OIE/FAO Foot-and-Mouth Disease Reference Laboratory Network

Annual Report 2013

Editor: Dr Donald King, The Pirbright Institute, UK

Contents

The Network of OIE/FAO FMD Reference Laboratories has been established with two principal goals:

(1) To understand global virus distribution and patterns and provide vaccine recommendations

and

(2) To improve the quality of laboratory testing carried out by international and national reference laboratories.

This requires sharing and joint evaluation of surveillance information from laboratory diagnosis, serotyping, genetic characterisation and vaccine matching tests and harmonisation of standards for diagnostic procedures.

This report is divided into two parts providing an update on progress towards each of these goals.

OIE/FAO Foot-and-Mouth Disease Reference Laboratories Network

Reporting Period: 1st January 2013 – 31st December 2013

Collated input from:

- Centro Panamericano de Fiebre Aftosa (PANAFTOSA) and OIE Reference Laboratory for FMD, Rio de Janeiro, Brazil.
- FAO Reference Centre for FMD for Central Asia and West Eurasia and OIE Reference Laboratory for FMD, Federal Governmental Institute, Centre for Animal Health (FGI ARRIAH), Vladimir, Russia.
- OIE Regional Reference Laboratory for Sub-Saharan Africa (RRLSSA), Gabarone, Botswana.
- OIE Reference Laboratory for Foot and Mouth Disease, Dirección de Laboratorio Animal, SENASA, Argentina.
- OIE/FAO FMD Reference Laboratory, Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna (IZSLER), Italy
- FAO Reference Laboratory for FMD in Africa and OIE FMD Reference Laboratory, Transboundary Animal Diseases Programme, ARC-Onderstepoort Veterinary Institute (ARC-OVI), South Africa.
- FAO Reference Centre for FMD and other vesicular diseases for the Americas and the Caribbean and OIE FMD Reference Laboratory, Foreign Animal Disease Diagnostic Lab, Plum Island Animal Disease Center (PIADC), Greenport, USA.
- OIE collaborating centre for validation, quality assessment and quality control of diagnostic assays and vaccine testing for vesicular diseases in Europe, and FAO Reference Centre for vesicular Diseases, CODA-CERVA, Ukkel, Belgium.
- OIE Regional Reference Laboratory for Foot and Mouth Disease in the South East (RRLSEA), Department of Livestock Development, Pakchong, Thailand.
- OIE and China National FMD Reference Laboratory, Lanzhou Veterinary Research Institute (LVRI), CAAS, Gansu, P.R. China
- FAO Reference Centre for FMD in South Asia, Project Directorate on FMD (PDFMD), Indian Council for Agricultural Research, Mukteswar, Nainital (Uttarakhand), India.
- FAO World Reference Laboratory and OIE Reference Laboratory for FMD (WRLFMD), The Pirbright Institute, Pirbright, UK

Additional input kindly supplied by:

- National Veterinary Research Institute, Vom, Nigeria
- Progressive Control of FMD in Pakistan (GCP/PAK/123/USA) FAO, Pakistan

Part 1: Genetic and antigen diversity and global distribution of foot-and-mouth disease viruses.

Foot-and-mouth disease (FMD) is highly contagious, infects a wide variety of domestic and wildlife cloven-hooved hosts. Its presence impacts upon rural livelihoods and restricts trade opportunities for countries where the disease is endemic, and poses a constant threat to those countries that are free of the disease. FMD virus lineages are not randomly dispersed throughout the world but are associated with particular ecological niches. The distribution of these FMD virus lineages is affected by cyclical upsurges in the prevalence of particular strains that may be associated with the evolution of FMD viruses to escape protective immunity in susceptible livestock populations and/or opportunities presented by movements of animals and their products. These features can give rise to pandemic events where FMDV lineages spread widely to affect new regions. Global surveillance for FMD is necessary to identify the current hazards and to predict heightened risk so that appropriate diagnostic tools and vaccines are available for detection and control. This requires sustained effort directed towards the monitoring of FMD outbreaks and ideally also of FMDV circulation and persistence, along with collection and characterisation of FMD viruses and integration of findings with associated epidemiological intelligence. Such an extensive effort requires a coordinated team approach encompassing national and international disease control services and their laboratories along with commercial vaccine and diagnostic providers.

The worldwide distribution of the different serotypes and variants of FMD virus as compiled in 2013 and the associated activities of the network laboratories are presented in this report.

1.1 Introduction

Global surveillance undertaken by the OIE/FAO FMD Laboratory Network aims to monitor the distribution of FMD viruses to predict risk for endemic and FMD-free countries. The work of international FMD reference laboratories in collecting and characterising FMDV isolates and the requirements and methodologies for vaccine selection has been previously reviewed (Ferris and Donaldson, 1992; Kitching 2000; Paton et al., 2005). FMDV is unevenly distributed throughout the world reflecting factors such as livestock density and species mix, patterns of husbandry, animal movement and trade, wildlife reservoirs and incentives and capacities for disease control. The virus exists as seven serotypes and multiple subtypes where cross-immunity is absent or incomplete. The situation is dynamic and complex and affected by viral evolution, waxing and waning of host immunity and changing ecosystems and trading patterns. Despite the propensity and opportunities for spread of FMDV into new regions, comparisons of VP1 gene sequences of viruses submitted over many years do show a tendency for similar viruses to recur in the same parts of the world (Knowles and Samuel, 2003; Rweyemamu et al., 2008) and this presumably reflects some degree of either ecological isolation or adaptation. On this basis, the global pool of FMD viruses can be subdivided into seven 'regional pools' in which genetically and antigenically distinctive virus strains tend to occur within a defined region.

The seven 'Regional Pools' referred to throughout this report are shown below in Figure 1.1 and represent:

Pool 1 – Eastern Asia
Pool 2 – Southern Asia
Pool 3 – Eur-Asia
Pool 4 – Eastern Africa
Pool 5 – Western Africa
Pool 6 – Southern Africa
Pool 7 – South America

The clustering of FMD viruses into 7 virus pools, with 3 pools covering Europe, the Middle-East and Asia, 3 pools covering Africa and 1 pool covering the Americas, is now enabling a targeted approach to be applied to the 'Progressive Global Control of FMD' initiative overseen by the OIE and FAO and for which the FMD Network laboratories will play a pivotal role.

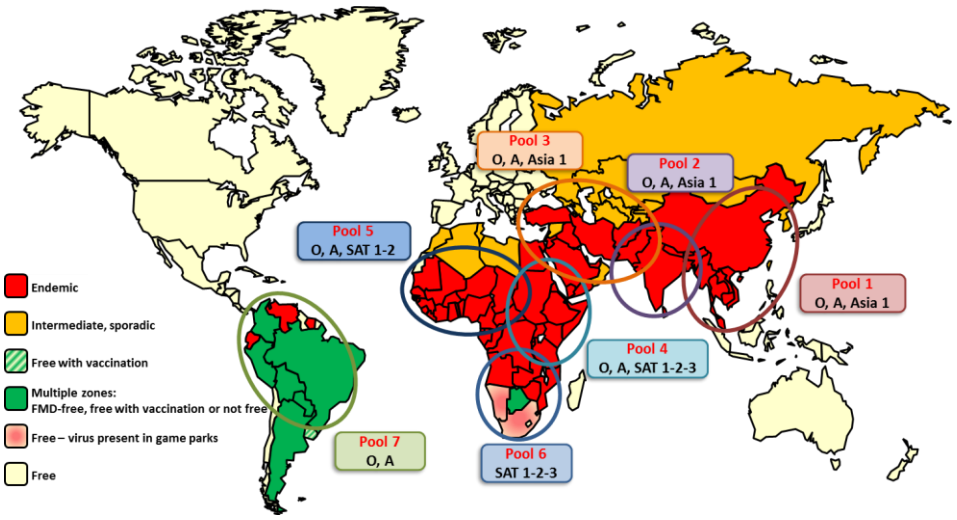

Figure 1.1: Distribution of the seven endemic pools of FMD showing the predominant viral serotypes that are present in each region, as well as the conjectured status of FMD in countries. Virus circulation and evolution within these regional virus pools results in changing priorities for appropriately adapted vaccines. Periodically, viruses spread between pools and to free regions, and countries at the interfaces between pools (such as in North Africa and Central Asia) often experience FMD outbreaks from different regional sources. Note on Pools 4-6: **In Africa there are currently three FMD virus pools loosely defined as covering East Africa (pool 4), West Africa (pool 5) and Southern Africa (pool 6). There is some overlap between pools 4 and 5. It has been suggested to extend pool 4 southwards to include Tanzania and to contract pool 6 to exclude that country.** Note that Paraguay is now FMD-free with vaccination.

References:

Ferris NP, Donaldson AI. (1992) Rev Sci Tech.11(3):657-84.
Kitching RP. (2000) Ann N Y Acad Sci. 916:139-46.
Paton DJ, Valarcher JF, Bergmann I, Matlho OG, Zakharov VM, Palma EL, Thomson GR. (2005) Rev Sci Tech. 24(3):981-93.

1.2 Overview of the Global situation in 2013

Information regarding FMD outbreaks can be found on the World Animal Health Information Database (WAHID) Interface (http://www.oie.int/wahis_2/public/wahid.php/Wahidhome/Home) from OIE, and the EMPRES Global Animal Disease Information System (http://empres-i.fao.org/) provided by FAO. Further supplementary data and updates are generated on a monthly basis by EuFMD (http://www.fao.org/ag/againfo/commissions/eufmd/commissions/eufmd-home/fmd-surveillance/situation-reports/en/).

During 2013, FMD outbreaks have continued to affect countries in the established endemic regions of the world. Particular attention has been focussed upon new FMD outbreaks and events that are summarised in Figure 1.2: for reported FMD outbreaks in East and Central Asia (China, Chinese Taipei, Mongolia, Russia and Kazakhstan), West EurAsia (Russia and Israel), North Africa (Libya) and Southern Africa (South Africa, Botswana and Zimbabwe). Additional disease outbreaks in countries in the FMD endemic pools have also been reported to OIE during 2013 (data collated in Table 1).

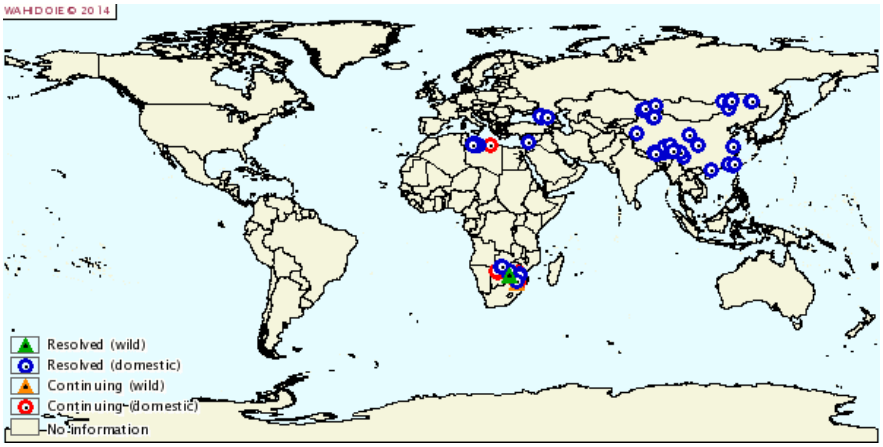

Figure 1.2: Map indicating the location of significant epidemiological events and disease outbreaks reported to OIE in *immediate notifications* or *follow-up reports*.

Table 1.1: New FMD outbreaks reported to OIE during 2013 (data retrieved March 2014): NB: not all outbreaks shown in Figure 1.2 are collated in this table and data may be incomplete.

Country	J	F	M	A	M	J	J	A	S	O	N	D	Totals
Afghanistan		2	8										10
Benin	2	1		3	1	20							27
Bhutan	1						11						12
Botswana	1												1
Burkina Faso	7	6		1		2	7	7	4	3			37
Cambodia		3		1	3	3	9	9	8	19	9	6	70
Cameroon	4		3		1								8
Chinese Taipei					3								3
DR Congo	3						5						8
Cote D'Ivoire	2												2
Egypt	9	13	4	5		1							32
Ethiopia	47												47
Ghana			1										1
Hong Kong SAR				1									1
Iran	289												289
Iraq	4	14	14	15	11	11							69
Kazakhstan					1	2							3
Kenya	8	2	1		8	3	1	2		5	6	6	42
Malaysia		5	4	1	1								11
Nepal	24												24
Niger	6	3	1		1								11
Nigeria		1	1				1	1					4
Qatar	6												6
Russia			4			6							10
Sri Lanka						1							1
Sudan	3	1											4
Thailand	3	3		1	1								8
Togo					4	4	1			1			10
Turkey	6	13	31	34	97	107							288
UAE		1											1
Vietnam	3	3	7		1	5	1	2	3	4	4		33

Further details of many of the characterisation of viruses retrieved from these outbreaks are provided later in this report. In South America, there is now tangible progress of the regional control programme to achieve FMD-free status since no clinical cases due to FMD have been reported in 2013, and it is now two years since any outbreaks have been reported across the entire continent (last reported outbreak in Paraguay in 2012).

1.2.1: Change in official status of countries and zones during 2013:

The official status of OIE member countries is shown in Figure 1.3

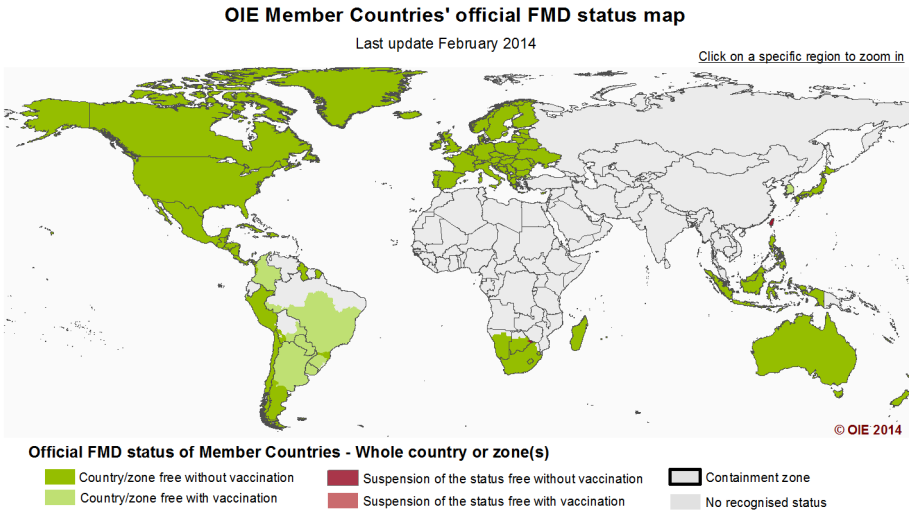

Figure 1.3: Official FMD status for OIE member countries. Data provided from the OIE: http://www.oie.int/en/animal-health-in-the-world/official-disease-status/fmd/en-fmd-carte/

The following information is obtained from the OIE: http://www.oie.int/animal-health-in-the-world/official-disease-status/fmd/lossreinstatement-of-status/)

Restoration of "FMD free zone where vaccination is not practiced"

South Africa: Subsequent to the suspension of the FMD free zonal status on 25 February 2011, the Delegate of South Africa submitted a dossier in September 2013 (and an addendum on 31 January 2014) to the Director General requesting the recovery of the status of an FMD free zone where vaccination is not practised in accordance with the relevant provisions of the OIE *Terrestrial Animal Health Code* (*Terrestrial Code*).

Restoration of "FMD free zone where vaccination is practiced" status for two zones

Paraguay: Subsequent to the suspension of the FMD free status of two zones on 18 September 2011 and 5 December 2011, the Delegate of Paraguay submitted a dossier on 6 June 2013 to the Director General requesting the recovery of the status of two FMD free zones where vaccination is practiced in accordance with the relevant provisions of the OIE *Terrestrial Animal Health Code (Terrestrial Code).* The Scientific Commission, by electronic correspondence amongst its members, considered the report and the recommendations of the *ad hoc* Group on evaluation of FMD status of Member Countries which met from 21 to 24 October 2013. Based on the documentation submitted and in accordance with Resolution No. 30 of the 81st General Session "Procedures for Member Countries for the official recognition and maintenance of disease status of certain animal diseases or risk status of bovine spongiform encephalopathy and the

endorsement of a national official control programme", the Scientific Commission concluded that the two zones (recognised in May 2007 and May 2011) in Paraguay fulfil the requirements of the *Terrestrial Code* to regain their status with effect from 1 November 2013 of " FMD free zone where vaccination is practiced" as recognised by the OIE World Assembly of Delegates in terms of Resolution XXI of May 2007 and Resolution 14 of May 2011.

Lifting of the containment zone and full restoration of "FMD free zone where vaccination is not practiced" status

Botswana: Subsequent to the suspension of the FMD free status on 11 May 2011, and the implementation of a containment zone approved by the OIE on 28 September 2011, the Delegate of Botswana submitted a dossier on 16 October 2013 to the Director General requesting the lifting of the containment zone and the full restoration of the "FMD free status where vaccination is not practised" for the zone designated by the Delegate of Botswana in documents addressed to the Director General in January and November 2009, in accordance with the relevant provisions of the OIE *Terrestrial Animal Health Code (Terrestrial Code)*. The Scientific Commission, by electronic correspondence amongst its members, considered the report and the recommendations of the ad hoc Group on evaluation of FMD status of Member Countries which met from 21 to 24 October 2013. Based on the documentation submitted and in accordance with Resolution No. 30 of the 81st General Session "Procedures for Member Countries for the official recognition and maintenance of disease status of certain animal diseases or risk status of bovine spongiform encephalopathy and the endorsement of a national official control programme", the Scientific Commission concluded that the containment zone fulfils the requirements of the *Terrestrial Code* to be lifted allowing a full recovery, with effect from 1 November 2013, of the status of the FMD free zone where vaccination is not practiced as recognised by the OIE World Assembly of Delegates in terms of Resolution No. 15 in May 2010.

Four countries now have FMD control programmes that are officially endorsed by the OIE: Algeria, Bolivia, Morocco and Tunisia.

