepal (<i>V.Chandra Jha</i>)	-	23
		6. Pakistan (<i>Qurban Ali</i>)	-	24
		7. Sri Lanka (<i>TBC</i>)	-	Not available
Break 1230-1330				
2-3 Working Groups: Parallel Sessions (Venue: conference facilities)				
1330-1530 5 simultaneous sessions of one hour each - followed by one hour of presentations and	Facilitators: Mohinder Oberoi V. Mandava M. Akram Keith Sumption R.Venkataramana n Danny Goovaerts V. A. V.A. Srinivasan	1. WG1: South Asia group: PCP progress and the long term vision (Roadmap)	-	Annex 2 in this report
		2. WG2: Regional Laboratory network services	-	Annex 2 in this report
		3. WG3: Regional FMD epidemiology; gaps and priorities	-	Annex 2 in this report

discussions		4. WG4: FMD Research in Asia; success stories and priorities for investment	-	Annex 2 in this report
		5. WG5: FMD vaccines: Production & Quality	-	Annex 2 in this report
10 minutes each plus discussion	<p><i>Chair:</i> <i>Mohinder Oberoi</i></p> <p><i>Co Chair:</i> <i>V. Alwar</i> <i>Srinivasan</i></p> <p><i>Rapporteur:</i> <i>G. R. Reddy</i></p>	Rapid Feedback from Working Groups	-	-
Break 1530-1630				
2-4 Epidemiology: Emergence and spread of FMDV				
1600-1620 20 minutes including 5 min discussion	<p><i>Chair:</i> <i>Keith Sumption</i></p> <p><i>Co-Chair:</i> <i>Satya Parida</i></p> <p><i>Rapporteur:</i> <i>Habibur Rahman</i></p>	Keynote: Dynamics of FMDV emergence and spread within regions; progress and gaps to achieve rapid threat detection (<i>Melissa McLaws, EuFMD/FAO</i>)	44	25
2-5 FMD epidemiology: Risk-based approaches to FMD control				
1620-1720 5 x 15 minutes including 3 min discussion	<p><i>Chair:</i> <i>M. Pal Yadav</i></p> <p><i>Co-Chair:</i> <i>B. Pattnaik</i></p> <p><i>Rapporteur:</i> <i>R. Dissanayake</i></p>	<p>1. Approaches to post vaccination monitoring. (<i>Samia Metwally, FAO, Italy</i>)</p> <p>2. The role of Asian buffalo in the epidemiology of FMD. (<i>Blesida Verin, BAI, Philippines</i>)</p> <p>3. FMD: Carrier state and role of carrier buffalo as source of transboundary spread in SEA and China. (<i>Satya Parida, WRL Pirbright, UK</i>)</p> <p>4. Risk based strategies for the control of emerging strains of Foot-and-mouth disease (FMD) virus in Bhutan. (<i>Kinzang Dukpa, NCAH, Bhutan</i>)</p>	46 48 50 53	26 27 28 29

1720-1740		5. Brief presentations from the Sponsors. (<i>Allanasons, Brilliant, Biovet, Merck, Pfizer, Sartorius India, Seppic</i>)	-	30a 30b
1740-1800 Discussion				
1800 Close				
1830-2130 Dinner				
Day 3 Wednesday (15-02-2012)		Big populations, big issues, big potentials: science and future impacts		
3-1 Socio-economic impacts of FMD management; who benefits, who is willing to pay?				
0830 – 0915 2 x 15 minutes 15 minutes discussion	<i>Chair:</i> <i>Mo Salman</i> <i>Co-Chair:</i> <i>Ganesh Kumar</i> <i>Rapporteur:</i> <i>Prakash Nayak</i>	1. Foot And Mouth Disease And Its Effect On Milk Yield: A Preliminary Economic Analysis On Small And Medium Livestock Holders In Pakistan. (<i>Giancarlo Ferrari, FAO, Italy</i>) 2. Socio-economic impacts of FMD on the dairy sector of India. (<i>Ganesh Kumar, ICAR, India</i>)	55 57	31 Not available 32
3-2 Diagnostics and Laboratory services: widening access of practitioners and vet services to quality services				
0915-1030	<i>Chair:</i> <i>Samia Metwally</i> <i>Co-Chair:</i> <i>Lal Krishna</i> <i>Rapporteur:</i> <i>Divakar Himadri</i>	1. The changing concept of FMD diagnostics: from central to local services. (<i>Aniket Sanyal</i>) 2. FMD diagnostics: current developments and application in the context of FMD control endemic countries. (<i>Wilna Vosloo, AAHL, Australia</i>) 3. Diagnostics services by subnational FMD labs: kits and quality assurance, future needs. (<i>Speaker: Pirbright, UK</i>) 4. Recommendations from WG2 on Regional services	59 61 63 -	33 34 35 Annex 2 in this report
Break 1030 - 1100				
3-3 Animal production systems, marketing and biosecurity: the elephant in the room for control?				
1100 - 1200	<i>Chair:</i> <i>Ronello Abila</i>	1. Public and private behaviors in biosecurity of production units and farm management systems; lessons learnt from RP, HPAI, FMD in South	-	Not available