1.3: Overview of the activities of the OIE/FAO FMD Laboratory Network during 2013

The OIE/FAO FMD Reference Laboratory Network is a vital contributor to the global control of FMD and provides opportunities and expertise for developing and sustaining laboratory capacity and capability, exchange of materials and technologies, harmonising approaches to diagnosis and supporting complementary research. Laboratories within the network regularly receive samples for FMD diagnosis from many parts of the world. The *in-vitro* antigenic properties of selected isolates are assessed for vaccine matching and nucleotide sequencing allows precise characterisation of new isolates and tracing of their origin by comparison with viruses held in virus collections. This analysis assists the monitoring of the 'real time' emergence and spread of FMD virus globally.

During 2013, 1034 clinical samples from suspect cases of FMD were tested by laboratories in the network. These samples were collected from 34 countries in Africa and Asia (Figures 1.4a and 1.5) in 6 out of the 7 FMD endemic pools. However, sampling within these pools is not equivalent: surveillance within West Africa (Pool 5) is particularly sparse and efforts are currently underway with the network to improve sample collection and testing in this region.

Serotype O is normally the predominant global FMDV serotype. However, during 2013 only 34% of samples (that were FMD virus positive and characterised using laboratory methods) were of serotype O and in contrast to previous years serotype A was the most frequently detected serotype (51% of characterised samples: Figure 1.4b). These numbers were also reflected in the

number of FMD virus positive samples that were sequenced by the network (Figure 1.4c). Although individual regional events can skew these statistics, data from Pools 1 and 3 do indicate that a larger proportion of outbreaks due to serotype A have been detected during 2013 (Appendix 1). Serotype C has not been detected since 2004 when the last cases due to the serotype were recognised in Kenyan and Brazil.

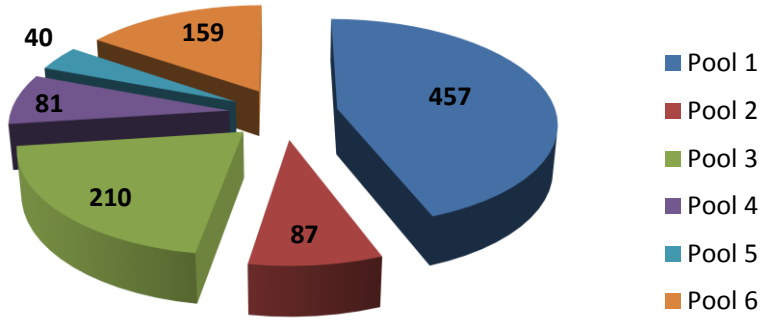

Figure 1.4a: Samples (n=1034) tested by the OIE/FAO FMD Laboratory Network during 2013 and their distribution across the seven FMD endemic pools.

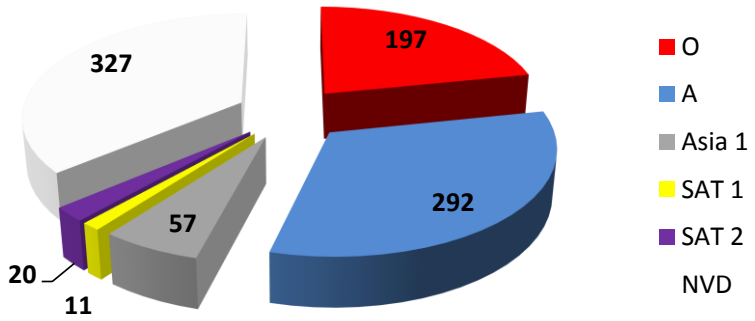

Figure 1.4b: Summary of results for samples that have been characterised and reported by the Network during 2013. NVD represents samples collected and tested that are negative for FMD virus (no virus detected)

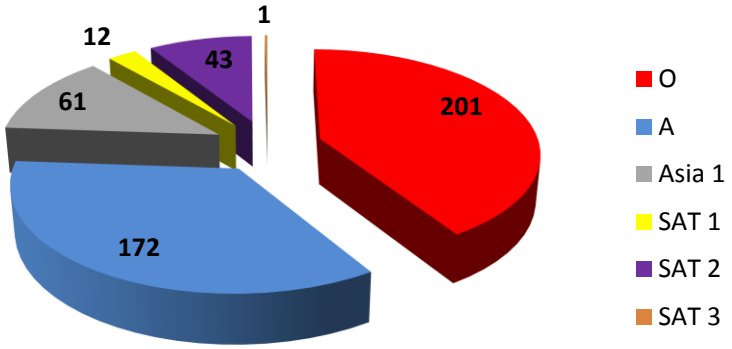

Figure 1.4c: Summary of 490 samples (viruses and field isolates) that were sequenced (VP1) during 2013

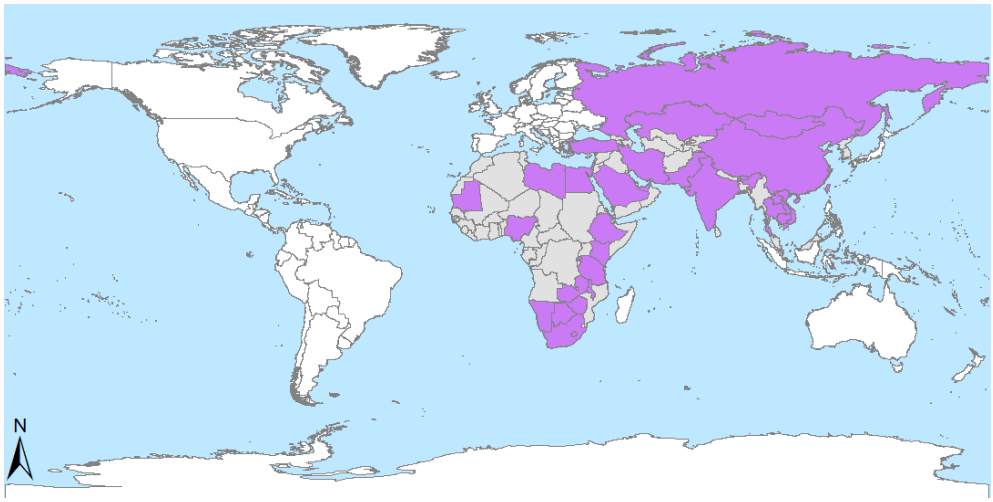

Figure 1.5: Distribution of samples collected (from a total of 34 countries: highlighted in purple) and tested by the OIE/FAO FMD Laboratory network during 2013.

The results for the individual samples are reported below. It is also important to note that a much larger number of sera (such as OPF and lymph node samples) were also received and tested by laboratories within the network during this period for surveillance activities: these numbers are also summarised in the tables for each of the individual endemic pools. Characterisation results obtained on samples received by WRLFMD and PANAFTOSA can also be found respectively at: http://www.wrlfmd.org/ and at: http://new.paho.org/panaftosa.

1.3.1. Provision of Expertise:

Network partners from WRLFMD (UK), BVI (Botswana), PIADC (USA), PANAFTOSA (Brazil), PD-FMD (India), LVRI (China) and CODA-CERVA (Belgium) together with representatives from OIE, FAO, EuFMD and the commercial vaccine sector have participated in an OIE/FAO working group to establish guidelines for post-vaccination monitoring (PVM). The purpose of this work is to provide a methodology to evaluate the effectiveness of FMD vaccination programme, and to identify ways to improve vaccination programmes. An expert team has been assembled under the umbrella of GF-TADs (FAO and OIE). This work is considering the use of FMD vaccination in the following different scenarios: (i) countries experiencing FMD and using vaccination schemes with the goal to reduce disease burden, (ii) Countries experiencing FMD with vaccination programmes with the goal to establish freedom from FMD with vaccination, (iii) Countries recognized by the OIE as FMD-free with vaccination and working towards FMD freedom without vaccination and (iv) Countries with a recent incursion of FMD and practicing "vaccination-to-live" after being free of disease. In addition, the goal of these guidelines is to enlighten decision makers on the effectiveness of FMD vaccination programmes. This work was adopted in the work-plan for the OIE/FAO FMD Laboratory Network in 2012. During 2013, draft guidelines have been prepared and are currently under-review by the working group with the aim to formally publish the work in late 2013 or early 2014.

Figure 1.6: Meeting of PVM expert team in Rome.

1.4 Vaccine matching and recommendations

These take two forms: Regional recommendations and details of locally produced vaccines for each of the FMD endemic pools are summarised in section 1.5 below, whilst the WRLFMD® recommendations for FMD free countries are given in Table 1.2. Details of vaccine matching work undertaken by the OIE/FAO FMD laboratory network are summarised in Appendix 2.

Table 1.2: Recommendations from WRLFMD on FMD virus strains to be included in FMDV vaccine antigen banks.

	Vaccine strain (for each category these are not listed in order of Importance)
High Priority	O Manisa O PanAsia-2 (*or equivalent*) O BFS or Campos A24 Cruzeiro Asia 1 Shamir A Iran-05 (or A TUR 06) A22 Iraq SAT 2 Saudi Arabia *(or equivalent i.e. SAT 2 Eritrea)*
Medium Priority	A Eritrea SAT 2 Zimbabwe SAT 1 South Africa A Malaysia 97 *(or Thai equivalent such as A/NPT/TAI/86)* A Argentina 2001 O Taiwan 97 *(pig-adapted strain or Philippine equivalent)*
Low priority	A Iran 96 A Iran 99 A Iran 87 or A Saudi Arabia 23/86 *(or equivalent)* A15 Bangkok related strain A87 Argentina related strain C Noville SAT 2 Kenya SAT 1 Kenya SAT 3 Zimbabwe A Kenya

1.5 Network activities in each of the regional endemic pools

Pool 1:

Regional synopsis:

FMD is endemic in the countries of mainland Southeast Asia where the SEACFMD Campaign (http://www.rr-asia.oie.int/activities/sub-regional-programme/stanz/seacfmd/) has adopted and is implementing a roadmap to control and eradicate the disease. Across the region, there has been an apparent relative increase in the number of FMD outbreaks due to serotype A that have been recently reported (see Appendix 1 Tables 1.1 – 1.3 and 1.8). There is now concern that field strains from the A/ASIA/Sea-97 lineage are not protected by A/MAY-97 vaccines that are used in the region. However this evidence is largely based on in-vitro vaccine matching data from FMD reference centres: therefore, empirical data from in-vivo potency trials is now urgently required to determine whether existing vaccines are suitable for use in the region.

Over the past five years, FMD lineages that are normally present in mainland Southeast Asian countries have caused outbreaks in neighbouring countries in East and Central Asia (for outbreaks

in 2013 see Figure 1.8). During 2013, FMD outbreaks in China included 4 due to O/ME-SA/PanAsia in Tibet (Cattle) and one each in Sicuan and Jiangsu Provinces, respectively in pigs due to O/SEA/Mya-98. Serotype A outbreaks (n=17) have affected 5 Chinese provinces (Guangdong, Qinghai, Xinjiang, Tibet and Yunnan) and have also occurred in Russia, Mongolia and Kazakhstan (for VP1 tree see Appendix 3, Figure A3.1). For serotype O, full genome sequence data generated at ARRIAH and WRLFMD have demonstrated that at least two separate O/SEA/Mya-98 lineages are responsible for outbreaks since 2010 in (i) The Russian Federation and Mongolia, and (ii) China, Japan, North Korea, South Korea and Russia, respectively (data reported by ARRIAH and WRLFMD: Valdazo-Gonzalez et al., 2013 – see Figure A3.2). Together, these recent events due to these three separate lineages that are normally restricted to countries in mainland Southeast Asia may be indicative of changing epidemiology of FMD in East Asia which may heighten risk for onward transmission to more distant countries including those that are FMD-free. During 2013, the Russian Federation has undertaken serological surveillance in a buffer zone that comprises the entire southern border (in 34 regions) of the country where vaccination with serotype O, A and Asia-1 is practised. Furthermore NSP sero-surveillance was also undertaken in northern regions of Russia (and Kaliningrad) to provide evidence that these areas are FMD-free. Wide-scale active surveillance has also been undertaken within pig slaughterhouses in 10 southern Chinese provinces, where sera (n=894) and lymph node samples (n=1020) were collected and tested (using SP and NSP serological assays, and by real-time RT-PCR, respectively) during March and April 2013: all samples tested generated negative results. Elsewhere in China, as part of a larger study at 31 sampling sites in 16 counties in Inner Mongolia involving sera (n=620) and OPF (n=592) samples, A/ASIA/Sea-97 was detected in OPF of cattle and sheep in 4 counties, and the results were reported in the Official Veterinary Bulletin (Vol 15, No. 10, 2013). These data provided evidence for the absence of FMDV circulation in these vaccinated populations. Surveillance has also been undertaken in Hainan Island, Yongji, Jinlin and Liaoning Provinces where FMD-free (with vaccination) zones have or are being established. Unfortunately, an outbreak caused by O/SEA/Mya-98 strain in 2012 in Dalian from pigs has led to a cancellation of FMD free status in Liaoning Province, and A/ASIA/Sea-97 strains were also found in OPF during active surveillance. In Thailand, active sero-surveillance using an NSP ELISA has yielded a positive rate of 4.0%. No outbreaks of FMD have

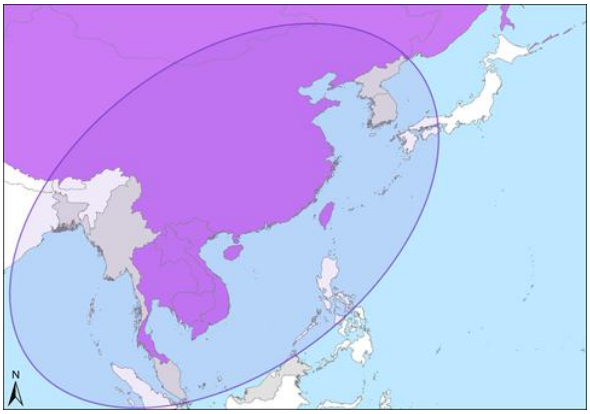

Figure 1.7: Countries within Pool 1 that have been sampled by FMD Reference centres during 2013 (in purple). FMD Endemic countries in pool 1 are those in mainland Southeast Asia (Myanmar, Thailand, Laos, Cambodia, Vietnam and Malaysia).

Figure 1.8 FMD outbreaks that have occurred during 2013 in Central and East Asia that have been as significant epidemiological events to OIE

been reported from the Philippines since 2005 and all the zones within the country were recognised as officially free of FMD in May 2011 by the OIE.

Conjectured circulating FMD viral lineages in pool 1 during 2013:

- Serotype O: O/SEA/Mya-98, O/ME-SA/PanAsia, O/CATHAY (see Figure A3.3)
- Serotype A: A/ASIA/Sea-97 (see Figure A3.4)
- Serotype Asia-1 (not detected in the region since 2005 (Myanmar) and 2006 (Vietnam, P.R. China)

Table 1.3: Overview of samples collected and tested from pool 1 during 2013

		Numbers of samples	
Laboratory	Countries of Origin	Clinical field cases	Surveillance activities
OIE RRL Pakchong	Cambodia, Laos, Thailand, Vietnam	143	5,202 LP 2,977 NSP
OIE RRL Lanzhou	PR China	52	~4,000 PCR ~10,000 SP and NSP
FGBI ARRIAH	Kazakhstan, Mongolia, Russia*	166	47,500 LP 26,500 NSP
WRLFMD	Cambodia, Laos, Hong Kong SAR, Mongolia, Thailand, Taiwan (Chinese Taipei), Vietnam	96	
Total		457	

* some samples from these countries overlap into pool 3, where virus incursions of virus strains from the Middle East have been characterised during 2013 (see below).

Vaccine recommendations:

- Internationally produced vaccines: O-Manisa, O-PanAsia (or suitable alternative), O-TAW, A-MAY/97, A22-IRQ, Asia 1-Shamir
- Locally produced vaccines (at RRL SEA): Thailand O Udornthani 189/87, Thailand A Sakolnakorn/97, A Saraburi/87, A Lopburi/12, Thailand Asia1 /85.
- Locally produced vaccines (at FGBI ARRIAH): A/Zabaikalsky/RUS/2013, O PanAsia-2, Asia-1 Shamir/89.
- Locally used vaccine strains (by Chinese manufactures): O/Mya-98 (O/Mya98/BY/2010), O/PanAsia (O/China99), AF72, Re-A/Sea-97 (Re-A/WH/09), and Asia1/GV (Asia1/JSL/06). These are produced as: Type O and Type A (monovalent vaccines), Type O-A and Type O-Asia1 (bivalent vaccine), Type O-A-Asia1 (multi-valent vaccine) and a synthetic peptide vaccine (Type O for use in pigs only). In China vaccination occurs 2 times a year (in spring and autumn). More than 700 million doses are used at each time implying up to 1.5 billion doses are produced and administered in China per year

Reference:

Valdazo-González B., Timina A., Scherbakov A., Abdul-Hamid N. F., Knowles N. J. and King D. P. (2013) Multiple introductions of serotype O foot-and-mouth disease viruses into East Asia in 2010-2011. *Veterinary Research* **44:** 76.

Pool 2:

Regional synopsis:

Pool 2 represents the Indian sub-continent where specific lineages of serotypes O, A and Asia circulate. Recent data from PD-FMD, India which has collated data from 22 different reporting centres in India indicates that the O/ME-SA/Ind-2001 is the predominant serotype O lineage circulating in the county (Figure A3.5). During 2012-13, 331 FMD outbreaks have been recorded in India (particularly from the Southern, Eastern and North-eastern regions) and 859 field samples have been tested by the different centres in the reporting network. Of these outbreaks 79% (n=263) have been characterised as serotype O, 5% (n=16) as serotype A and 16% (n=52) as serotype Asia 1. Serotype O has been recovered in all regions (Southern, Northern, Central, Western, Eastern and North-eastern), whereas only small numbers of serotype A viruses have been found in Southern and North-eastern Regions: Karnataka State (Bangalore), Uttar Pradesh, Odisha State, Jharkhand State and Assam State. Sequences recovered during 2013 demonstrate the dominance of the O/ME-SA/Ind-2001 strain (88/89 sequences generated during 2012-13). This lineage (Subramaniam et al., 2013) has recently caused FMD outbreaks in Libya and Saudi Arabia (see report for pool 3). Within serotype Asia-1, all viruses characterized since 2005 have been grouped within a single major lineage (named lineage C), which can be sub-divided into two genetic clusters (termed Eastern and Western: Figure A3.6). Results of a serological study to detect FMDV circulation in domesticated small ruminants in India have been recently published. A total of 4407 and 4035 serum samples from sheep and goats, respectively, were collected at random covering majority of the states across the country during 2010–2012 (Figure 1.10). These samples were analyzed for antibodies against the non-structural proteins (NSP) of FMD virus in an indirect 3AB NSP ELISA and against the structural proteins (SP) in a liquid phase blocking (LPB) ELISA. A total of 20.35% sheep and 13.60% goats were found to be positive for 3AB NSP antibodies providing a serological evidence of extensive viral activity. Laboratory data from WRLFMD and other National Reference Laboratories has been generated for Bhutan, where serotype O (also from O/ME-SA/Ind-2001 lineage) has been detected in 2013, Sri Lanka (serotype O), Nepal (most recent viruses characterized during 2012 were serotype O) and Bangladesh (where serotypes O and Asia-1 have been detected in 2013).

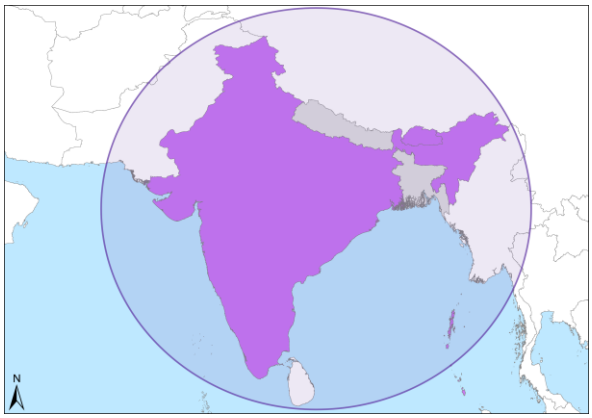

Figure 1.9: Countries within Pool 2 that have been sampled by FMD Reference centres during 2013 (in purple).

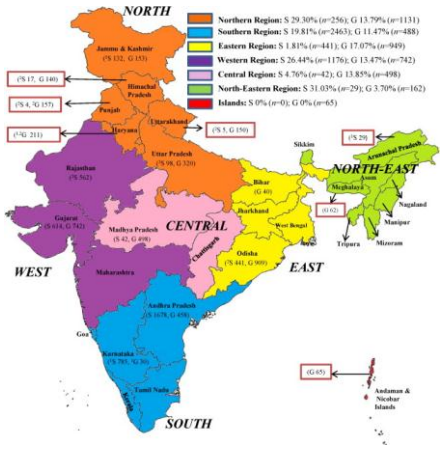

Figure 1.10: Map of India showing region-wise NSP-Ab seropositive sheep and goat populations. Data and figure from Rout et al., 2014

Conjectured circulating FMD viral lineages in pool 2 during 2013:

- O/ME-SA/Ind-2001 (the O/ME-SA/Ind-2011 lineage that emerged during 2011 has not been recognised during 2012-13)
- O/ME-SA/PanAsia-2 (last detected in 2011 in Sri Lanka)
- A/ASIA/IND (genotype 18)
- Asia-1 (lineage C subdivided into Eastern and Western clusters)

Table 1.4: Overview of samples collected and tested from pool 2 during 2013

		Numbers of samples	
Laboratory	Countries of Origin	Clinical field cases	Surveillance activities
PD-FMD	India	77*	Not reported
WRLFMD	Bhutan	10	-
Total		87	

* a larger number of field samples (n=859) have been tested by other reporting centres in India

Vaccine recommendations:

- Internationally produced vaccines: O/ME-SA/PanAsia-2 (or suitable alternative)
- Locally produced vaccines (by Indian suppliers): O/IND/R2/1975, A/IND/40/2000 and Asia1/IND/63/1972

References:

Rout M., Senapati M., Mohapatra J. K., Dash B. B., Sanyal A. and Pattnaik B. (2014) Serosurveillance of foot-and-mouth disease in sheep and goat population of India. Prev. Vet . Med. **113**: 273-277.

Subramaniam S, Sanyal A, Mohapatra JK, Sharma GK, Biswal JK, Ranjan R, Rout M, Das B, Bisht P, Mathapati BS, Dash BB, Pattnaik B. (2013). Emergence of a novel lineage genetically divergent from the predominant Ind2001 lineage of serotype O foot-and-mouth disease virus in India. Infect. Genet. Evol. **18:** 1–7

Pool 3:

Regional synopsis:

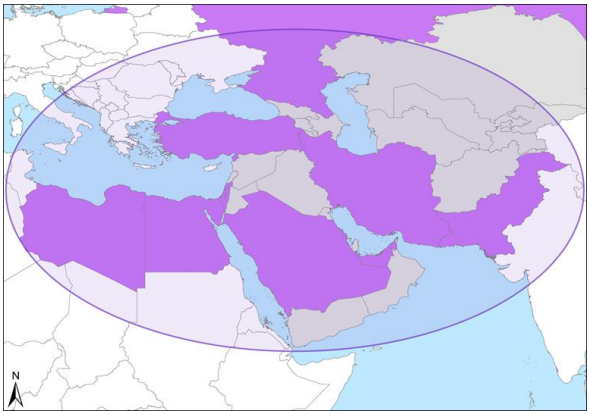

Figure 1.11: Countries within Pool 2 that have been sampled by FMD Reference centres during 2013 (in purple).

The epidemiology of FMD in pool three is complex and a number of established strains (within serotypes O, A and Asia 1) have continued to cause outbreaks during 2013 across a wide area. The predominant FMD virus lineages in the region are O/ME-SA/PanAsia-2, A/ASIA/Iran-05 and serotype Asia-1. However, with serotypes O and A, multiple sub-lineages co-circulate (see Figure 1.12). The extent of reported FMD cases in the region are outlined in Table 1.1 for Iran, Iraq and Turkey, and additional data has been provided to the network from Pakistan where a total of 1639 FMD outbreaks have been observed (information for January-September

2013 supplied by FAO, Islamabad). These outbreaks in Pakistan have been typed as serotype O for n=499 (30.4%), serotype A for n=770 (47.0%) and Asia-1 for n=87 (5.3%): the reminder comprise outbreaks due to mixed serotypes. The majority of these outbreaks (n=1283) have been reported in Sindh Province. Furthermore, recently characterized samples submitted to WRLFMD from Pakistan revealed the presence of examples of a new genetic lineage of the O/ME-SA topotype (see Figure A3.7). These findings continue to demonstrate the complexity of FMD epidemiology in West Eurasia and show how viral lineages overlap and are continuously changing in this region.

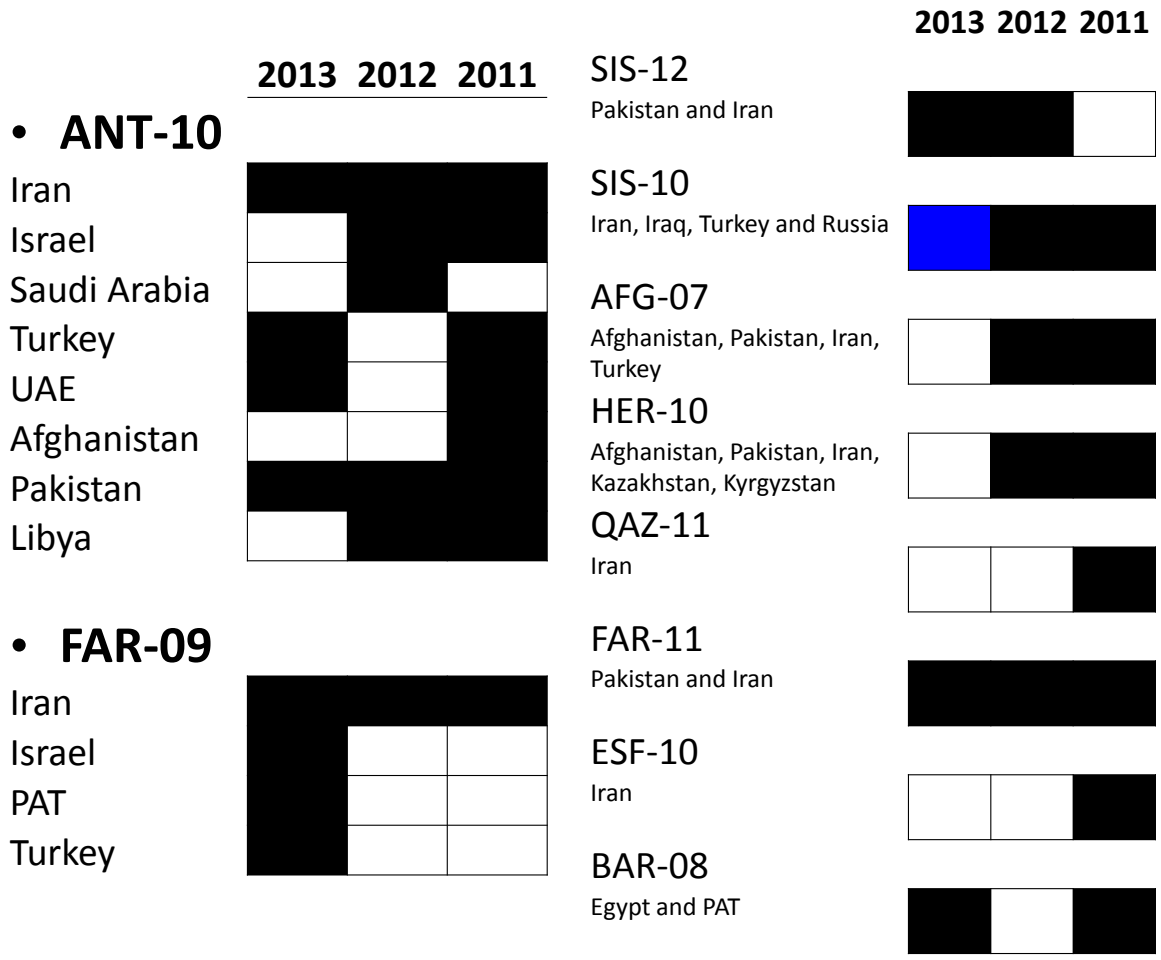

Figure 1.12: Distribution of two FMDV serotype O and eight serotype A sub-lineages in pool 3 during 2011-2013. The FMD virus lineage recovered from outbreaks in Russia is highlighted in blue.

FMD strains from these endemic countries can also spread into new areas: during June 2013, FMD outbreaks were reported in Mountain region Garnukha, Urupsky, Karachayevo-Cherkesskaya Respublika, in the North Caucasus area of Russia near the Black Sea. A further outbreak was reported in the same Respublika, and subsequent FMD outbreaks were reported in cattle in Krasnodarskiy Kray (n=3) and a rural community Nizhny Kurkuzhin, Baksansky, Kabardino-Balkarskaya Respublika (n=1). VP1 sequencing for a representative virus was undertaken at ARRIAH and analysed at the WRLFMD confirming that the virus belonged to the A/ASIA/Iran-05 lineage (from the SIS-10 sub-lineage) and are distinct from FMD viruses from the A/ASIA/Sea-97 lineage that have also caused outbreaks during 2013 in Eastern Russia (see Appendix 3, Figures A3.1 and A3.8). During November and December, the WRLFMD characterized

FMD viruses that have been recently collected from cattle in Libya and Saudi Arabia. The samples from Libya were received to Pirbright via IZSLER, Brescia, Italy. Sequence analysis undertaken in collaboration with the Project Directorate on Foot-and-Mouth Disease, Mukteswar, India (PD-FMD) indicates that these are separate introductions of the O/ME-SA/Ind-2001 lineage most closely related to contemporary viruses from Bhutan and India (see Appendix 3, Figures A3.9 and 3.10). These are unexpected findings that are in contrast to recent analysis of other serotype O FMD viruses from Libya or in Saudi Arabia. The O/ME-SA/Ind-2001 lineage appears to be normally restricted to the Indian sub-continent and has only previously caused FMD outbreaks on a small number of occasions in the Middle East. The exotic incursion of this new lineage in North Africa has followed quickly after the cases due to SAT 2 that occurred during 2012 and it will important to monitor the spread of this lineage during 2014.

Conjectured circulating FMD viral lineages in pool 3 during 2013:

- O/ME-SA/PanAsia-2 (predominantly from ANT-10 and FAR-09 sub-lineages)
- O/ME-SA/Ind-2001 (recent incursion during 2013 from the Indian sub-continent)
- A/ASIA/Iran-05 (from SIS-12, SIS-10, FAR-11 and BAR-08 sub-lineages)
- Asia-1 (Sindh-08 lineage)

Table 1.5: Overview of samples collected and tested from pool 3 during 2013

		Numbers of samples	
Laboratory	Countries of Origin	Clinical field cases	Surveillance activities
FGBI ARRIAH	Russia	6	
IZSLER	Libya*, Egypt*	22†	6067 sera
WRLFMD	Libya*, Iran, Israel, Pakistan, Palestinian Autonomous Territories, Saudi Arabia, Turkey, UAE	182	
Total		210	

* overlaps into pool 4, where virus incursions of virus strains from the African pool 4 can also arise; †These samples were also tested at WRLFMD

Vaccine recommendations:

- Internationally produced vaccines: O/ME-SA/PanAsia-2 (or suitable alternative), O/Manisa, A Iran-05 (or A TUR 06), A22/Iraq, Asia-1 Shamir
- ARRIAH: O/PanAsia-2, Asia-1 Shamir/89 and a recently produced vaccine for A/ASIA/Iran-05 in Russia: A/Krasnodarsky/RUS/2013 (for vaccine matching data see Appendix 2)
- Other suppliers in the region: SAP FMD Institute, Ankara, Turkey, JOVAC, Jordan, Iran and Egypt

Pool 4:

Regional synopsis:

Pool 4 represents a link between FMD endemic regions in sub-Saharan Africa and countries in North Africa and the Middle East. Within the region, four different FMD serotypes co-circulate and some viral lineages have restricted geographical distributions even within this pool. In the

past, FMD virus lineages from this region have caused outbreaks in the Arabian Peninsula (O/EA-3: Yemen in 2006 and 2008-09). There are also a number of examples of FMDV viruses that have moved north to cause widespread outbreaks of disease in Libya (O/EA-3 and SAT 2 in 2012) and Egypt (O/EA-3 in 2012; A/AFRICA/G-VII in 2006 and in 2012; A/AFRICA/G-IV and SAT 2 which were closely related to addition FMD cases due to SAT2 in the Palestinian Autonomous Territories). Analysis of VP1 sequence data recovered from SAT 2 outbreaks in Libya and Egypt during 2012 suggest that separate incursions of SAT 2 FMDV were responsible for these field cases and that at least two different incursions have occurred into Egypt. The outbreaks in 2012 were the first FMD outbreaks due to SAT 2 in Egypt since 1950, and reinforce the ease by which FMDV can cross international boundaries. The precise transmission routes of these viruses into North Africa and the Middle East is not always clear: however, some reports indicate that for some of these lineages that the epidemiological patterns are consistent animal movements from livestock production centres in the horn of Africa.

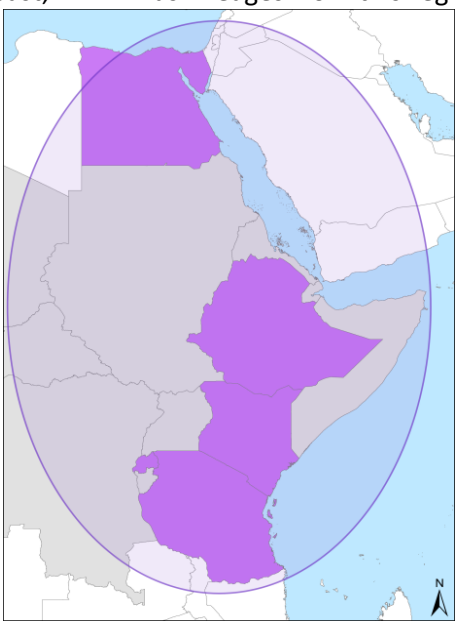

Figure 1.13: Countries within Pool 4 that have been sampled by FMD Reference centres during 2013 (in purple).

Conjectured circulating FMD viral lineages in pool 4 during 2013:

- O (topotypes EA-2 (Kenya, Tanzania, DR Congo, Uganda), EA-3 (Ethiopia, Eritrea, Sudan, Egypt) and EA-4 (Ethiopia, Kenya, Uganda): see Figure A3.11)
- O/ME-SA/Sharqia-72 (detected in samples collected in Egypt in 2009)
- A/AFRICA (genotypes I (Kenya, Tanzania, D.R. Congo), IV (Sudan, Eritrea, Egypt) and VII (Ethiopia, Egypt))
- A/ASIA/Iran-05 BAR-08 sub-lineage (Egypt)
- SAT 1 (topotypes I (Kenya, Tanzania): see Figure A3.12 and IX (Ethiopia))
- SAT 2 (topotypes IV (Kenya, Tanzania), VII (Sudan, Egypt), XIII (Ethiopia, Sudan))
- SAT 3 (only detected in African buffalo in the south of the QENP, Uganda in 1970 & 1997)

Table 1.6: Overview of samples collected and tested from pool 4 during 2013

		Numbers of samples	
Laboratory	Countries of Origin	Clinical field cases	Surveillance activities
WRLFMD	Egypt, Ethiopia, Kenya, Tanzania	81	
Total		81	

Vaccine recommendations:

- Internationally produced vaccines: O/Manisa, O/PanAsia-2 (or equivalent), A/Eritrea, SAT2/Eritrea

- Locally produced vaccines from KEVIVAPI (Kenya): O/Kenya 77/78, A/Kenya 5/80, SAT1 Tanzania T155/71 and SAT2 Kenya 52/84 and NVI (Ethiopia): O Ethiopia O 281, A Ethiopia A110 and BVI (Botswana).