	<p><i>Co-chair:</i> <i>R.K.Singh</i></p> <p><i>Rapporteur:</i> <i>Khadak Singh</i> <i>Bisht</i></p>	<p>Asia. How can behavior be influenced to invest in disease prevention?. (TBC. HPED speaker, FAO)</p> <p>2. Structure and trends of India's livestock sector and implications for FMD control. (Joachim Otte , FAORAP, Thailand)</p> <p>3. FMD control in huge market/fattening complexes. (Muhammad Afzal, Pakistan)</p>	<p>65</p> <p>67</p>	<p>36</p> <p>37</p>
Break 1200-1300				
<p>3-4 Science serving future control. Scientific potential: Under-resourced or under-used? The potential and use of recent scientific developments and products for improved control of FMD in endemic countries</p>				
1300 – 1500	<p><i>Chair:</i> <i>Juan Lubroth</i></p> <p><i>Co-Chair:</i> <i>Gaya Prasad</i></p> <p><i>Rapporteur :</i> <i>Jyoti Misri</i></p>	<p>1. The Role of OIE in transforming science into practise and policy making. (Joseph Domenech, OIE, France)</p> <p>2. Putting it together: the potential role of modeling to explore the impact of FMD control options in endemic countries. (Mo Salman, CSU, USA)</p> <p>3. Presentation from WG4 on priorities for scientific investment, and on communicating and influencing policy (science based policy)</p> <p>4. The Global Foot and Mouth Disease Research Alliance (GFRA): current actions and future perspective. (Luis Rodriguez, ARS, USDA, USA)</p> <p><i>Followed by Forum with selected scientific and policy participants. (Panel TBC)</i></p>	<p>69</p> <p>71</p> <p>-</p> <p>75</p> <p>-</p>	<p>38</p> <p>39</p> <p>Annex 2 in this report</p> <p>40</p> <p>-</p>
<p>3-4 Recommendations and Closure</p>				
<p>Representative from ICAR, DADE, FAO, OIE, GFRA and EufMD</p>				

Annex 2: Working Group (WG) reports

These Working Groups met on day 2 and provided their feedback to the Plenary Session. The text below is a summary of their presentations.

WG 1: South Asia- PCP progress and Long term vision

a) *Summarize the current, major activities in this area that are funded and active:*

- Regional Coordination (HPED) funded by EC
- India
 - FMD CP in 221 districts in southern India
 - Sero monitoring
 - Epidemiological study on outbreaks
 - Sero surveillance activities to understand the NSP/SP
 - Research activity- Vaccine
- Vaccine procurement and develop strategy, epidemiology and surveillance (Bangladesh).

b) *What are the issues affecting their progress and how may they be resolved*

- Vaccine availability/insufficient vaccine
 - MS either procure or produce sufficiently their need to have country demand
 - Political commitments, funding , cheap vaccine
 - List of vaccine producing manufacturers
- Free animal movement
 - Animal movement control at country level
 - Vaccination in both the side of the country
 - Awareness programme
 - Legislative support to restrict the movement
 - Lesson learned from SEAC FMD
- Strategy- need to be developed that will linked to financial justification
- Lab capacity-
 - Strengthening of lab
 - Capacity buildings
 - Sharing of information
- Training- capacity building

c) *Immediate priorities for action*

- Political commitment
- Quality vaccine delivery and storage
- Vaccine back
- Mid- to-long term investment

- Strengthening regional cooperation
 - Establish the FMD regional working group- regional task force
 - SAARC CVO forum
 - Strengthening of animal health system in the field of
 - ∴ Epidemiology
 - ∴ Diagnosis
 - ∴ Human resources
 - ∴ Awareness and Communication

WG 2: Regional Lab Network Services

Current, major activities in the area funded and active

- FMD specific networking concept is relatively new to the Member countries; although FMD diagnosis is long been in place
- Countries have variable capacities in diagnosis and surveillance
- Fair capacity lies with laboratories in the region majorly limited to serotyping.

Issues affecting their progress

- Funding at the moment is national or regional or donor supported. This warrants sustainability in future.
- Working group proposes multi-donor support system to the process or introduction of matching grant based assistance
- Operational issues.

How may they be resolved?

- Training and refreshers need continuous input.
- Flow of validated kits and reagents.
- Knowhow of good sample collection and dispatch.
- Inter lab comparison and proficiency testing.
- Regular assessment and monitoring of laboratory capacities.
- Information sharing between member countries.
- Identifying requirements for operationalization.
- Immediate priorities for research
- Research related to diagnosis and epidemiology

Priorities for mid-to long term investment in research

- The laboratories are variable in their requirements and capacities; there is therefore a need to provide enough support in terms of infrastructure in bringing them up to an optimal level of performance

WG 3: Regional Epidemiology-Gaps and Priorities

Rapporteur: Muhammad Akram

- a) International projects:
 - EU-HPED-RSU-Regional Epidemiology Centre-Network of SAARC Labs and Epidemiology units; Outbreak investigation, analysis and training;
 - Pak/USA FMD project;
 - GTFS Italian funded FAO implemented project Pakistan, Afghanistan;
 - Japan Capacity building program;
 - Australia –OIE;
 - WB Afghanistan - broad animal health project.

- b) b. National projects
 - GOI-PDFMD coordinated project;
 - All other countries have their routine programs for FMD control.