Pool 5:

Regional synopsis:

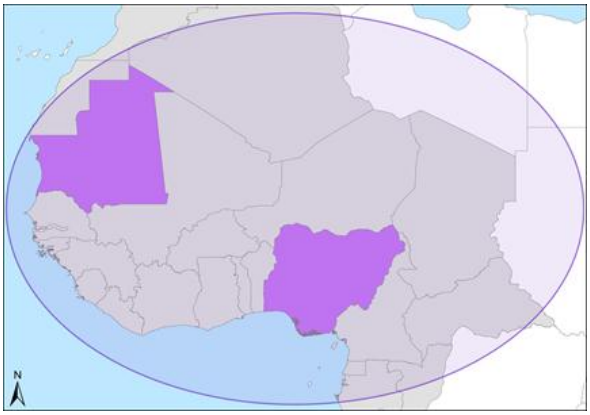

Figure 1.14: Countries within Pool 5 that have been sampled by FMD Reference centres during 2013 (in purple).

FMD is endemic in the whole region covered by pool 5 and epizootic outbreaks are regularly observed, but rarely investigated. In West and Central Africa FMD outbreaks are under sampled and rarely serotyped. The limited amount of sequence data that has been generated indicates that for some FMD lineages there are close epidemiological links between countries in in this region and elsewhere in sub-Saharan Africa (Pool 4: Bronsvoort et al., 2004; Habiela et al., 2010). The regional lab network for West and Central Africa (RESOLAB), a specific network on FMD is facilitating the collaboration between laboratories in the region to encourage sample collection, analysis and shipment. RESOLAB is the West & Central Africa Veterinary Laboratories network for Avian influenza and TADs which was launched in December 2007 in response to the rapid spread of HPAI / H5N1 in 2006 in order to harmonize control and surveillance activities. The coordination Unit – FAO-ECTAD at the Regional Animal Health Centre in Bamako, Mali and covers this area. In 2010 the network formed sub-networks for a number of priority diseases such as FMD, Rabies & PPR with the aim of harmonizing and enhancing FMD surveillance and diagnostic activities, collection of sample for virus identification. Laboratories capacities for FMD diagnosis is being enhanced through training focusing on FMDV detection and identification, and serology studies as well as focused funding support provided from EuFMD (via the European Union) to WRLFMD to assist in the characterization of samples collected from field outbreaks. It is intended that the information generated for the region will be disseminated to the international community.

Conjectured circulating FMD viral lineages in pool 5 during 2013:

- Serotype O (topotypes WA and EA-3 (Nigeria))
- Serotype A (topotype AFRICA, genotypes IV and VI)
- Serotype SAT 1 (?)
- Serotype SAT 2 (topotype VII)

Table 1.7: Overview of samples collected and tested from pool 5 during 2013

		Numbers of samples	
Laboratory	Countries of Origin	Clinical field cases	Surveillance activities
NVRI, Vom	Nigeria	13	630 sera
WRLFMD	Mauritania	27	
Total		40	

Vaccine recommendations:

- Internationally produced vaccines: O/Manisa, O/PanAsia-2 (or equivalent), A/Eritrea, SAT2/Eritrea

References:

Bronsvoort, B. M., A. D. Radford, V. N. Tanya, C. Nfon, R. P. Kitching, and K. L. Morgan, 2004: Molecular epidemiology of foot-and-mouth disease viruses in the Adamawa Province of Cameroon, *J. Clin. Microbiol.* 42, 2186–2196

Habiela M., Ferris N. P., Hutchings G. H., Wadsworth J., Reid S. M., Madi M., Ebert K., Sumption K. J., Knowles N. J., King D. P. and Paton D. J. (2010) Molecular characterisation of foot-and-mouth disease viruses collected from Sudan. *Transboundary and Emerging Diseases* **57**: 305-314.

Pool 6:

Regional synopsis:

FMD field strains in Pools 6 are normally restricted to FMD virus lineages from the three Southern Africa Territories serotypes (SAT 1, SAT 2 and SAT 3) and domesticated livestock populations in certain countries (South Africa, Lesotho and Swaziland) and zones (in Botswana and Namibia) are FMD-free (without vaccination), although FMDV is still present in African buffalo with game parks and reserves.

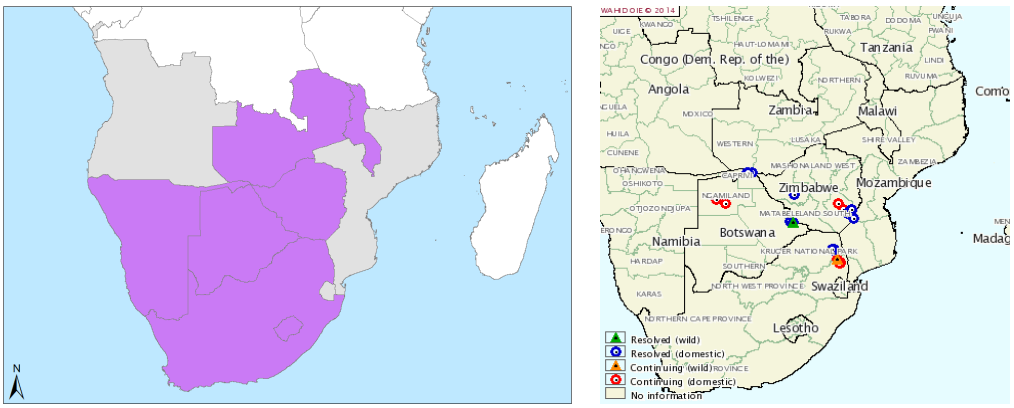

Figure 1.15: Countries within Pool 6 that have been sampled by FMD Reference centres during 2013 (in purple). Map on the right shows the location of FMD outbreaks that have occurred during 2013 that have been reported to OIE.

Eurasian FMDV serotypes (O and A) have not been detected in Southern African countries since O/ME-SA/PanAsia caused outbreaks in South Africa in 2000, although countries on the northern boundaries of this pool (Tanzania and Zambia) share serotype O and A FMD virus lineages with

endemic countries in East Africa. During 2013, new epidemiological events have been reported to OIE in South Africa, Zimbabwe, Namibia and Botswana. During April 2013, an FMD outbreak (due to serotype SAT 2, characterised by BVI) was reported in Masvingo, in southeast Zimbabwe and seven further outbreaks (May-July) have been reported in cattle in Masvingo (5) and Manicaland (2). There is evidence that some of the affected villages border a national park with wild buffaloes which share grazing and watering points with cattle. A further FMD outbreak (serotype not defined) was occurred in Matabeleland North, Zimbabwe during April 2013. FMD outbreaks have been reported in Botswana (Ngamiland and in the North-East Region) and in Namibia (Caprivi Strip). In South Africa during July and August 2013, four outbreaks of FMD (due to serotype SAT 1) occurred in cattle with contact with wildlife in Limpopo Province within South Africa's FMD protection zone in the portion where vaccination for FMD is undertaken by State Veterinary Services (Figure 1.15). Subsequent to these outbreaks, eleven FMD outbreaks (due to serotype SAT 2) have occurred in Mpumalanga Province (from July-December 2013: see Figure A3.12) which is also within South Africa's FMD protection zone in the portion where vaccination for FMD is done by State Veterinary Services.

Conjectured circulating FMD viral lineages in pool 5 during 2013:

- Serotype SAT 1 (topotypes I, II and III)
- Serotype SAT 2 (topotypes I, II and III)
- Serotype SAT 3 (topotypes I, II and III)

Table 1.8: Overview of samples collected and tested from pool 6 during 2013

		Numbers of samples	
Laboratory	Countries of Origin	Clinical field cases	Surveillance activities
ARC-OVI	South Africa, Namibia	126	35,448 LP 122 SP 368 NSP 923 VNT
RRLSS, BVI	Botswana, Lesotho, Malawi Rwanda*, Zambia, Zimbabwe,	33	70 LP 200 NSP
WRLFMD	Namibia		60 probang samples tested by VI and RT-PCR
Total		159	

* overlaps with pool 4

Pool 7

Regional synopsis:

No outbreaks have been reported in the South America during 2013 and it is almost 2 years since the last reported outbreak in the continent (from Paraguay in 2012). Thus, no samples have been collected from suspect field cases and sent to FMD reference laboratories during the past 12 months. In view of the marked reduction in clinical FMD cases, FMD active surveillance

serosurveys have been undertaken recently in Paraguay (2012), Bolivia (2013) and Ecuador (2011-2013).

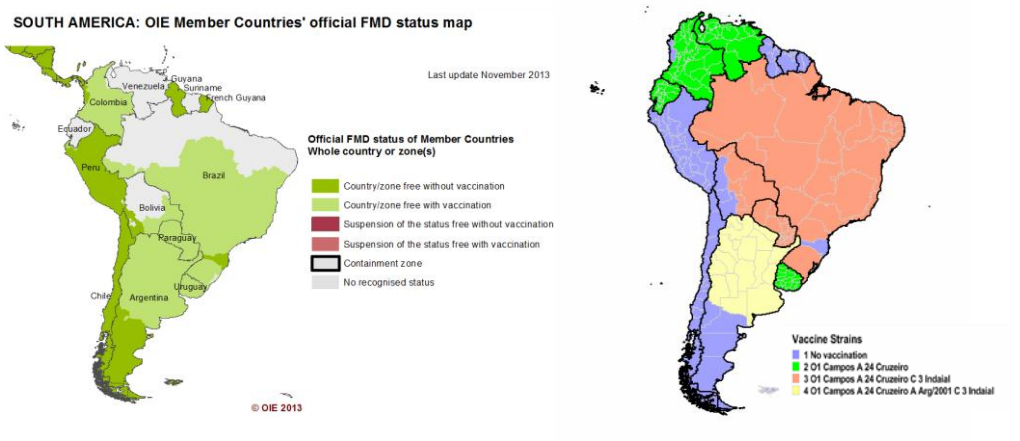

Figure 1.16: Left-hand figure shows official status (from OIE) of countries within Pool 7 and right hand figure overviews use of FMDV vaccines in the continent.

1.6. Information gaps and threats

Submission of samples from endemic regions has continued to be mainly in response to increased number or severity of outbreaks, although in some cases there are proactive projects promoting sample submission. Reactive sampling provides an incomplete survey of the global virus pool and often lacks context in the form of information on the history accompanying the samples. Nevertheless, the bias towards things that are out of the ordinary may be helpful in providing early warning for new epidemics. It is hoped that there will be growing uptake of regional FMD control schemes following the endorsement and continuation of the OIE/FAO Progressive Control Pathway FMD initiative under the Global Framework for eradication of transboundary animal diseases which received unanimous backing at the 2nd Global Control for FMD meeting in Bangkok in June 2012 from all OIE member states. The progressive control pathway (PCP) tool will be an essential aid to countries that are currently endemically infected with FMDV and intend to carry out surveillance to identify the types of virus present and the extent of infection.

The main gaps in knowledge about the global distribution of FMDV come from countries without control schemes, especially in sub-Saharan Africa and in southern and central Asia.

Part 2: Improving the quality of laboratory tests from international and international reference laboratories

2.1 Proficiency testing schemes organised by the OIE/FAO FMD Laboratory Network

RRL SEA (Pakchong)
Scope: to evaluate FMDV serology using LP-ELISA and NSP tests, and antigen ELISA typing tests for 8 laboratories within the SEACFMD campaign (Cambodia, Lao PDR, Malaysia, Myanmar, Thailand (RRL), Vietnam (Hanoi), Vietnam (Ho Chi Minh) and Singapore, and 8 laboratories within Thailand (VRDC Western part (Ratchaburi), VRDC Upper Northern (Lumpang), VRDC Lower Northern (Pisanuloke), VRDC Upper North Eastern (Khonkean), VRDC Lower North Eastern (Surin), VRDC Eastern part (Chonburi), VRDC Southern Part (Nakhon Sri Thammarat) and National Institute of Animal Health (Bangkok).

FGBI ARRIAH
A FMDV proficiency test was coordinated by ARRIAH for 9 external laboratories in neighboring countries: Armenia, Azerbaijan, Ukraine, Belarus, Moldavia, Uzbekistan, Tajikistan, Kazakhstan, and Kyrgyzstan. During November 2013, samples of inactivated FMDV antigens and sera from recovered and vaccinated animals will be sent to participating laboratories.

LVRI CAAS
LVRI provides materials (sera and samples panels) for an annual PTS that is organized on an annual basis by the Bureau of Vet of MOA, China.

NVSL-FADDL
The laboratory provided PT panels and reagents for diagnostic tests to US NALHN laboratories and Mexico.

PANAFTOSA
During 2013, PANAFTOSA has organised PT exercises for vesicular virus detection by RT-PCR which will be completed (10 laboratories) during November, and has finalised a PT exercise for vesicular virus antigen detection where 12 laboratories have reported results.

WRLFMD
During 2013, the WRLFMD has organised and coordinated a PTS for virology and serology diagnosis of FMD (and Swine Vesicular Disease) and has completed the reporting phase of the previous PT exercise undertaken during 2012 (Phase XXV). The main purpose of these exercises has been to assess whether laboratories can correctly interpret the virological and serological status of the samples that are sent. Therefore, particular tests and assays are not normally specified: rather laboratories are invited to select tests that they believe are appropriate, and use them to interpret the status of the samples.

The format of the PT panels (Phase XXVI) comprises 4 panels of samples:

- Panel 1: Infectious materials from pigs with a vesicular condition for FMD/SVD virus detection. These samples are treated as if they are received from a suspected case of FMD or SVD. These samples can be tested using a wide range of assay formats, but are only suitable for laboratories that have adequate containment facilities.
- Panel 2: Non-infectious materials comprising FMDV and SVDV that have been inactivated using binary ethyleneimine (BEI) and inocuity tested by two passages in primary bovine thyroid cells with negative results. These samples can be used

outside of the most specialised high-containment laboratories and can be tested using antigen detection ELISA and molecular methods such as RT-PCR.

- Panel 3: Non-infectious serum samples for FMDV antibody assays. The laboratories have been asked to interpret the status of these samples in context of possible vaccination histories with O_1 Manisa (2011), O_1 Manisa or Asia 1 Shamir (2012) and type O, Asia 1 or SAT 2 (2013).
- Panel 4: Non-infectious serum samples for SVDV antibody assays.

All samples undergo 10x testing at WRLFMD to demonstrate consistent assay results prior to sending these materials to the participating laboratories. Once the samples have been tested by the different laboratories, results are sent to WRLFMD and collated together. Data generated by participating laboratories is presented (in a coded manner) at the EURL meeting (annually) and at EUFMD (bi-annually). In addition, laboratories are given individual feedback on their results including observations and non-conformities according to predefined criteria. Laboratories with non-conformities are invited to contact us to discuss a course of action to rectify any test deficiencies

Table 2.1: Summary of laboratories that have participated in the PT schemes that were organised in 2012 (results reported in 2013) and 2013.

	2012	**2013**
Number of invited laboratories	76	86
Shipments sent	59	54
Participants from European Union (funded by EURL)	25	26*
	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, The Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, The Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom
Participants funded by EuFMD	21	22
Participants from non-EU European and neighbourhood countries (funded by EUFMD)	Armenia, Azerbaijan, Belarus, Croatia, Egypt, Georgia, Iran, Israel, Lebanon, Morocco, Norway, Serbia, Switzerland, Tunisia, Turkey	Algeria, Armenia, Azerbaijan, Belarus, Bosnia, Georgia, Iran, Lebanon, Libya, Macedonia, Montenegro, Morocco, Norway, Serbia, Switzerland, Tunisia, Turkey
International participants (funded by EUFMD)	Botswana, Brazil, Ethiopia, Russia, South Africa, Thailand	Botswana, Ethiopia, Kenya, South Africa, Thailand
Self-funded participants	Australia, Canada, USA	Australia, Canada, Chile, New Zealand, USA

* Croatia is now a member of the European Union (since 2013)

2.2 Supply of reagents

RRL SEA (Pakchong)

The Pakchong laboratory can supply rabbit trapping and guinea-pig detecting antibodies for serotypes O, A and Asia 1 strains circulating in Southeast Asia. The laboratory can also supply concentrated inactivated antigens and control sera suitable for use in ELISA tests.

Table 2.1: Regents supplied by RRL SEA Pakchong during 2013

Type of reagents	Supplied nationally	Supplied to other OIE member countries	Total
Rabbit trapping antibody for type O, A and Asia1	Type O= 76sets Type A = 77 sets Type Asia1 = 70 sets	Type O=8sets Type A =8 sets Type Asia1 = 8 sets (Myanmar, Laos, Cambodia)	Type O = 84 sets Type A = 85 sets Type Asia1 = 78 sets
Guinea pig detecting antibody for type O, A and Asia1	Type O=83sets Type A=91sets Type Asia1 = 85 sets	Type O= 8sets Type A= 8sets Type Asia1=8sets (Myanmar, Laos, Cambodia)	Type O= 91sets Type A= 99sets Type Asia1 = 93 sets
Non concentrated Inactivated FMD antigen for type O, A and Asia1	Type A = 250 ml	---	Type A = 250 ml
Concentrated inactivated (50x) antigen type O, A and Asia1	TypeO = 465 ml Type A = 445 ml TypeAsia1= 315 ml	TypeO = 30 ml Type A = 30 ml Type Asia1 = 30 ml (Myanmar, Laos, Cambodia)	TypeO= 495ml TypeA= 475ml Type Asia1 = 345 ml
Control serum for C++, C+ and C-	C++ = 525 ml C+ = 525 ml C- = 375 ml	C++ =120ml C+ =120ml C- =120ml (Myanmar, Laos, Cambodia)	C++ = 675 ml C+ = 675 ml C- = 495 ml

FGBI ARRIAH

Table 2.2: Regents supplied by FGBI ARRIAH during 2013

Type of reagent	Quantity	Recipient countries
FMDV antibody kits	599	Azerbaijan, Kazakhstan, Belarus, Russia
FMDV antigen kits	17	Kyrgyzstan, Kazakhstan
FMDV antigen	79	Azerbaijan, Kazakhstan
FMDV sera	79	Azerbaijan, Kazakhstan

The FMD Regional Reference Laboratory provided a number of FMD ELISA kits to Kazakhstan, Belarus, and Azerbaijan.