- c) Issue / Gaps:
 - Lack of background information-Denominator; value chain; Husbandry system;
 - Capacity Building in epidemiology;
 - Animal movement;
 - Reporting system;
 - Policy makers.

- d) Research Agenda (Priorities)
 - Baseline;
 - Denominator;
 - value chain;
 - Reporting;
 - Wild life-wild boar;
 - Vaccination monitoring;
 - socioeconomic impact.

WG 4: FMD research in Asia; success stories and priorities for investment

Facilitator: Dr Keith Sumption

1. Summarize the current, major activities in this area that are funded and active.

A number of research groups are actively involved with FMD research in India and Pakistan. Several groups are working on FMD in India including ICAR institutes, state universities and Industries. These organizations are working on disease epidemiology, surveillance, molecular epidemiology, R&D on vaccine using both conventional and molecular

approaches, virus-host interactions. In Pakistan three institutions are involved with FMD research.

2. What are the issues affecting their progress and how may they be resolved?.

Issues

- i) Lack of coordinated efforts in the region to prioritize FMD research
- ii) Lack of funding in some countries

How they may be solved

Regular scientific meetings in the region (Asia) should be encouraged for exchange of ideas and information and to enhance regional cooperation. One of the potential options is to hold regular meetings between SAARC member countries and GFRA partners/members to address the key issues. Discussions should involve industry, where lot of un-published research has been performed. There were strong recommendations in the area to coordinate research to avoid duplication of efforts.

3. What are the TOP (immediate) priorities for research (research agenda for SAARC)?.

- i. Duration of immunity of the vaccine
- ii. Stability of the vaccine.
- iii. Landscape epidemiology (phylo-geography of FMDV in SAARC).

4. What are priorities for mid- to long-term investment in research?.

Mid Term

i. Improving duration of immunity of the vaccine through various research approaches including:

- Testing improved adjuvants
- Evaluate different routes of delivery
- Development of thermostable vaccine
- Research on T-helper stimulants and

- ii. Integrated models for FMD management (epidemiological-economic).

Long-term

- Research on host-virus interactions (including breed resistance).

WG5: FMD vaccines: Production and Quality

1. Summarize the current, major activities in this area that are funded and active:

- i) Installed capacity of vaccine manufacturing in India is about 350 million doses which is inadequate to meet the regional demand;
- ii) Some manufacturers in South Asia produce vaccine of questionable quality;
- iii) The region lacks national independent quality control laboratories;
- iv) Current practice is the vaccine manufacturers are vested with the responsibility of vaccine quality assurance;
- v) Funding is from own resources. No external funding.

2. What are the issues affecting their progress and how may they be resolved?:

Issues

- i) Availability of vaccine;
- ii) Quality of vaccine;
- iii) Cold chain maintenance;
- iv) Availability of suitable vaccine strains to manufacturers to cater to needs of the region;
- v) Post-vaccinal monitoring.

How to resolve?

- i) Harmonization of pharmacopoeial standards for the region;
- ii) Establishment of vaccine bank for the region;
- iii) Rationalization of vaccine strains for the region;
- iv) Cold chain indicators.

3. What are the immediate priorities for research (research agenda for SAARC)?:

- i) Alternate methods for vaccine quality testing;
- ii) Thermostable vaccine;
- iii) Extended duration of immunity;
- iv) Validation of *in vitro* tests to assess quality of vaccine.

4. What are priorities for mid- to long-term investment in research?:

- i) An independent quality control laboratory at national/regional level;

- ii) Alternate platforms for vaccine production;
- iii) Alternate vaccine delivery platforms.

Annex 3: Abstracts and presentations

Oral presentations (and abstracts)

Kindly refer to Annex 1 (Scientific programme: Agenda of the session, where you can find a row for 'abstracts' and another row for 'presentations', to find the indications to retrieve the presentations.

Example:

Leadership	Presentations <i>(in italic: Speaker)</i>	Item in book of abstracts <i>(# page in book)</i>	PPTs <i>(on line)</i>
Chair: <i>Keith Sumption</i> Co-Chair: <i>Satya Parida</i> Rapporteur: <i>Habibur Rahman</i>	Keynote: Dynamics of FMDV emergence and spread within regions; progress and gaps to achieve rapid threat detection (<i>Melissa McLaws, EuFMD/FAO</i>)	44	33

This number refers to the page in the book of abstracts that you may have and that is also available for consultation and to be downloaded from:

<http://www.fao.org/ag/againfo/commissions/eufmd/commission/eufmd-home/en/>

Please go to

<http://www.fao.org/ag/againfo/commissions/eufmd/commission/eufmd-home/en/>

and click on this number to see the presentation.

Poster presentations (and abstracts)

Please click on <http://www.fao.org/ag/againfo/commissions/eufmd/commission/eufmd-home/en/> to find the complete set of abstracts for the poster presentations.

List of abstracts for poster presentations:

1. Antigenic cartography of FMDV Serotype O, Indian Isolates (*B. S. Mathapati*)
2. FMD virus down regulates the bovine peripheral blood mononuclear cells *in vitro* (*N.K.Kakker*)

3. Application of RNA transfection in diagnosis of FMD (*B. Pattnaik*)
4. Prevalence of antibodies against structural and non structural proteins of FMD virus in sheep from rural cohorts in Haryana, India (*N.K. Kakker*)
5. Emergence and re-emergence of different genotypes/lineages of FMDV in India (*B.Pattnaik*)
6. Non genetic factors affecting variability in immune response and transcriptional profile of IL-6 and 21 crossbred cattle vaccinated with FMD trivalent vaccine (O/A/Asia1) (*B. Pattnaik*)
7. Detection of Persistently FMD infected cattle by mucosal IgA test (*S. Parida*)
8. Use of RT-lamp for diagnosis of FMDV in clinical samples (*B.Pattnaik*)
9. Multiple NSP based profiling Elisa for differentiation of FMD infected and vaccinated animals (*B. Pattnaik*)
10. Success of FMD control programme in Haryana, India: epidemiological and sero-monitoring studies (*B. Pattnaik*)
11. Kinetics of FMDV specific IgA and non structural protein antibodies for detection of persistently FMD infected cattle (*N.K.Kakker*)
12. Platform technologies for diva testing of FMD – a review (*M. Hema*)

Annex 4: List of participants

1) By country (including public organizations and institutions) ; 2) Private companies

1. BY COUNTRY

AFGHANISTAN

Dr M. Zahir ALOKOZAI
Ministry of Agriculture, Irrigation and
Livestock
e-mail: mohibullahhalimi@yahoo.com

Dr Halimi MOHEBULLAH
Ministry of Agriculture, Irrigation and
Livestock
e-mail: mohibullahhalimi@yahoo.com

Dr M. Qasim TALASH
Ministry of Agriculture, Irrigation and
Livestock
e-mail: mohibullahhalimi@yahoo.com

AUSTRALIA

Dr Wilna WOSLOO
Australian Animal Health Laboratory
e-mail: Wilna.Vosloo@csiro.au

BANGLADESH

Dr M. Mohsin ALI
Govt. of Bangladesh
e-mail: directorlri@yahoo.com

Dr A Md. HAQUE
Department of Livestock services, Ministry
of Fisheries & Livestock, Government of
Bangladesh.
e-mail: ahaquepd@yahoo.com

Dr Anwar HOSSAIN
University of Dhaka
e-mail: anwar5533@yahoo.com

Dr Mat YAMAGE

FAO ECTAD
e-mail: Mat.Yamage@fao.org

BHUTAN

Dr Tenzin DHENDUP
Ministry of Agriculture and Forests
e-mail: tenzind10@yahoo.com

Dr Tashi DORJI
Ministry of Agriculture and Forests
e-mail: Tdorji69@yahoo.com

Dr Kinzang DUPKA
Ministry of Agriculture and Forests
e-mail: Kinzangd@yahoo.com

CHINA

Dr Jijun HE
Lanzhou Veterinary Research Institute
e-mail: hejijun1979@163.com

Dr. Quiang ZHANG
Lanzhou Veterinary Research Institute
e-mail: qzhang1616@sohu.com

FRANCE

Dr Joseph DOMENECH
OIE
e-mail: j.domenech@oie.in

INDIA

Dr. Acharya, R.M.
Former DDG(AS)
e-mail: radhamohanacharya@yahoo.com

Dr. Ayyappan, S
DG, ICAR

e-mail: dg.icar@nic.in

Dr. Basagoudanavar, Suresh
Sr.Sci, IVRI, Bangalore
e-mail: Surbh2001@gmail.com

Dr. Basar, K.
Deputy Director(AH) Arunachal Pradesh
e-mail: Dr_karbom_b@yahoo.com

Dr. Batobyal, A.
JC, DAHD&F
e-mail: jclp@nic.in

Dr. Bambal, R.G.
JC, DAHD&F
e-mail: rajendrabambal@hotmail.com

Dr. Bhasin, Vineet
Pr.Sci(AGB), ICAR, New delhi
e-mail: Dr_vineetbhasin@hotmail.com

Dr. Bhat, P.N.
Former DDG(AS), ICAR, New Delhi

Dr. Bhatt, Lenin
PDFMD, Jaipur, Rajasthan
e-mail: leninbhatt@yahoo.com

Dr. Bhushan, Indu
PDFMD, Jammu

Dr. Biswal, Jitendra
Scientist, PDFMD
e-mail: jkubiswal@gmail.com

Dr. Biswakarma, Badal
PDFMD, Itanagar
e-mail: Biswakarma123@gmail.com

Dr. Bujarbaruah, K.M.
VC, AAU, Guwahati
e-mail: kmbujarbaruah@rediffmail.com

Dr. Chand, Ramesh
Director, NCAP, New Delhi
e-mail: rc@ncap.res.in

Dr. Dangji, K.S.