LVRI, CAAS

LVRI, Lanzhou have the capacity to provide FMDV diagnostic reagents for FMDV Ag-Capture ELISAs, FMDV Serotyping RT-PCRs, FMDV multiplex RT-PCRs and FMDV real-time RT-PCRs. For

serological assays, LVRI can provide reagents for LPB-ELISA, IHA, FMDV NSP-3ABC ELISA, FMDV NSP-2C3AB antibody colloid-gold test strips and reagents for dot-blots and are currently developing assays for SPC-ELISA.

Table 2.3: Regents supplied by LVRI, CAAS during 2013

Type of reagent	Quantity	Recipient Laboratories
LPB-ELISA Kit	~10,100 kits	Provincial Animal CDC lab
NSP-3ABC-ELISA kit	~1,200 kits	Provincial Animal CDC lab
IHA Antigen (for type O)	10,450 kits	Provincial Animal CDC lab
Multiplex RT-PCR Kit	~400 kits	Provincial Animal CDC lab
IS-ELISA kit	15 kits	CNFMDRL only
Strips for antibodies FMD type O, A , Asia 1	255 kits	Provincial Animal CDC lab

RRLSS, BVI

BVI can produce and provide the following diagnostic reagents: rabbit hyper-immune sera for ELISA, Guinea-pig hyper-immune sera for ELISA, inactivated antigens for ELISA and negative sera. These reagents are supplied to National Veterinary Laboratories on demand.

Table 2.4: Regents supplied by LVRI, CAAS during 2013

Type of reagent available	Related diagnostic test	Produced / stored	Amount supplied nationally (ml, mg)	Amount supplied internationally (ml, mg)	Name of recipient OIE Member Countries and of institutions
Control positive sera (OIE-approved international sera)	LPB ELISA SAT 1; SAT2 and SAT3	Produced	0 ml (positive)	5 ml Each	Zimbabwe / Lesotho National Laboratory
Control negative sera (OIE-approved international sera)	LPB ELISA SAT 1, SAT2 and SAT3	Produced	0 ml	5ml	Zimbabwe/ Lesotho National Laboratory
Antigens SAT1,2 and 3	Antigen ELISA typing	Produced	350ml each	60ml each	Zimbabwe/ Lesotho National Laboratory

IZSLER

IZSLER can produce reagents and kits for FMDV antigen and FMDV-specific antibodies. Antigen

detection serotyping assays include combined kits for serotypes O, A, Asia 1 and C and O, A, SAT1 and SAT2). Solid phase competitive-ELISAs (SP-ELISAs) are also available for serotypes O, A and Asia-1 as well as a NSP (3ABC) ELISA. During 2013, a new SP-ELISA has been developed for the detection of SAT2-specific antibodies. During 2013, ready-to-use kits have been provided to 12 countries (shown in Table 2.4 below).

Table 2.5: Diagnostic kits and reagents provided by IZSLER during 2013

Funded by	Country	NSP assays	Ag-detection		SP-ELISA			
			O, A, C, Asia-1	O, A, SAT1, SAT2	O	A	Asia-1	SAT 2
EuFMD	Pakistan	40	60		15	15	15	
	Turkey		5	1	3	3	3	
	Greece		2		1	1	1	
	Iran	2	34		3	3	3	
	Lebanon		1	1				
	Nepal*	1	1		1			
IAEA	Mali			2				
	Myanmar	3	4		3	2		
National institutes	New Zealand		1	1	1	1	1	
	Russia	4	2	3	3	3	3	
	Poland	1	1	1	1	1	1	1
	Chad				3	3		3
	Total	**51**	**111**	**9**	**34**	**32**	**27**	**4**

* reagents supplied for training course

PANAFTOSA
During 2013, PANAFTOSA has supplied a large number of reagents for FMDV diagnostic kits including: I-ELISA (73,000), EITB (3,000), 3ABC ELISA/EITB system (133,500), ELISA-IS antigen typing (2,100), LP-ELISA for FMD sero-surveillance (3,000) and LP-ELISA for VSV sero-surveillance (4,000) and LP-ELISA for FMDV vaccine quality control (276,000). In addition viral cDNA, FMDV and VSV strains and cell lines have been provided.

2.3 Training courses organised by Network partners

FGBI ARRIAH: Two research workers from Poland received training in FMD clinical diagnostics and sampling at ARRIAH (Russia, Vladimir) during October 2013.

During 2013, LVRI organized a training course to improve prevention and control of FMD in China (16-18 July, 2013) with participants from 31 Chinese Provinces. Research scientists from LVRI also participated in a conference on cross-border animal disease prevention and control in China, Mongolia and Russia (Jan, 2013, Russia) and the 14th China FMD Scientific Research Conference in Guilin, in Oct, 2013, where 20 staff from CNFMDRL (Chinese NRL) were invited and gave reports relating to FMD epidemiology, vaccines and vaccination program, prevention and control and research progress.

ARC-OVI has undertaken the following training activities during 2013: as part of the Southern African Centre for Infectious Disease Surveillance (SACIDS) project a course has been organized to demonstrate sampling of buffalo and in-house training of PhD students (July – October 2013). A

training workshop for the diagnosis of transboundary animal diseases in the region (FMD, ASF, RVF, LDS and PPR) was held in May 2013. During June and December 2013, ARC-OVI has also facilitated training to establish serological and molecular testing at CVL, Namibia.

At IZSLER, Brescia, a veterinarian from AHRI Cairo, Egypt visited for 3 weeks in April 2013 (supported by EuFMD). Training was provided on all FMDV diagnostic assays (for virus and Ab detection) and large-scale testing and titration of sera (SP and NSP Ab by IZSLER-kits): 1500 sera from a serosurvey in Egypt were examined during the training and interpretation of sero-surveillance laboratory results was provided. During June 2013, 4 veterinarians from Libya (one for each Lab: Tripoli, Bengasi, Shahat and Alzawia) participated on a 2-week training course in Brescia (supported by Italian Ministry). Training was provided on antigen and Ab detection and serotyping for FMDV, using IZSLER kits. This training course accessed sera from a large sero-survey conducted in Libya (anti-SP and anti-NSP Ab).

RRLSEA-Pakchong organised a 2 week training course on RT-PCR and sequencing for FMD for 2 scientists from Indonesia (1 veterinarian and 1 technician) supported by OIE-SRR SEA during December 2013.

PANAFTOSA: during 2013 the following technical training courses (one–two week long each) were offered in laboratory diagnostic methods including cell culture production and maintenance, detection and differential diagnosis (FMDV and VSV) using RT-PCR, LP-ELISA for post vaccination monitoring by detection of FMDV-specific antibody, I-ELISA 3ABC/EITB for FMD sero-surveillance and laboratory biorisk management.

The WRLFMD organises a two-week training course for FMD diagnostics held at the Pirbright Institute on an annual basis. This laboratory-based course is designed for laboratory technicians or those who have a limited knowledge of FMDV and are responsible for implementing FMDV diagnostic techniques within the laboratory. The course focuses on FMDV diagnostic techniques including serological, molecular and virological methods. These courses are delivered through a series of seminars, practical demonstrations and hands-on lab work, and also include instruction into the working practises required in high containment laboratories (BSL3). During 2013, seven scientists from Brazil, Jordan, New Zealand, Tanzania, Uganda, Zambia and Zimbabwe participated on this course.

2.4 Collaborative projects

Table 2.6: Summary of representative collaborative research projects that involve OIE/FAO FMD Lab Network partners

	Collaborators	Purpose of collaboration
FGBI ARRIAH	Framework of Interstate Target Eurasian Economic Community (EurAsEC) programme «Innovative biotechnologies»	Development of test system real time PCR for differential diagnosis of foot and mouth disease and swine vesicular disease
	Specific cooperative with USDA	FMDV strain characterization
	Agreement between FAO and FGBI ARRIAH	Services related to the development and validation of non-invasive sampling techniques in wild boar for the detection of

		FMDV genome
ARC-OVI	SADC-TADS	Regional sampling of buffalo
	CORUS	Assessment of foot and mouth disease control methods within the Greater Limpopo trans-frontier conservation area
	SACIDS	A One Health VIRTUAL CENTRE linking 5 southern African countries (academic and research institutions), involved with infectious diseases of humans, animals in smart partnership with international research centres (www.**sacids**.org)
WRLFMD	SACIDS	See above
	BBSRC/DfID: CIDLID	Understanding the epidemiology of FMD in endemic settings and the valuation of appropriate tools for control
	Rapidia-field	Development and evaluation of new diagnostic tools for veterinary diseases for use in the field and simple laboratories (http://rapidia.eu/)
	Epi-seq	Use of next-generation sequencing technologies to develop new tools to understand the evolution and molecular epidemiology of livestock diseases (http://www.epi-seq.eu/)
	DISCONVAC	Development and enhancement of FMD vaccine-based control strategies for free and endemic regions
	NADIR	EU-network of animal disease infectiology research facilities (http://www.nadir-project.eu/)
CODA-CERVA	Rapidia-field	See above
	Epi-seq	See above
	DISCONVAC	See above
IZSLER	DISCONVAC	See above

Appendix 1: Details of clinical samples from field cases of tested within the network during 2013

Table A1.1: RRL SEA (Pakchong, Thailand): 143 clinical samples

Country	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	NVD
Cambodia	6	-	-	-	-	-	7
Laos	9	-	-	-	-	-	3
Thailand	27	56	-	-	-	-	25
Vietnam	4	3	-	-	-	-	3
Totals	**46**	**59**	**0**	**0**	**0**	**0**	**38**

Table A1.2: Federal Budget Governmental Institution Federal Centre for Animal Health (FGBI ARRIAH, Russia): 172 clinical samples

Country	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	NVD
Kazakhstan	-	1	-	-	-	-	15
Russia	-	68	-	-	-	-	85
Mongolia	-	3	-	-	-	-	0
Totals	**0**	**72**	**0**	**0**	**0**	**0**	**100**

128 of these samples were positive by RT-PCR and 44 generated NVD results by RT-PCR

Table A1.3: Lanzhou Veterinary Research Institute (CAAS, LVRI, China): 52 clinical samples

Country	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	NVD
PR China	6	17	-	-	-	-	29
Totals	**6**	**17**	**0**	**0**	**0**	**0**	**29**

Table A1.4: Project Directorate on Foot-and-Mouth Disease (PD-FMD, Mukteswar, India): 77 clinical samples

Country	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	NVD
India	32	19	26	-	-	-	-
Totals	**32**	**19**	**26**	**0**	**0**	**0**	**0**

All these clinical materials were passaged in BHK21 and LFBK cells

Table A1.5: RRLSS, BVI (Gaborone, Botswana): 33 clinical samples

Country	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	NVD
Botswana	-	-	-	-	2	-	3
Rwanda	-	-	-	-	-	-	14
Zimbabwe	-	-	-	-	14	-	-
Totals	**0**	**0**	**0**	**0**	**16**	**0**	**17**

Table A1.6: IZSLER (Brescia, Italy): 22 clinical samples

Country	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	NVD
Libya	9	-	-	-	-	-	13
Totals	**9**	**0**	**0**	**0**	**0**	**0**	**13**

Table A1.6: ARC-OVI (Onderstepoort, South Africa): 126 clinical samples (partial data reported below)

Country	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	NVD
Namibia	-	-	-	-		-	
South Africa	-	-	-	1	1	-	
Totals	**0**	**0**	**0**	**1**	**1**	**0**	

Table A1.7: WRLFMD (Pirbright, UK): 396 clinical samples

Country	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	NVD
Bhutan	2						8
Cambodia	2						
Egypt		10					15
Ethiopia	5						4
Hong Kong SAR	1						1
Iran	5	18					4
Israel							3
Kenya		2		7	1		5
Laos	5						
Libya	9						13
Mauritania							27
Mongolia		5					5
Palestinian Ter.	2	3					
Pakistan	17	31	24				3
Saudi Arabia	6						2
Taiwan	1						
Tanzania		15		2	1		14
Turkey	14	17	4				5
Thailand	5	7					1
UAE	2						
Vietnam	28	15					20
Totals	**104**	**123**	**28**	**9**	**2**	**0**	**130**

Note: no clinical samples were submitted to reference centres in South America (PANAFTOSA, Brazil or Senasa, Argentina) during 2013.

Additional data was contributed by:

Table A1.9: NVRI, Vom, Nigeria: 13 clinical samples (partial data reported below)

Country	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	NVD
Nigeria	-	2	-	1	1	-	
Totals	**0**	**2**	**0**	**1**	**1**	**0**	

Summary (total of FMD virus positive and negative samples reported during 2013)

	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	NVD
Totals	**197**	**292**	**57**	**11**	**20**	**0**	**327**

Appendix 2: Vaccine matching studies undertaken by network partners during 2013

Vaccine efficacy is influenced by both vaccine potency and vaccine match and it is possible that a poor match may to some extent be compensated by high potency vaccines and by administering more than one dose at suitable intervals. The use of oil adjuvant is also expected to improve efficacy. Thus, a vaccine with a weak antigenic match to a field isolate, as determined by serology, may nevertheless afford some protection if it is of sufficiently high potency. Therefore, in the absence of a good match, or where the match is unknown, vaccines of high potency should preferably be used. The r_1 values shown below, represent the one way serological match between vaccine strain and field isolate, calculated from the comparative reactivity of an antiserum, raised against the vaccine in question, to the vaccine virus and the field isolate.

Key:

	Matched with the vaccine
	Not matched with the vaccine

For VNT:
$r_1 \geq 0.3$ – suggest that there is a close relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection
$r_1 \leq 0.3$ - suggest that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect.

For LB-ELISA:
$r_1 \geq 0.4$ – suggest that there is a close relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection
$r_1 \leq 0.4$ - suggest that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect.

Table A2.1: Pool 1: RRL SEA (Pakchong): 32 field isolates (serotypes O and A):

Countries	O Udornthani 189/87 (Thai vaccine Strain)	A Lopburi/12 (Thai vaccine Strain)
Cambodia (2013)	5/5	nd
Laos (2013)	5/5	nd
Thailand (2013)	4/4	11/13
Vietnam (2013)	2/2	3/3

Testing undertaken using LP-ELISA: figures in the table detail number of samples that were matched against each vaccine strain.

Table A2.2: Pools 1 and 3: FGBI ARRIAH (Vladimir): 5 field isolates (serotype A):

Isolates	Country	Vaccine strains				
		A22 No 550	A22 Iraq/64	A Iran/97	A TUR/06	A Kyrg/07
A/Zabaikalsky/RUS/2013	Russia					
A/Zabaikalsky/Sr Borzya/RUS/2013	Russia					
A/East Kazakhstan/2013	Kazakhstan					
A/Krasnodarsky/2013*	Russia					
A/KChR/2013	Russia					

Testing undertaken using VNT

Tables A2.3/4: Pool 1: LVRI, CAAS: 5 field isolates (serotypes O and A)

Isolates	Vaccine strain
	O/Mya98/BY/2010
O/BY/2010/Swine (Mya-98)	PD_{50}
O/China99 (PanAsia)	PD_{50}
O/Taw-97 (CATHAY)	PD_{50}
O/TZ/CHA/2011 (PanAsia)	R value 0.62

	Vaccine strains		
Field isolate	AF72	Re-A WH/09	A/GDMM/13
A/GDMM/2013 (r-value)			
in-vivo (protection test)	13/16 (>75%)	15/16 (>75%)	14/16 (>75%)

Table A2.5: Pool 2: PD-FMD, Mukteswar: 90 field isolates (serotypes O, A and Asia-1)

Countries	O/IND/R2/1975	A/IND/40/2000	Asia-1/IND/63/1972
India (2013)	36	22	32

Almost all of these field Isolates showed an r-value of > 0.3 (using VNT).

Pool 6: ARC-OVI

Vaccine matching is undertaken using VNT to establish r-values against the following strains: SAT 1 (Topotype I: KNP/196/91, SAR/9/81, Topotype II: BOT/1/06 and topotype III: ZAM/1/06), SAT 2 (Topotype I: KNP 19/89 and topotype II: ZIM/7/83) and SAT 3 (topotype I: KNP 10/90). Capacity to determine vaccine matching using ELISA approaches is also being established in the laboratory.

Pool 7: SENASA and PANAFTOSA

Within pool 7 well established vaccine matching capabilities are available at the region reference centers for the vaccine antigens that are widely used in South America. These antigens are: O1 Campos, A24 Cruzeiro, A/Arg/2001 and C3 Indial. In South America, the in-vivo Protection against Podal Generalisation (PGP) test is used to establish vaccine potency. This test involves 16 vaccinated + 2 control animals which are subsequently challenged with a viral dose of 10,000 BID50%.

Pools 1, 2, 3, 4, 6: Vaccine matching data from WRLFMD: serotype O, A, Asia-1, SAT 1 and SAT 2: 103 field isolates (further details of these reports can be found at: http://www.wrlfmd.org/ref_labs/fmd_ref_lab_reports.htm.

WRLFMD vaccine matching data:

Table A2.6: Vaccine matching studies for Serotype O FMDV by VNT (39 isolates)

		Vaccine strain						
	Field isolate	O-3039	O1 Manisa	O TAW/98	O TUR/5/09	O-4625	O Campos	O/SKR/7/10
Pool 1	O/CAM/1/2012	M	N	M	M			
	O/CAM/2/2012	M	N	M	M			
	O/HKN/1/2013	N	N	N	N	M	N	N
	O/LAO/1/2012	M	N	M	M			
	O/LAO/5/2012	M	N	M	M			
	O/TAW/1/2012	M	N	M	M	M		M
	O/TAW/1/2013	M	N	borderline	M			
	O/TAI/14/2012	borderline	N	N	N			
	O/TAI/19/2012	M	M	M	M			
	O/TAI/1/2013	M	N	M	borderline			
	O/VIT/22/2013	M	N	M/N*				
	O/VIT/51/2013	M	M	M				
	O/VIT/11/2013	M	M	M	M			
	O/VIT/18/2013	M	M	M	M			
Pool 2	O/BHU/12/2012	M	N	N	M	M		
	O/BHU/1/2013	M	N	M	M			
	O/SRL/2/2012		N		M	M		
	O/SRL/3/2009		M		M	M		
	O/SRL/9/2010		M		M	M		
Pool 3	O/IRN/36/2012		M		M	M		
	O/IRN/11/2013		M		M	M		
	O/UAE/1/2013		N		M	M		
	O/LIB/1/2013	M	N	M	M			
	O/LIB/7/2013	M	N	M	M			
	O/PAK/12/2012		M		M	M		
	O/PAK/17/2012		M		M	M		
	O/PAK/55/2012	M	N	M	M			
	O/PAK/3/2013	M	N	M	M			
	O/PAK/24/2013	M	N	M	M			
	O/PAT/14/2013	M	N	M	M			
	O/SAU/1/2013	M	N	M	M			
	O/SAU/4/2013	M	N	M	M			
	O/SAU/6/2013	M	N	M	M			
	O/SAU/7/2013	M	M	M	M			
	O/TUR/3/2013	M	borderline	M	M			
	O/TUR/12/2013	M	M		M	M		
	O/TUR/24/2013	N	borderline		M	M		
	O/TUR/29/2013	M	borderline		M	M		
4	O/EGY/25/2012		M		M	M		

M/N* - two sera were tested. One resulted in a vaccine match while the other did not.
O/TAW/01/2013 was also tested against O Campos (borderline r_1-value) and O PHI/98 (vaccine match).