D.G, A.H, Haryana
e-mail: dangikrishan@yahoo.co.in

Dr. Dash, B.B.
Senior Scientist, PDFMD, Mukteshwar
e-mail: bbdash@gmail.com

Ms. Dhankhar, Deepa
Agri Specialist, USDA, India
e-mail: Deepa.dhankhar@aphis.usda.gov

Dr. Dutt, Triveni
JD(Extn), IVRI, Izatnagar, India
e-mail: jdee@ivri.res.in

Dr. Garg, S.K.
Former VC, DUVAS, Mathura, India
e-mail: Shri.garg@rediffmail.com

Gangadharan, Rudhra
Secretary, DAHD&F

Gilky, Marc
USDA/Aphis, New delhi, India
e-mail: Merc.c.gilky@aphis.usda.gov

Dr. (Ms) Gupta, Neelam
Pr.Sci(ABT), ICAR
e-mail: neelamgnbagr@gmail.com

Dr. Gupta, Rajan
Pr.Sci(AN), ICAR
e-mail: rgupta60@yahoo.co.in

Dr. Gupta, S.C.
ADG(AP&B), ICAR
e-mail: scguptaadg@hotmail.com

Dr. Gupta, Sanjay
Vety Surgeon, PDFMD, Jammu
e-mail: Sanjay_vet2004@yahoo.com

Dr.(Ms) Hema, M.
Associate Prof, SVVU, Tirupati
e-mail: Hemamasarapu70@gmail.com

Dr. Hegde, Raveendra
Scientist, PDFMD, Bangalore
e-mail: honkankereravi@yahoo.com

Dr. Hemadri, Divakar

Pr.Sci, PDADMAS, Bangalore
Dr. Hosamani, M.
Sr.Sci, IVRI, Bangalore
e-mail: Madhu.hosa@gmail.com

Dr. Kakker, N.
Sr.Scientist, PDFMD, Hisar, Haryana
e-mail: nkmksk@rediffmail.com

Dr. Kalla, P.N.
Director(Extn), RAU, Bikaner
e-mail: kallapn@gmail.com

Dr. Kataria, Jagmohan
JD, IVRI, Izatnagar
e-mail: jmkataria@rediffmail.com

Dr. Kishore, Subodh
Pr.Sci, IVRI, Bangalore
e-mail: subodhkishore@gmail.com

Dr(Ms) Koratala, Vanisree
Asstt Director(AH), PDFMD, VBRI,
Hyderabad
e-mail: drkoratala@yahoo.com

Dr. Kumar, Arvind
Professor, HAU, Hisar
e-mail: arvind.kumar1956@gmail.com

Dr. Kumar Bhradwaj , Ashwani
PDFMD, RDDDL, Jalandhar
e-mail: Abhwardwaj2@yahoo.com

Dr. Kumar, B. Ganesh
Sr. Scientist, PDADMAS, Bangalore
e-mail: drgankum@yahoo.com

Dr. Kumar, Manoj
AICRP on FMD, BVC, Patna
e-mail: drmanojmicro@rediffmail.com

Dr. Kumar, S. Nanda
Deptt of AH, PDFMD, Trivandrum
e-mail: drnand@yahoo.com

Dr. Kumar, Vijaya
Director, DAH, Kerala

Dr. Kumar, G. Sai
Sr. Scientist, IVRI

e-mail: saikumarivri@gmail.com
Dr. Kumar, Ravinder
Asstt Professor, SVPUAT, Meerut
e-mail: Ravinder774@rediffmail.com

Dr. Lal krishna
Former AHC & ADG(AH)
e-mail: Lalkrishna1948@hotmail.com

Dr. Lokhande, T.
PDFMD, Bhopal
e-mail: drtlokhande@gmail.com

Dr. Madan, M.L.
Former DDG(AS) & VC, Mathura

Mehrishi, Rajiv
Secretary, ICAR
e-mail: Secy.icar@nic.in

Dr. Maity, Somnath
Asstt Director, AICRP on FMD regional
centre, Kolkata
e-mail:
Maitysomnath64@rediffmail.com

Dr(Ms) Minakshi Prasad
Professor, LLRUVAS, Hisar
e-mail: Minakshi.abt@gmail.com

Dr.(Ms) Misri, Jyoti
Pr.Sci(AH), ICAR Headquarters, Krishi
Bhavan, New delhi
e-mail: Jmisri.icar@yahoo.in

Dr. Mohan, Vinay
Asstt Director, NRDDL, Jalandhar
e-mail: ymwadhawan@gmail.com

Dr. Mohapatra, J.K.
Scientist, PDFMD, Mukteshwar
e-mail: Jajati1@gmail.com

Dr. Mukhopadhyay, A.K.
Former PC, PDFMD
e-mail: drakmukho@gmail.com

Dr. Motwani, Kishore T.
Head, Zydus AHL, Ahemdabad
e-mail: kishoremotwani@zydusahl.com

Dr. Mallick, B.B.
Former VC, WBUAFS

Dr. Nayak, Prakash
Communication Expert, FAO, Kathmandu,
Nepal.
e-mail: Prakash.nayak@fao.org

Dr. Nanda, A.S.
AHC, DAHD&F
e-mail: asinghnanda@gmail.com

Dr. Naveen, K.A.
JD, NIAH, Baghpat
e-mail: Jd_niah@rediffmail.com

Dr. Naeem Khalid
Chief Scientist, NARC, Islamabad, Pakistan
e-mail: Naeem22@comsats.net.pk