Table A2.7: Vaccine matching studies for Serotype A FMDV by VNT (40 isolates)

		Vaccine strain						
	Field Isolate	A Iran05	A22 IRQ	A MAY/97	A TUR/06	A/IND/17 /82	A/ERI/98	A/SAU/95
Pool 1	A/MOG/1/2013	M	M	N	M			
	A/MOG/5/2013	M	M	N	M			
	A/MOG/11/2013	M	M		M			
	A/MOG/13/2013	M	M		M			
	A/TAI/13/2012	N	N	borderline	borderline			
	A/TAI/16/2012	N	N	N	N			
	A/TAI/2/2013	M	M	N	M			
	A/TAI/5/2013	N	N	M	N			
	A/VIT/42/2013	N	borderline	M	M			
	A/VIT/60/2013	N	borderline	borderline	M			
	A/VIT/15/2012	N	N	N	N			
	A/VIT/16/2012	N	N	N	N			
	A/VIT/5/2013	N	M	N	M			N
	A/VIT/6/2013	N	M	N	M			N
Pool 3	A/PAK/13/2012	M	M	N	M		N	
	A/PAK/39/2012	N	N	M	N		N	
	A/PAK/43/2012	N	N	borderline	M			
	A/PAK/56/2012	N	N	N	M			
	A/PAK/1/2013	N	M	N	M			
	A/PAK/25/2013	M	M	N	M			
	A/IRN/7/2013	N	N		N			
	A/IRN/24/2012	N	N		N			
	A/IRN/33/2012	N	N		M			
	A/TUR/9/2013	N	N		M			
	A/TUR/14/2013	N	N		M			
	A/TUR/21/2013	N	N		M			
	A/PAT/10/2013	N	N		M			
	A/PAT/11/2013	N	N		N			
	A/PAT/12/2013	N	N		N			
Pool 4	A/EGY/3/2013	N	N		N		N	
	A/EGY/13/2013	N	N		N		N	
	A/EGY/17/2013	N	N		N		N	
	A/EGY/19/2013	N	N		N		N	
	A/KEN/5/2012	N	N		N			
	A/KEN/6/2012	N	N		N			
	A/TAN 40/2012	M	M	N	M		N	
	A/TAN/1/2013	M	M		M		N	
	A/TAN/3/2013	M	M		M		M	
	A/TAN/56/2012	M	M		M		N	
	A/TAN/73/2012	N	N		M		N	

A/KEN/05/2012 was also tested against A/ERI/98 and found not to be a vaccine match.
A/KEN/06/2012 was tested against A/ERI/98 and found to be a vaccine match.

Table A2.8: Vaccine matching studies for Serotype Asia1 FMDV by VNT (11 isolates)

		Vaccine strain		
	Sample Reference	Asia1/IND/8/79	Asia1 Shamir	Asia1 Shamir 6PD50
Pool 3	Asia1/PAK/10/2012	N	N	N
	Asia1/PAK/29/2012	N	N	M
	Asia1/PAK/30/2012	N	N	N
	Asia1/PAK/35/2012	M	N	N
	Asia1/PAK/37/2012	N	N	M
	Asia1/PAK/42/2012	N	N	
	Asia1/PAK/56/2012	N	N	
	Asia1/PAK/7/2013	N	borderline	
	Asia1/PAK/23/2013	N	M	
	Asia1/TUR/2/2013	N	N	N
	Asia1/TUR/13/2013	N	N	N

Table A2.9: Vaccine matching studies for Serotype SAT1 FMDV by VNT (6 isolates)

		Vaccine strain
	Sample Reference	SAT1 RHO/12/78
Pool 4 and 6	SAT1/KEN/4/2013	M
	SAT1/KEN/10/2013	M
	SAT1/TAN/49/2012	M
	SAT1/TAN/50/2012	M
	SAT1/ZAM/6/2012	M
	SAT1/ZAM/8/2012	M

Table A2.10: Vaccine matching studies for Serotype SAT2 FMDV by VNT (7 isolates)

		Vaccine strain	
	Sample Reference	ERI 3218	SAT2/ZIM/7/83
Pool 4	SAT2/EGY 31/2012	M	M
	SAT 2/KEN/04/2012	N	N
	SAT2/TAN/36/2012	N	N
	SAT2/TAN/64/2012	M	M
Pool 6	SAT2/ZAM/1/2012	N	N
	SAT2/BOT/17/2012	M	M
	SAT2/BOT/20/2012	M	M

Appendix 3: Nucleotide sequence analysis

Table A3.1: FMDV nucleotide sequence data (490 VP1 and 24 complete genome) generated during 2013:

	VP1 sequences						Complete genomes
Laboratory	Serotype O	Serotype A	Serotype Asia 1	Serotype SAT 1	Serotype SAT 2	Serotype SAT 3	
RRL SEA (Pakchong)	-	8	-	-	-	-	-
FGBI ARRIAH (Russia)	-	9	-	-	-	-	3
LVRI CAAS (Lanzhou)	6	2	-	-	-	-	-
PD-FMD (Mukteswar)*	89	25	32	-	-	-	-
RRLSS, BVI (Botswana)	-	-	-	3	36	1	-
ARC-OVI (South Africa)	-	-	-	-	5	-	-
WRLFMD (Pirbright)	106	128	29	9	2	-	21
Totals	**201**	**172**	**61**	**12**	**43**	**1**	**24**

* P1 and VP1 data generated for selected isolates

Selected Phylogenetic trees

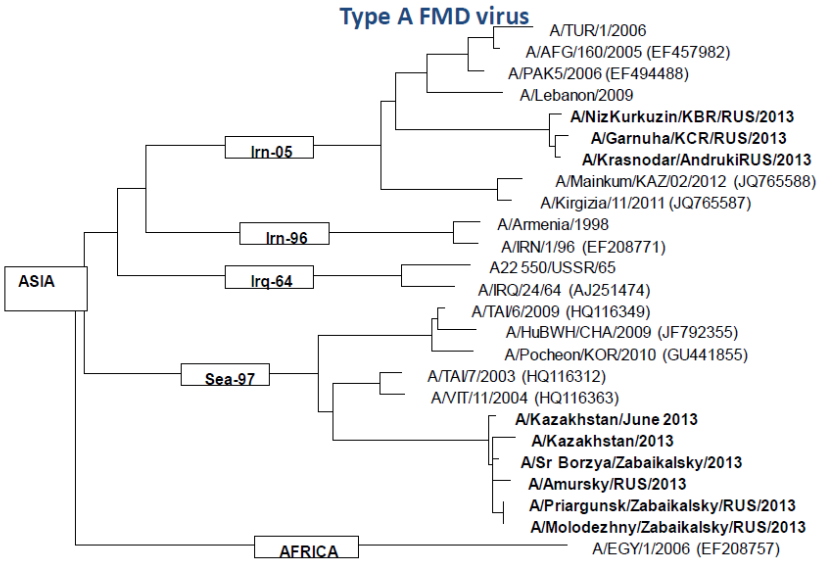

Figure A3.1: Phylogenetic tree generated at FGBI ARRIAH to showing the two FMD virus lineages (A/ASIA/Iran-05 in the North Caucasus and A/ASIA/Sea-97 in Eastern Russia) that have caused outbreaks during 2013.

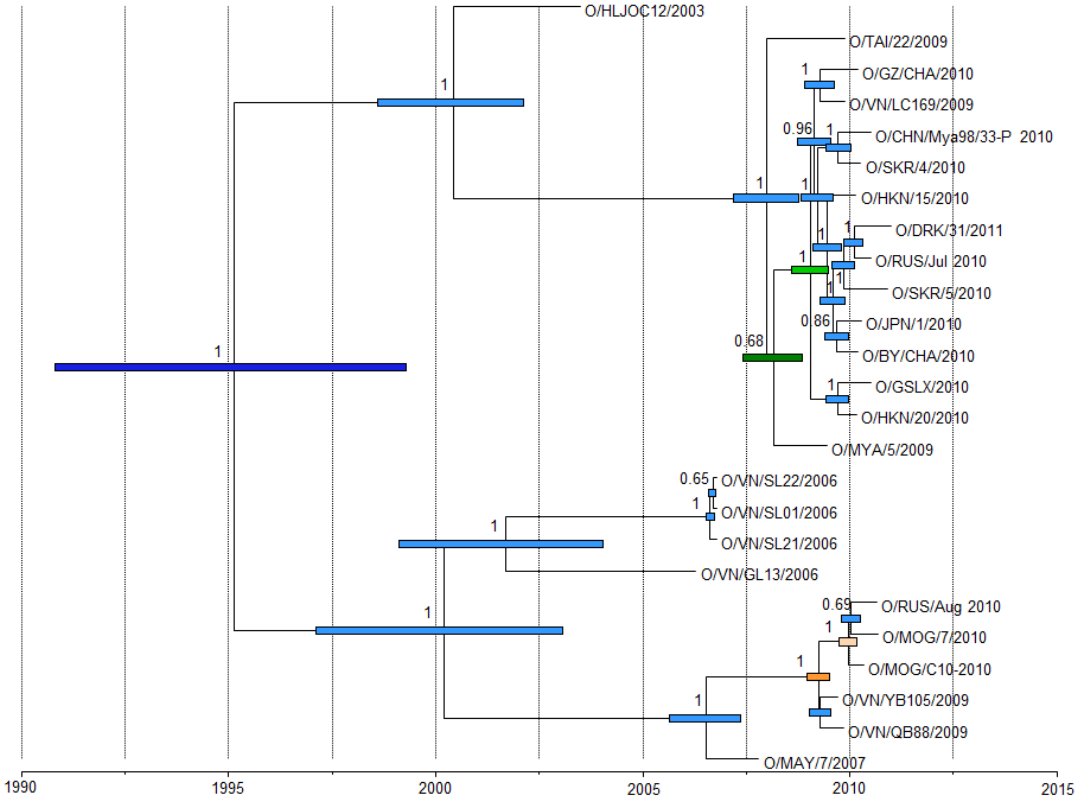

Figure A3.2: Bayesian maximum-clade-credibility time-scaled phylogenetic tree (BEAST) using the polyprotein of 25 O/SEA/Mya-98 FMD viruses showing the two separate O/SEA/Mya-98 lineages that have caused FMD outbreaks in Southeast and East Asia. Uncertainty for the date of each node (95% highest posterior density – HPD - intervals) is displayed in bars. Only node labels with posterior probabilities > 0.6 are indicated.

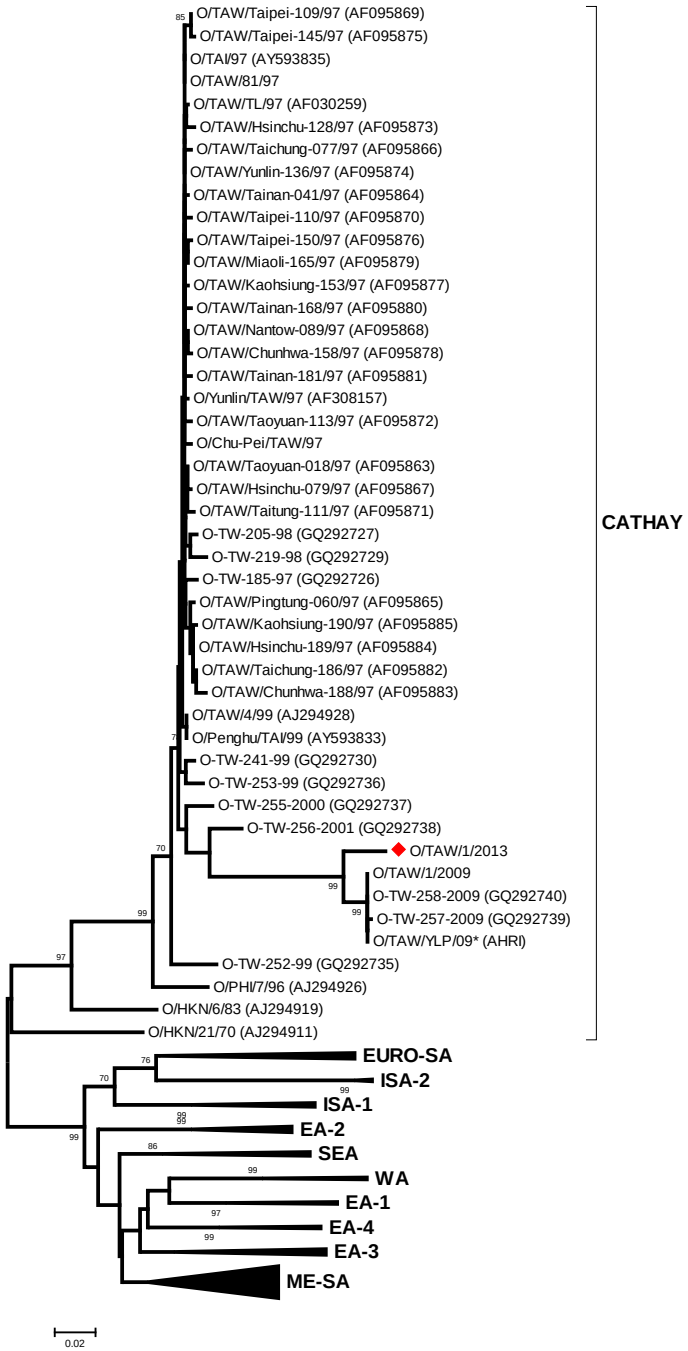

Figure A3.3: Phylogenetic tree for O/CATHAY sample (highlighted by red diamond) that was received to WRLFMD during 2013.

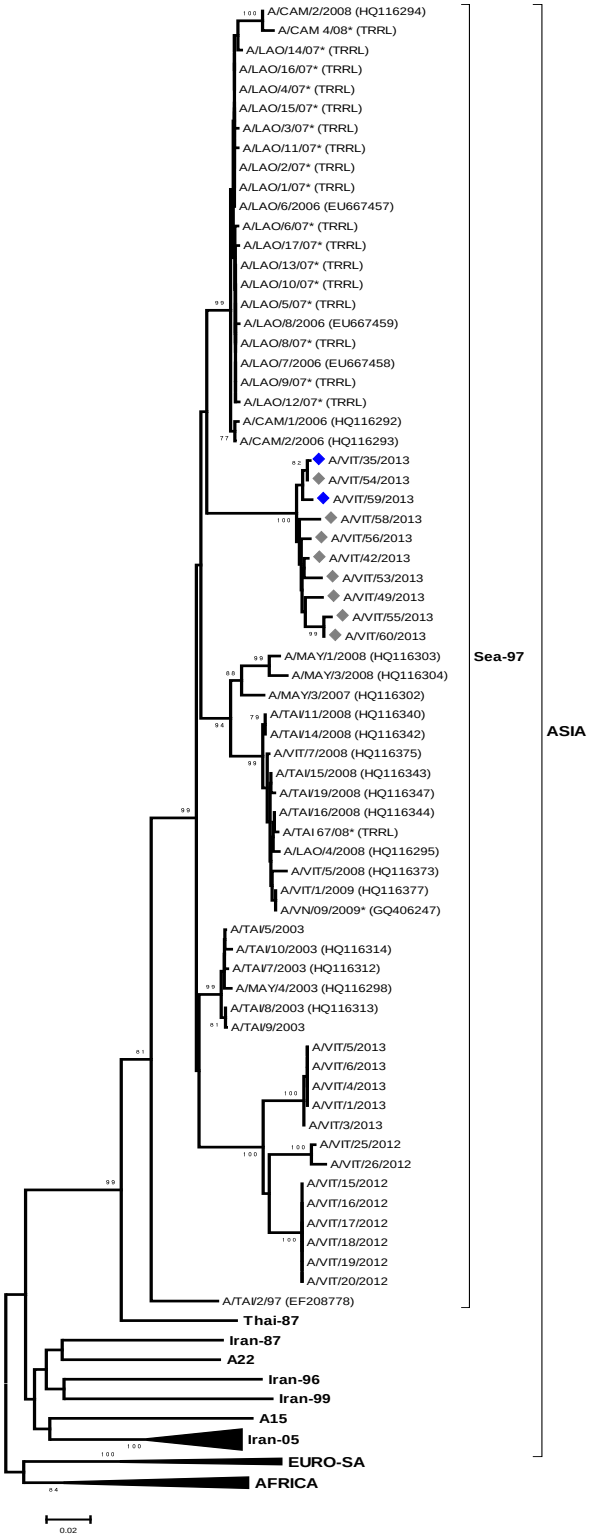

Figure A3.4: Phylogenetic tree for A/ASIA/Sea-97 samples from Vietnam (highlighted by blue and grey diamonds) that were received to WRLFMD during 2013. Additional trees can be found at: http://www.wrlfmd.org/fmd_genotyping/index.html.

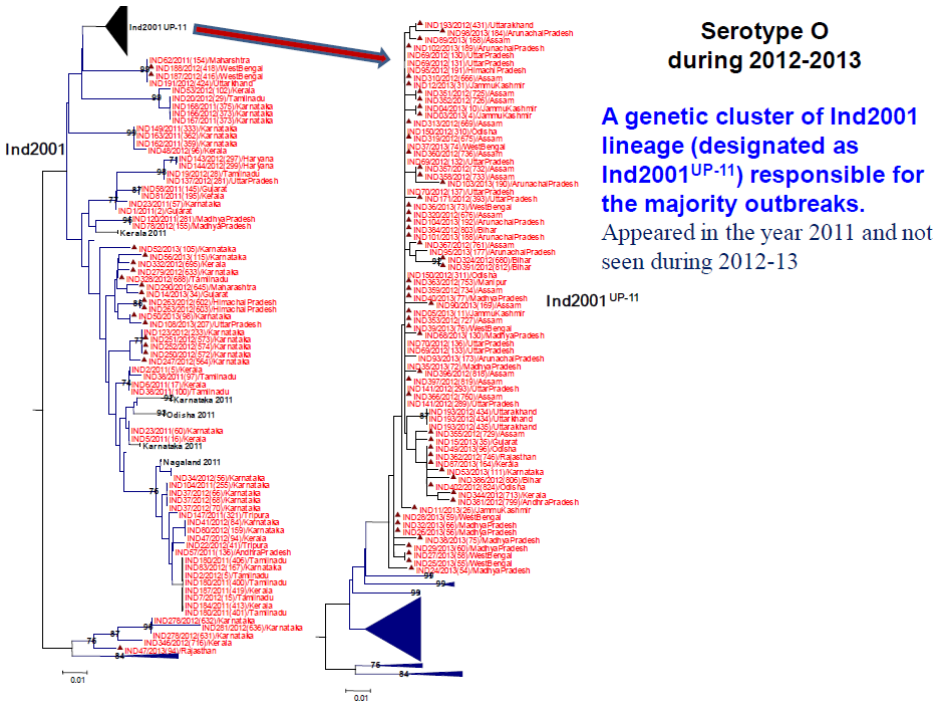

Figure A3.5: Phylogenetic tree generated by PD-FMD outlining serotype O samples that have been characterised during 2013.

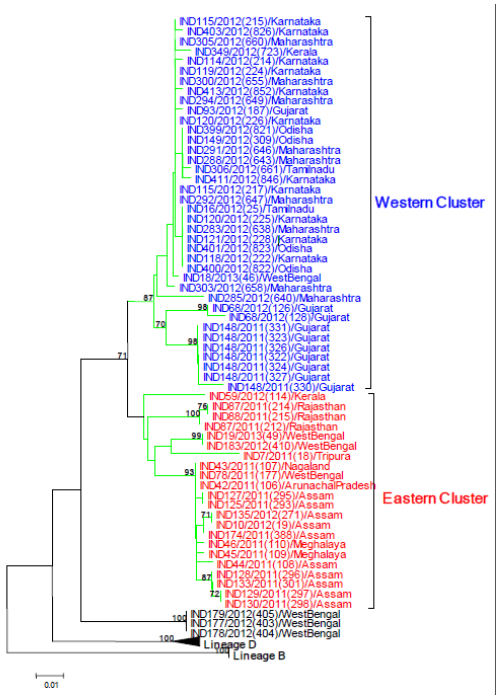

Figure A3.6: Phylogenetic tree generated by PD-FMD outlining serotype Asia-1 samples that have been characterised during 2012-13.

Figure A3.7: Phylogenetic tree for serotype O viruses received to the WRLFMD from Pakistan (highlighted by red diamonds). Four samples O/PAK/51/2012, O/PAK/53/201, O/PAK/55/2012 and O/PAK/22/2013 belong to an unnamed sub-lineage within the O/ME-SA topotype. Additional trees can be found at: http://www.wrlfmd.org/fmd_genotyping/index.html.

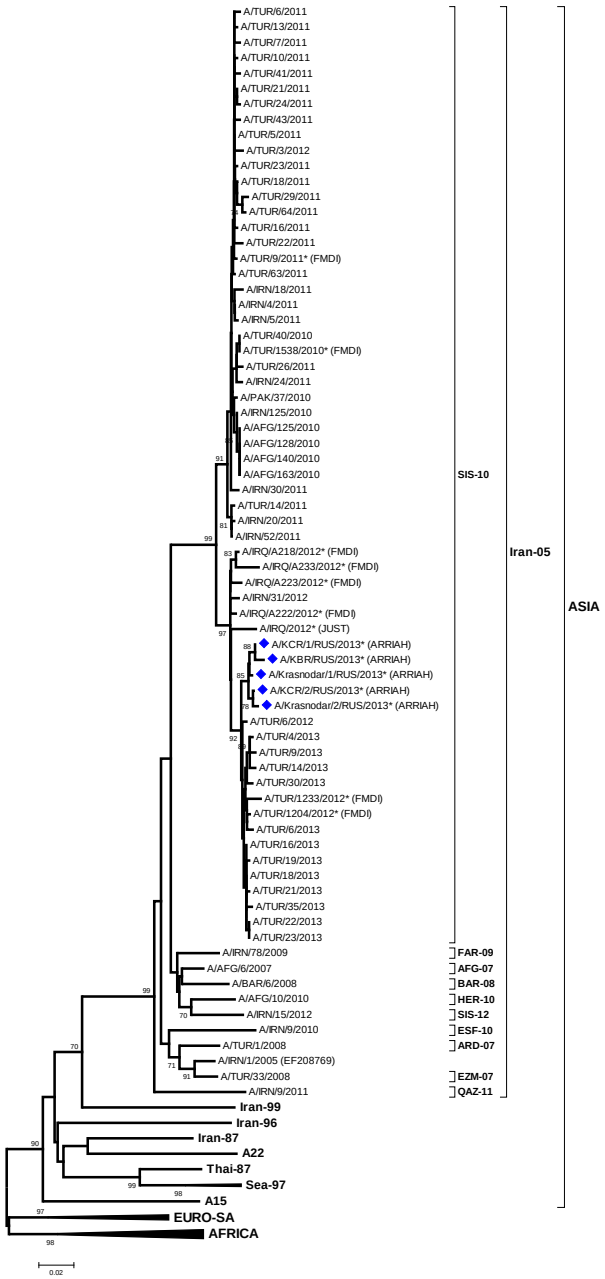

Figure A3.8: Phylogenetic tree (from WRLFMD) for sequences generated at FGBI ARRIAH for serotype A recovered from FMD outbreaks in the North Caucasus area.

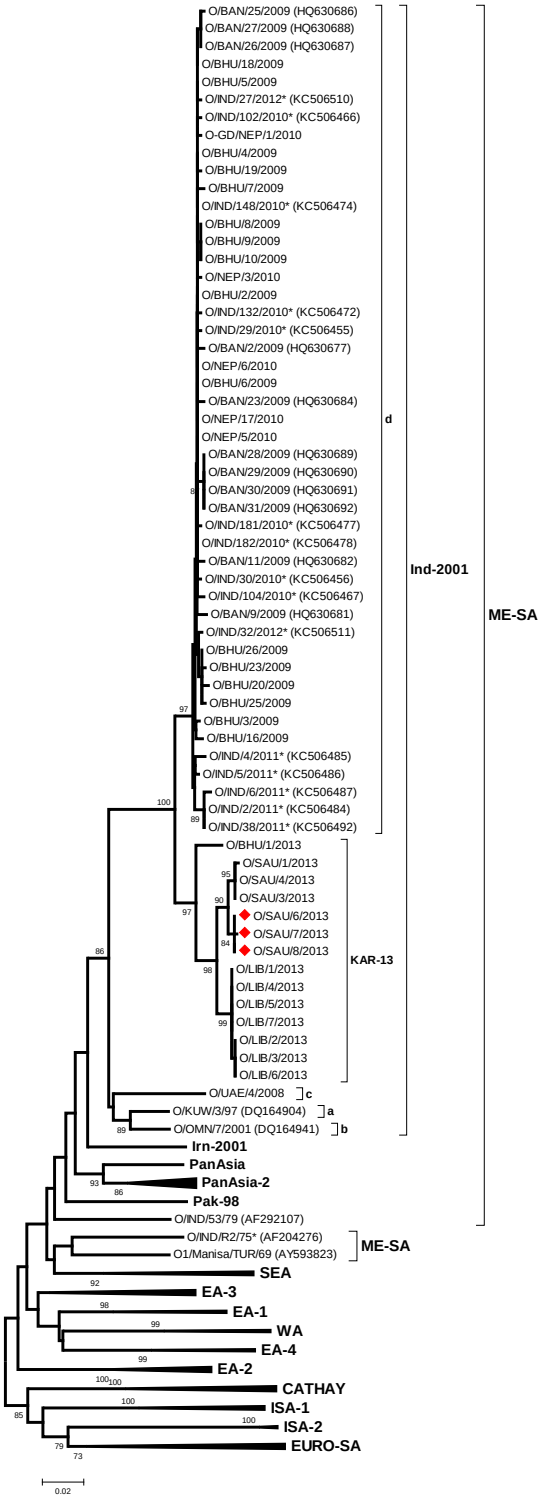

Figure A3.9: Phylogenetic tree for serotype O viruses (from the O/ME-SA/Ind-2001 strains) received to the WRLFMD from Saudi Arabia (highlighted by red diamonds). Close relationship to viruses from Libya and Bhutan (also sampled during 2013) are shown.

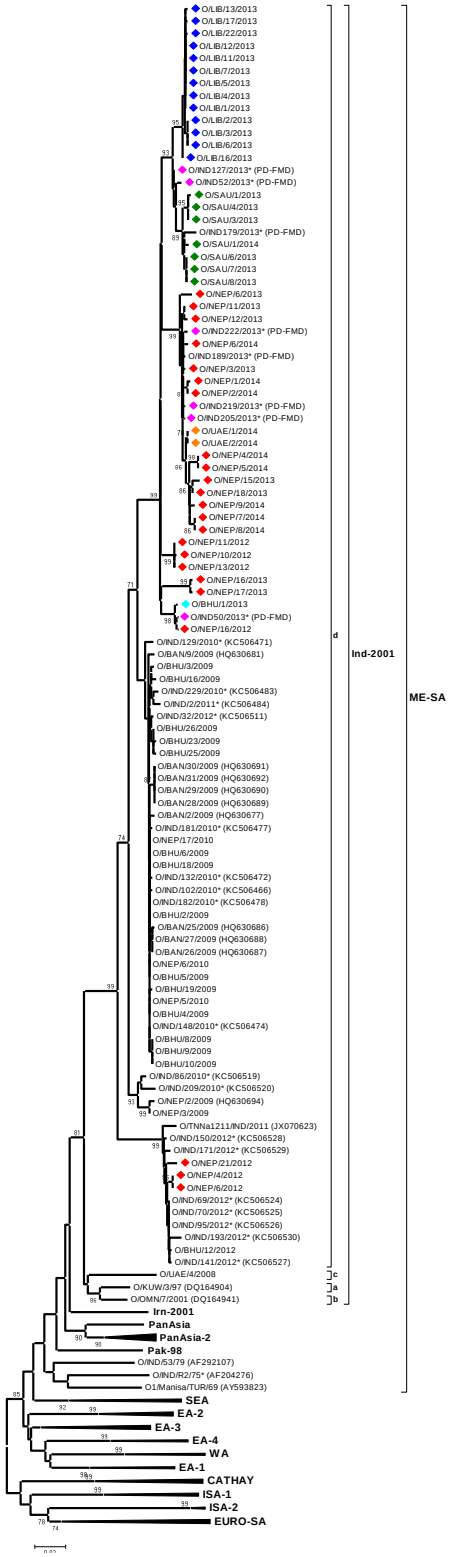

Figure A3.10: Phylogenetic tree for serotype O viruses (from the O/ME-SA/Ind-2001 strains) causing outbreaks in North Africa (Libya: Blue diamonds) and the Middle East (Saudi Arabia: green diamonds and recent examples from UAE (orange diamonds). Representative sequences from the Indian sub-continent are also shown (Nepal: red diamonds, India: Pink diamonds and Bhutan: Light blue diamond).

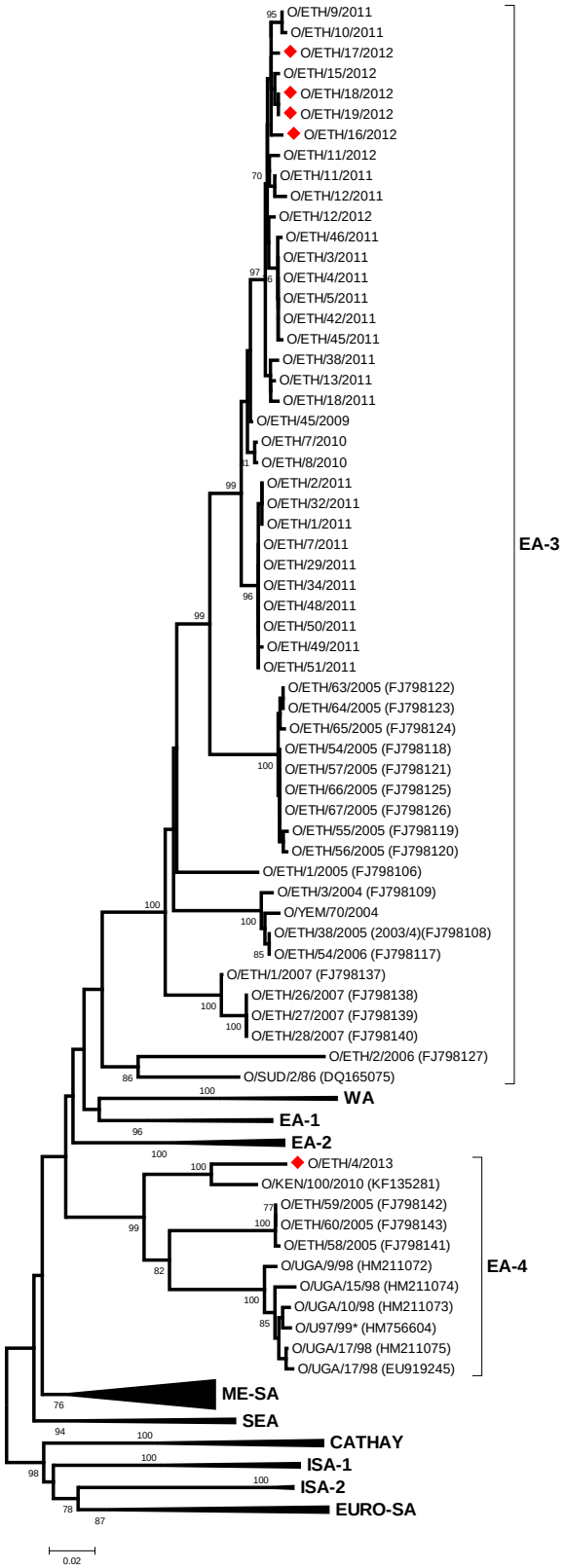

Figure A3.11: Phylogenetic tree for serotype O viruses (from O/EA-3 and O/EA-4 topotypes) received to the WRLFMD from Ethiopia (highlighted by red diamonds). Additional trees can be found at: http://www.wrlfmd.org/fmd_genotyping/index.html.

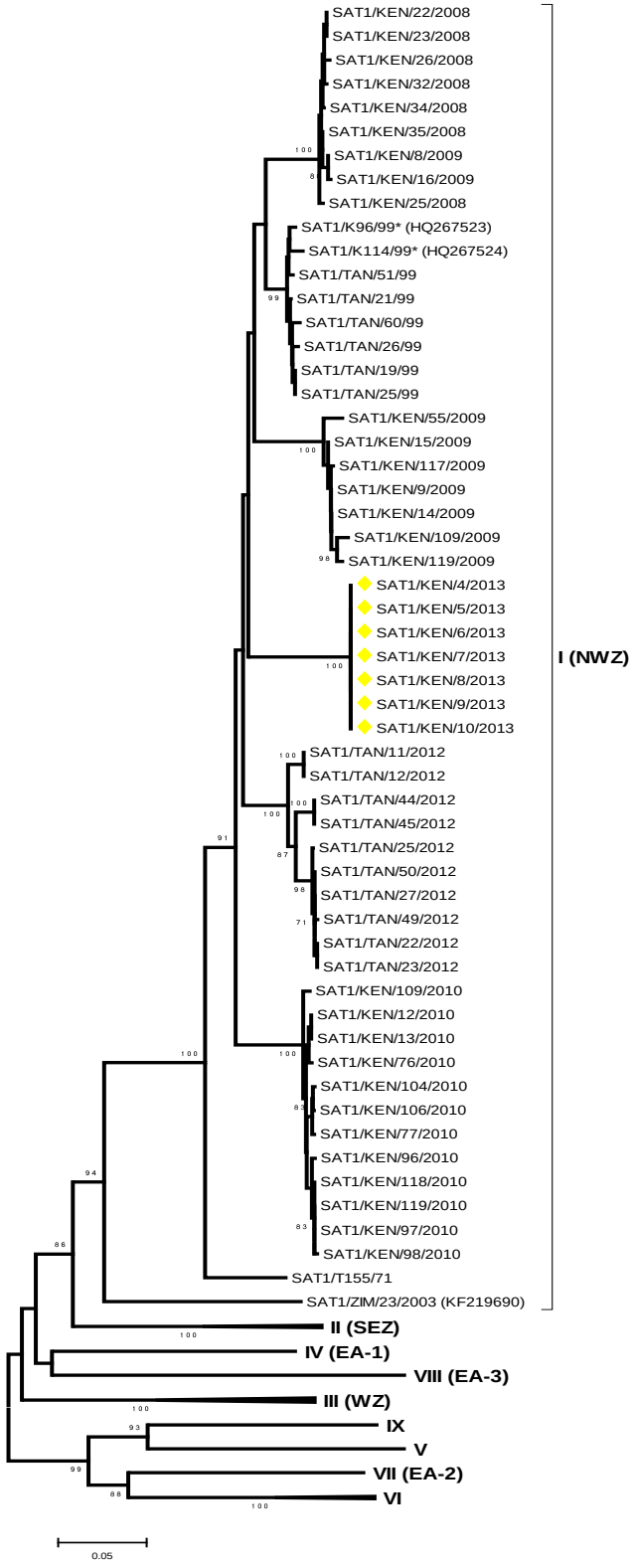

Figure A3.12: Phylogenetic tree for serotype SAT 1 viruses (from topotype I: NWZ) received to the WRLFMD from Kenya (highlighted by yellow diamonds). Additional trees can be found at: http://www.wrlfmd.org/fmd_genotyping/index.html.