Dr. Negi, A.B.
National Project Coordinator, FAO

Dr. Padmanaban, P.
Director, AH, Puducherry

Dr. Pandey, A.B.
Incharge IVRI, Mukteshwar
e-mail: Abpandey58@rediffmail.com

Dr. Patel, Kacchia.
Director, AH, Gujarat
e-mail: Dr_kachhia@yahoo.com

Prof. Pathak, K.M.L.
DDG(AS)
e-mail: Ddgas.icar@nic.in

Dr. Patel, P.S.
Dey. Director, PDFMD, Bhopal

Dr. Pattnaik, B.
Director, PDFMD, Mukteshwar
e-mail: pattnaikb@gmail.com

Dr. Pradhan, H.K.
National Consultant, WHO, New Delhi
e-mail: hkpradhan45@rediffmail.com

Dr. Pradhan, K.
Former VC, OUAT & RAU

Dr. Prakash, B.S.
ADG(ANP)
e-mail: bsp1001@rediffmail.com

Dr. Prasad, C.S.
VC,MAFSU, Nagpur
e-mail: Cadaba_prasad@yahoo.co.in

Dr. Prasad, Gaya
ADG(AH)
e-mail: gprasad1986@gmail.com

Dr. Prasad, C. Renuka
Director, IAHV, Bangalore
e-mail: diriahvb@gmail.com

Dr. Purohit, A.K.
Former Director(Extn), RAU, Bikaner
e-mail: ak_pur@sify.com

Dr. Rahman, Habibur
Director, PDADMAS, Bangalore
e-mail: hricar@gmail.com

Dr. Rajput, A.K.
Executive Director, Poultry Association
e-mail: Drakr2005@gmail.com

Dr. Rao, M. Sudarsana
JD(AH), AICRP FMD, Hyderabad
e-mail: jddiap@gmail.com

Dr. Rana, R.S.
JS, DAHD&F, Krishi Bhavan, New delhi

Dr. Rana, S.K.
Sr. Scientist(R&D), NDDDB, Hyderabad
e-mail: skrana@nddb.coop

Dr. Ranjan, Rajiv
Scientist, PDFMD, Mukteshwar
e-mail: drrajraj@gmail.com

Dr. Rautmare, Sunil Shivajirao
Deputy Comm, AH, PDFMD, Pune
e-mail: rautmaresunil@yahoo.com

Dr. Reddy, G.R.
Pr. Sci, IVRI, Bangalore
e-mail: drreddygr@gmail.com

Dr. Reddy, G.S.
CGM, IIL, Hyderabad
e-mail: gsredy@indimmunw.xom

Dr. Rout, M.
Scientist, PDFMD, Mukteshwar
e-mail: drmrout@gmail.com

Dr. Sahoo, Hare Krushna
Research Asstt, ADRL, Cuttack

Dr. Sanyal, Aniket
Pr.Sci, PDFMD, Mukteshwar
e-mail: aniket.sanyal@gmail.com

Dr. Saravanan, S.
Scientist, PDFMD, Mukteshwar
e-mail: saranvirol@gmail.com

Dr. Selvaraj, S.M.
Rinderpest Officer, DAH, Tamilnadu,
Chennai
e-mail: Rexline.selvaraj@gmail.com

Dr. Sharma, A.K.
Sr.Sci, IVRI, Mukteshwar
e-mail: Sharmaak62@yahoo.co.in

Dr. Sharma, Gaurav
Scientist, PDFMD, Mukteshwar
e-mail: gauravet@gmail.com

Dr. Sharma, K.
PDFMD, Guwahati
e-mail: ksharma1956@sify.com

Dr. Sharma, M.C.
Director, IVRI
e-mail: dirivri@ivri.res.in

Dr. Sharma, Ravindra
PDFMD, Hisar
e-mail: rsharma698@gmail.com

Dr. Sharma, R.S.
President, IVA
e-mail: drsharmars@gmail.com

Dr. (Ms) Sharma, Shingini
AD, NIAH, Baghpat
e-mail: shingini@doctor.com

Dr. Sinha, Dharmendra
Director, IAH&P, Patna
e-mail: lrsapatna@gmail.com

Dr Sharma, V.D.
Dean, Sai Instt, Dehradun
e-mail: vdsharmadoan@gmail.com

Dr. Sherikar, A.T.
Former VC, MAFSU
e-mail: atsherikar@gmail.com

Dr. Sikdar, A.
PDFMD, Kolkata
e-mail: animesh.sikder@rediffmail.com

Dr. Singh, A.P.
VC, Pt. DDU, Mathura
e-mail: singhambika1945@gmail.com

Dr. Singh, L. Chaoba
PDFMD, Imphal

Dr. Singh, Jeevan
Director, DAH, Manipur
e-mail: jeevan.thingbaijam@gmail.com

Dr. Singh, Nem
Former JD, IVRI
e-mail: singhnem1945@gmail.com

Dr. Singh, R.K.
Director, NRC Equine
e-mail: rks_virology@yahoo.com

Dr. Singh, V.P.
JD(Aca), IVRI
e-mail: vijendra61@gmail.com

Dr. Sreenivasa, B.P.
Sr.Sci, IVRI, Bangalore
e-mail: bpsrini@gmail.com

Dr. Srinivasan, V.A.
IIL, Hyderabad
e-mail: srini@indimmune.com

Dr. Srivastava, A.K.
Director, NDRI
e-mail: dir@ndri.res.in

Dr. Sapara, Mahendrakumar B.
Veterinary Officer, DAH&VS, Daman
e-mail: ahvs-dmn-dd@nic.in

Dr. Suryanarayana, VVS
Pr.Sci, IVRI, Bangalore
e-mail: veluvarthy@yahoo.com

Dr. Swain, C.R.
PD, A.D.R.I., Cuttack

Dr. Taneja, V.K.
VC, GADVASU, Ludhiana
e-mail: vijay_taneja@hotmail.com

Dr. Tanwar, R.K.
Director(Clinics), RAJUVAS, Bikaner
e-mail: rktanwardr@yahoo.com

Dr. Trivedi, T.P.
e-mail: tptrivedi@icar.org.in

Dr. Tyagi, Bhushan
AC, DAHD&F

Dr. Uppal, P.K.
Former Dir, NRC Equine

Dr. Venkatramanan, R.
JD, IVRI, Bangalore
e-mail: venkat1953@gmail.com

Dr. Venkatasubbarao, M.
FAO, Nepal
e-mail:
venkatasubbarao.mandava@fao.org

Dr. Verma, Amit Kumar
PDFMD, Mathura
e-mail: dr_amitverma@sify.com

Dr. Verma, Rishender
JD(CADRAD), IVRI
e-mail: rishendra_verma@yahoo.com

Dr. Vijayakumar, K.
JD, DAHD&F
e-mail: vijikumar@yahoo.com

Dr. Yadav, M.P.
Former VC, SVBPAU, Meerut
e-mail: yadav_mp@hotmail.com

I.R. IRAN

Dr Alireza BAHONAR
University of Tehran
e-mail: abahonar@ut.ac.ir

ISRAEL

Dr Michel BELLAICHE
Israeli veterinary Services
e-mail: michelb@moag.gov.il

ITALY

Dr Giancarlo FERRARI
FAO – Animal Health Service
Viale delle Terme di Caracalla, 00153,
Rome
e-mail: giancarlo.ferrari@fao.org

Dr Juan LUBROTH
FAO – Animal Health Service
Viale delle terme di Caracalla, 00153 Rome
e-mail: Juan.Lubroth@fao.org

Dr Keith SUMPTION
Secretary, EUFMD (Animal Health Service
Animal Production and Health Division
FAO – Viale delle Terme di Caracalla
00153 Rome
e-mail: keith.sumption@fao.org

Dr Melissa MCLAWS
EuFMD Consultant
e-mail: Melissa.McLaws@fao.org

Dr Samia METWALLY
FAO – Animal Health Service
Viale delle terme di Caracalla, 00153, Rome
e-mail: Samia.Metwally@fao.org

Mrs. Nadia RUMICH
Animal Health Service
Animal Production and Health Division
FAO – Viale delle Terme di Caracalla
00100 Rome
e-mail: nadia.rumich@fao.org

JAPAN

Dr Chantanee BURANATHAI
OIE
e-mail: c.buranathai@oie.int

KENYA

Nene VISHVANATH
International Livestock Research Institute
e-mail: v.nene@cgiar.org

NEPAL

Dr Muhammad AKRAM
FAO
e-mail: Muhammad.akram@fao.org
Dr Man Khaling BUDHHI
Govt. of Nepal
e-mail: buddhy-khaling@hotmail.com

Dr Singh BISHT KHADAK
FAO
e-mail: bisht.khadaksingh@fao.org

Dr Prakash NAYAK
FAO
e-mail: Prakash.Nayak@fao.org

Dr Mohinder OBEROI
FAO
e-mail: mohinder.oberoi@fao.org

Dr Muhammad TAREQUE
Director (ARD & Transport) at the SAARC
Secretariat
e-mail: mamannan@saarc-sec.org

Dr Pasang TSHERING
FAO
e-mail: Pasang.tshering@fao.org

The NETHERLANDS

Dr. Chris BARTELS
EuFMD Consultant
e-mail: Chris.Bartels@fao.org

Dr. Aldo DEKKER
Central Veterinary Institute
e-mail: Aldo.Dekker@wur.nl

PAKISTAN

Dr. Muhammad AFZAL
FAO
e-mail: muhammadimam.afzal@fao.org

Dr. Nazir Awan FARHAT
Livestock & Dairy Development
Department
e-mail: farhatawan1962@hotmail.com

Dr. Hussain MANZOOR
FAO
e-mail: Manzoor.Hussain@fao.org

Dr. Khalid NAEEM
Animal Science Institute,
National Agricultural Research Centre
e-mail: Khalid.naeem@fao.org

Dr. Ali QURBAN
National Veterinary Laboratory
e-mail: drqurban@yahoo.com

Dr. Muhammad SHER
Livestock & Dairy Development
Department
e-mail: drshervet@yahoo.com

PHILIPPINES

Dr. Blesida VERIN
Philippines Animal Health Centre
e-mail: blesvanguard@hotmail.com

SOUTHAFRICA

Dr. Francois MAREE
ARCO-OVI
Old Soutpan Road, 0110 Pretoria
e-mail: MareeF@arc.agric.za

SRI LANKA

Dr. Ravi DISSANAYAKEI
FAO
e-mail: ravi.dissanayake@fao.org

THAILAND

Dr. Ronello ABILA
OIE
e-mail: r.abila@oie.int

Dr. Subhash MORZARIA
FAO Regional Office for Asia and the Pacific
e-mail: Subhash.morzaria@fao.org

Dr. Joachim OTTE
FAO RAP
e-mail: Joachim.Otte@fao.org

Dr. Panithan THONGTHA
Regional Reference Laboratory for FMD in
South East Asia
e-mail: ekkpasang3dld@hotmail.com

TURKEY

Dr. Sinan AKTAS
FAO SEC
e-mail: sinan.aktas@fao.org

UK

Dr. Bryan CHARLESTON
Institute for Animal Health
Pirbright Laboratory
Ash Road, Pirbright, GU24 0NF Woking,
Surrey
e-mail: bryan.charleston@bbsrc.ac.uk

Dr. David PATON
IAH, FAO WRL
Laboratory Institute for Animal Health
Ash Road, Pirbright, Woking, Surrey GU24
0NF
e-mail: david.paton@iah.ac.uk

Dr. Satya PARIDA
Institute for Animal Health
Pirbright Laboratory
Ash Road, Pirbright, GU24 0NF Woking,
Surrey
e-mail: satya.parida@iah.ac.uk

USA

Dr. Luis RODRÍGUEZ
United States Department of Agriculture
40550 Route 25, NY 11957 Orient
e-mail: luis.roDr.iguez@ars.usda.gov

Dr. Aida Elizabeth RIEDER
USDA
e-mail: Elizabeth.Rieder@ars.usda.gov

Dr. Mo SALMAN
CSU
e-mail: M.D.Salman@ColoState.EDU

Dr. Abu SAYED
APHIS USDA
e-mail: Abu.Sayed@aphis.usda.gov

2. PRIVATE COMPANIES

ADDITIONAL SECY & FA
Pujari, P.K.

FEDERAL CENTRE FOR ANIMAL HEALTH,
Russia
Mr. Borisov Alexey
e-mail: afanaseva@arriah.ru

Mr. Dimitry Mikhailishin
e-mail: fetyukova@arriah.ru

ALLANASONS Ltd, India
Dr. Alavi, Fauzan
Director
e-mail: fmalavi@allana.com

Dr. Appar. K.
DGM

e-mail: skappar@gmail.com

Dr. Aziz, Afzal
President

e-mail: aaziz@allana.com

Dr. Kadimi, Rashid

e-mail: kadimini@allana.com

Dr. Khan, Junaid
Manager, Hyderabad

e-mail: jkhan@allana.com

BIOVET Ltd, India

Dr. Bhattacharya, T.
General Manager, Karnataka
e-mail: Tbhatta02@yahoo.co.in

Dr. Jacob, Joe
VP, Bengaluru

e-mail: Joe238@biovet.in

Dr. Prasad, Sai D
VP, Karnataka

e-mail: prasadd@biovet.in

BRILLIANT BIOPHARMA Ltd, India

Dr Mishra, Biswanath
Vice President, Hyderabad
e-mail: bilvaccine@gmail.com

Dr. Boda, Maurya
CMD, Hyderabad

e-mail: cmd@bbpl.co.in

Dr. Raju, C.B.

Executive Director, Hyderabad
e-mail: brilliantvetvac@rediffmail.com

GALMed, India

Dr. (Ms) Dhawan, Mamta

IIL, India

Dr. Bhargav, N.S.N.
GM, Hyderabad

e-mail: nsnb@indimmune.com

Dr. Pandey, Tarun
Executive, Hyderabad

e-mail: Tarun.pandey@indimmune.com

Dr. Kavle, Ramnath
Head(Marketing), Hyderabad

e-mail: Ramnath@indimmune.com

Dr. Thapliyal, S.K.

e-mail: skt@yahoo.co.in

INTERVET India Pvt Ltd, India

Dr. Mohan, E.V.S.
Director, Pune.

e-mail: mohan.earanky@merck.com

Dr. Bhattacharya, Supriya
Manager, Research and Development,
Pune

e-mail: Supriya.bhattacharya@intervet.com

Dr. Rao, K. Ananda
GM (VSD), Pune

e-mail: Ananda.koppunuru@intervet.com

Dr. Sood, Manoj
Head- Regulatory Affairs, Pune

e-mail: manoj.sood@merck.com

MERCK, The Netherlands

Dr. Danny GOOVAERTS
Director Global R&D Governmentally
Regulated Disease

e-mail: danny.goovaerts@merck.com

MERIAL, India

Dr. Kazek, Christophe

Dr. Parekh, Mayank

MERIAL, France

Mr. Philippe DUBOURGET
e-mail: philippe.dubourget@merial.com

Mr. Christophe KAZEK

e-mail: christophe.kazek@merial.com

NDBB, India

Dr. Mohan, M. Madhan

Scientist, Hyderabad

e-mail: madan@indimmune.com

VIVIMED, India

Dr. Krishnamachary, S.

Sr.Vice President, Hyderabad

Dr. Rao, Manohar

PFIZER Animal Health, India

Dr. Rawat, Dinesh Singh

GPM, Mumbai

e-mail: dinesh.rawat@pfizer.com

SARTORIUS STEDIM, India

Dr. Raju, M.S.V.N.

SEPPIC, India

Dr. Deville, Sebastian

ZYDUS A.H. Ltd., India

Dr. Atrey, Arun

MD

e-mail: arunatrey@zyduscadila.com