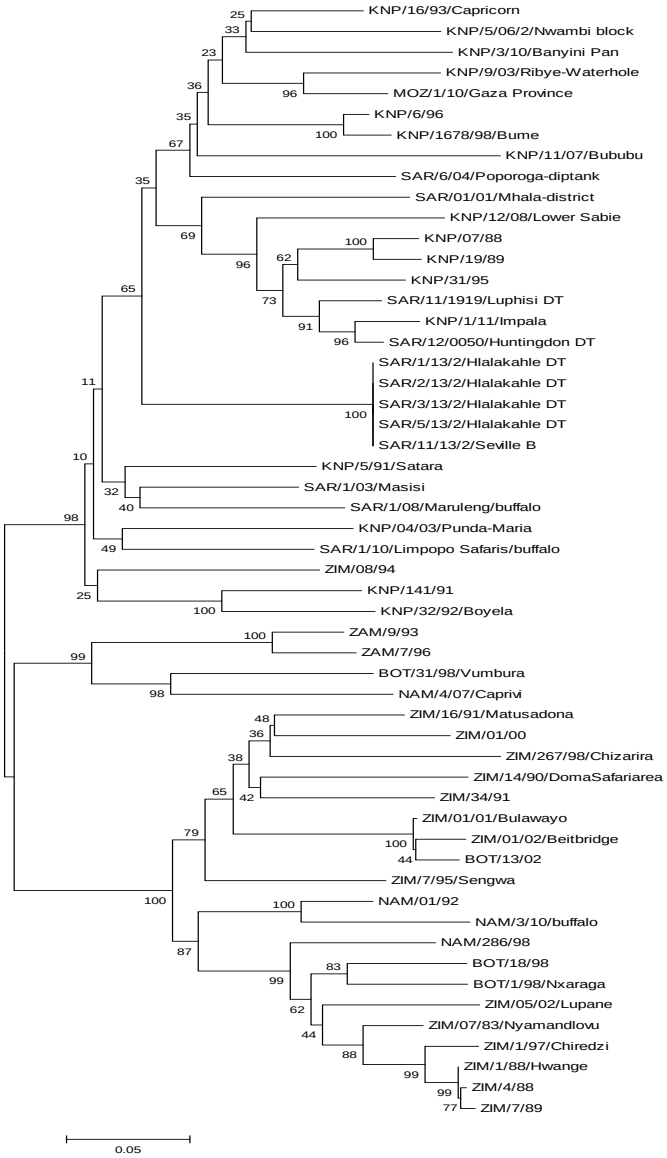

Figure A3.13: Phylogenetic tree generated at ARC-OVI for serotype SAT 2 viruses received from outbreaks in cattle in South Africa.

Appendix 4: Report from the 8th OIE/FAO FMD Laboratory Network Meeting, Bangkok: 14th – 15th November 2013

Day 1: Dr Don King welcomed the delegates to the meeting

- Global update (from WRLFMD presented by Dr Don King)
  Over the past 12 months, 360 samples have been submitted to WRLFMD generating 219 FMD viral isolates representing 5 of the FMDV serotypes. The presentation highlighted three important epidemiological events that have occurred recently: the ongoing cases due to serotypes O and A in East Asia; the spread of new a serotype Asia-1 lineage (Sindh-08) in the Middle East; and the recent outbreaks due to serotypes SAT2 and O in the Middle East and in North Africa. The recent detection of O/ME-SA/Ind-2001 lineage in Libya (during November 2013) is unexpected and emphasizes the value of coordinated surveillance by network partners (in this case IZSLER, PDFMD and WRLFMD) to detect and characterize emerging FMD viral lineages.

Summary of regional and country updates

- Central Asia (from ARRIAH presented by Dr Svetlana Kremenchugskaya)
  During 2013, 20 outbreaks due to serotype A have been detected in Russia. Sequence data demonstrates that the outbreaks in the west of the Russian Federation are caused by A/ASIA/Iran-05 and distinct from those in eastern Russia (and East Mongolia and Southeast Kazakhstan) where the virus implicated is A/ASIA/Sea-97. Locally produced vaccines that are recommended for use against circulating strains are: A/Zabaikalsky/RUS/2013 (Sea-97), A/Krasnodarsky/RUS/2013 (Irn-05), O PanAsia-2 and Asia-1 Shamir/89. Large scale post-vaccine monitoring has been undertaken at 26 centers close to all of the southern borders of the Russian Federation involving 47,500 samples tested by LPBE and 26,500 samples tested by NSP ELISA. In addition, a further survey in Northern Russia has been undertaken in support of OIE-free status.

- Southern Africa (from OVI presented by Dr Livio Heath)
  Two FMD outbreaks have occurred in South Africa during 2013 (SAT1 in Limpopo Province and SAT2 in Mpumalanga Province, both in July 2013) and one in Namibia (SAT2 in Caprivi which was difficult to isolate). A new vaccine production facility at Onderstepoort will start in 2016 and will focus on vaccine production for South Africa.

- Southern Africa (from RRLSS - BVI presented by Dr George Matlho)

This presentation provided an update of the reagents and tests available at RRLSSA. In addition to Botswana, RRLSS, receives samples from Namibia, Mozambique, Malawi and Zambia on a regular basis. Analyses of recent samples from Botswana and Zimbabwe have detected SAT2 serotype.

- Nigeria (from NVRI, Vom presented by Dr Hussaini Ularamu)
  Dr Ularamu provided an overview of the FMD situation in Nigeria where 4 of the FMD virus serotypes have been reported (O, A, SAT1 and SAT2). Recent results (for serotypes A, SAT1 and SAT2) using the new monoclonal antibody antigen ELISA kits from IZSLER were presented highlighting the utility of these new assays for use in the West African region.

- Southeast Asia (from RRL-Pakchong presented by Dr Somjai Kamolsiripichaiporn
  Serotypes O and A continue to cause FMD outbreaks in a number of countries in mainland SEA. During 2013, Ag-ELISA has been used to detect 21 serotype O viruses (from Laos, Cambodia, Vietnam and Thailand) and 18 serotype A viruses (from Vietnam and Thailand). Recent serotype O sequences provide evidence for the continued circulation of O/SEA/Mya-98 in Thailand and Cambodia and O/ME-SA/PanAsia in Laos and Cambodia. Serotype A sequences from the region represent the A/ASIA/Sea-97 strain. There has been no evidence of Asia-1 serotype in recent samples submitted to RRL.

- East Asia (from LVRI, presented by Dr Jijun He)
  During 2013, 23 FMD outbreaks have been reported in PR China. These represent serotype A (17 outbreaks), O/SEA/Mya-98 (2 outbreaks in pigs) and O/ME-SA-PanAsia (4 outbreaks in cattle). Nucleotide sequence data generated for the serotype O samples shared close relationships to previously characterized samples from the country. Serotype A appears to be mainly circulating in the west of China (in 4 provinces: Qinhai, Xinjiang, Tibet and Yunnan), apart from 1 single case in Guangdong in the southeast. Recent serotype A (A/ASIA/Sea-97) sequences are different to those previously characterized in PR China and indicate a close link to countries in Southeast Asia as well as recent sequences recovered from cases in Mongolia and the Russian Federation, although the precise transmission routes into the country are unknown. On-going surveillance activities in the south of China (serology and RT-PCR on lymph node tissues [n=1020]) and Inner Mongolia (serology and RT-PCR of OPF) have failed to provide evidence of local circulation of FMDV. FMD-free zones (with vaccination) are now being established (Hainan Island, Yongji, Jinlin and Liaoning Provinces), although an outbreak caused with O/SEA/Mya-98 strain in 2012 in Dalian from pig has led to a cancellation of FMD free status in Liaoning Province, and A/ASIA/Sea-97 strains were also found in OPF in active surveillance. An overview of laboratory capacity and reagents was also provided.

- South Asia (from PD-FMD presented by Dr Aniket Sanyal)
  This presentation provided an overview of the samples (n=77 isolates) that have been received to PD-FMD during 2013 from field cases of FMD in India. These are predominantly serotype O (n=32) which is found in all regions of India. However, cases due to serotype A (constant presence in south and north-east of the country) and Asia-1 (constant presence in west, east and northeast of the country) have also been detected. Sequences recovered demonstrate dominance of Ind-2001 strain (88/89 sequences generated during 2012-13). Within serotype Asia-1, all viruses characterized since 2005 have been grouped within a single major lineage (named lineage C), which can be sub-divided into two genetic clusters (termed Eastern and Western). Data was also presented for Bhutan, where serotype O (from O/ME-SA/Ind-2001 lineage) has been detected in 2013, Sri Lanka (serotype O), Nepal (most recent viruses characterized during 2012 were serotype O) and Bangladesh (where serotypes O and Asia-1 have been detected in 2013).

- Pakistan (from FAO Pakistan presented by Dr Muhammad Afzal)
  This year (until September 2013), 1639 FMD outbreaks have been reported in Pakistan, of which over 78% have been in Sindh Province. Data was presented that summarized these recent FMD outbreaks providing evidence that Serotype O, A and Asia-1 are actively circulating in the country. A number of these cases appear to present mixed infections due to different combinations of these different serotypes. Sequence data was also presented from PIADC and WRLFMD characterizing these viruses as O/ME-SA/PanAsia-2 (at least two sub-lineages), A/ASIA/Iran-05 (SIS-12 sub-lineage) and ASIA-1/Sindh-08. In light of recent changes, the components of the trivalent vaccine used in the country have been modified during 2013 to include O/PanAsia-2, A/Turkey/06 and Asia-1/Sindh/08.

- South America (from SENASA presented by Dr Eduardo Maradei)
  No outbreaks have been reported in the South American Continent for over 12 months and no samples have been sent from suspect field cases during 2013. The presentation provided an overview of the vaccination program in Argentina and the processes in place to control the quality of vaccines. The results generated for an in-vivo vaccine potency trial using O/SP/Paraguay/2011 challenge strain were presented. An OIE twinning project with the FMD Laboratory in Paraguay (SENACSA) is underway to address FMD diagnosis, FMD vaccine quality control and characterization of FMD reference strains.

- South America (from PANAFTOSA presented by Dr Rossana Allende)
  This presentation provided an overview of the PHEFA and COSALFA plans for FMD eradication from South America. Dr Allende stressed the importance of coordination of countries (and laboratories) in South America to achieve FMD control in the region. In view of the marked reduction in clinical FMD cases, FMD active surveillance serosurveys have been undertaken recently in Paraguay (2012), Bolivia (2013) and Ecuador (2011-2013). PANAFTOSA has coordinated regional PT schemes and has provided reagents for diagnostic tests and vaccine quality tests to other countries in the region. An update was also provided to describe the use of the LPBE test for post-vaccine monitoring.

- North America (from NVSL-FADDL presented by Dr Consuelo Carrillo)
  The FMD related diagnostic activities undertaken by FADDL during 2013 included: ruling out FMD from domestic vesicular cases and international samples received for testing (all negative). This work included testing of samples by virus isolation (LK and IB-RS-2), real time RT-PCR and serology using VIAA and 3ABC NSP ELISA. A collaborative FMD project with NRVC in Kazakhstan was also initiated, providing training in FMD diagnostic tests and evaluation of post-vaccine monitoring. An OIE twining project is preparation. The laboratory also provided PT panels and reagents for diagnostic tests to US NALHN laboratories and Mexico

- North America (from CFIA presented by Dr Charles Nfon)
  The laboratory diagnostic activities undertaken by CFIA during 2013 were reviewed included suspect field cases (all negative) and samples received for export testing. The testing algorithm used to define positive and negative samples was described.

- Europe (from CODA-CERVA presented by Dr David Lefebvre)
  This talk provided an update about a European collaborative FMD project (DISCONVAC). The talk also updated the group about on-going research to develop antiviral compounds for FMDV.

- Europe (from IZSLER presented by Dr Santina Grazioli)
  IZSLER has developed a range of new ELISA kits for FMDV antigen (O, A, C and Asia-1), and antibody detection (O, A, Asia-1 and NSP). During 2013, a new SPCE for FMDV SAT2-specific antibodies has been developed. Ready-to-use kits have been provided to laboratories in

Europe, Asia, Africa and Australasia for evaluation. During 2013, training has been provided to veterinary scientists from Egypt and Libya and samples (sera and clinical material from suspect cases) has been received by IZSLER for testing. These samples include O/ME-SA/Ind-2001 samples from Libya reported by WRLFMD.

- Australia (from AAHL presented by Dr Wilna Vosloo)
  A short update of national capacity was provided which includes devolved testing via the LEADDR network. Within this network, the specificity of a 3ABC assay (generated by AAHL) has been evaluated using 3311 sera. A summary was also provided outlining on-going collaborative projects that particular focus on vaccine protection in Vietnam and training of early career scientists from Vietnam.

Breakout session 1:
In three groups, delegates discussed:
1. How can the FMD Network assist in the implementation of FMD control programs using the PCP monitoring tool?
2. Where are the gaps in the Network?..... proposing solutions
3. How can the FMD Network support the development of regional leading laboratories and network of NRLs ?

Summary of discussions and recommendations

- Improved tools to disseminate data rapidly between the Network partners, other NRLs and OIE and FAO are needed
- Interaction between regional pools: the network should ensure that experience (and best practise) gained in the control of FMD in endemic countries (such as in South America, Southeast Asia, SADC) is shared, and can be transferred (where appropriate) to other control programs.
- More efforts are required to harmonise tests used in different laboratories
- There are still many resource, functional and geographical gaps in the network
- In general, Reference Laboratories from FMD-free countries are willing to assist to close the gaps (it is often in their interest to do so), but they also require sustained funding, and perhaps a more coordinated approach to do this.

Day 2:

- Proficiency testing schemes (from WRLFMD, Presented by Dr Don King)
  An overview of PT schemes that aim to harmonize the performance of laboratory tests was provided including the scope of the PTS coordinated by WRLFMD on an annual basis. These exercises provide confidence to national governments (as wells as OIE and FAO) about the status and capability of the participating laboratories. In additional to WRLFMD, other network partners manage PT schemes for regional NRLs (including RRL-Pakchong for SEA, ARRIAH for labs in Russia and central Asia, SENASA/PANAFTOSA for laboratories in South America). In view of the time, effort and costs associated with the organization of these exercises, members of the network agreed to explore routes to better coordinate these activities.
- Vaccine Matching

Members briefly summarized local tools and approaches that are used in their laboratories for vaccine matching. Most laboratories use VNT as their primary assay for vaccine matching although LP-ELISA is used at RRL-SEA (and also at WRLFMD and PANAFTOSA as a back-up).

- WRLFMD – 293 field isolates (111 serotype O, 162 serotype A, 7 serotype Asia-1, 6 serotype SAT1 and 7 serotype SAT2) tested during 2013. An additional research project (funded by BBSRC/CIDLID) to investigate vaccine selection for East African viruses.
- During 2012-2013, 90 field isolates have been tested at PD-FMD.
- AAHL/CSIRO provided a short update of in-vivo vaccine efficacy testing carried out in pigs, cattle and sheep for SEA and East Asian field strains using vaccines in the Australian bank (from Merial)

- Post vaccination Monitoring (presented by Dr Samia Metwally, FAO)
  Talk outlined the rationale and benefits of employing PVM for FMD control. A working group (that includes some members of the OIE/FAO network) has been established to provide guidelines for the use of PVM in different FMD control scenarios and to influence the use of this approach by decision-makers. The development of these guidelines was previously a component of the Network work plan for 2012. This work will be published shortly by OIE and FAO and there are also plans to publish this work in a peer-reviewed journal.

Breakout session 2:
In three groups (based on FMDV global virus pools), delegates discussed:
1. Vaccine priorities and recommendations
2. Gaps in vaccine availability and vaccination
3. Tools available to assess vaccine matching and effectiveness

Summary of vaccine matching discussion and recommendations

- A current focus of vaccine matching work undertaken within the network (particularly at WRLFMD) is to provide recommendations for FMD-free countries regarding antigens held in international vaccine banks
- There needs to be more emphasis on locally produced vaccines used in endemic pools.
- Where possible, vaccine recommendations should be tailored for each of the endemic pools
- Reagents used for vaccine matching studies need to be standardised (and more widely shared between laboratories), and the nomenclature used to define the reagents should be made clearer (as an example see table below)
- Efforts to harmonise approaches used by the different reference centres are urgently needed (see 2014 work-plan and suggested PT for vaccine matching)
- Once harmonised, it may be possible to share data between different reference centres to more effectively coordinate vaccine matching
- Data needs to be presented in a more coherent manner (matrix system)
- Additional recommendation: to implement a regional antigen bank for South and Central America (for exotic strains) which could coordinate with the North American vaccine bank

- Updates from OIE (FMD GF-TADs Working Group activities presented by Dr Joseph Domenech) and FAO (Update on regional PCP roadmaps and FAO activities presented by Dr Samia Metwally)

- Dr Filip Claes (FAO) provided an overview of the system (Open-FMD) that is being developed by the Swiss Institute of Bioinformatics with support from FAO. The goal is to provide an open access and curated system that includes FMDV sequences together with analysis and search tools (such as those used for sequence alignments and phylogenetic tree-building, BLAST etc.). This system will be linked to EMPRES-i to facilitate links to field epidemiology and FMD outbreaks. Users will be able to upload new data and use the tools to generate reports and undertake analysis. A prototype system is available at: http://openfmd.vital-it.ch/# and beta-testing will be initiated by the end of the year. Network partners recognised that this system provides a tremendous opportunity to improve the manner in which data is shared between FMD laboratories. The feedback from the members of the Network was very positive and it was agreed that the network would provide volunteers to test the system. A number of questions were raised about the content provided on the system and the security of "private" sequences. In view of these issues, the network members were keen to maintain contact with SIB to influence (where possible) the format and functionality of the Open-FMD system.

The table below summarizes antisera and homologous vaccine reagents that have been used recently by the different network laboratories.

	FMDV serotype						
	O	A	C	Asia-1	SAT1	SAT2	SAT3
WRLFMD*	O1 Manisa Russia2000 O-3039 O-4625 SKR/2010 TAW/98 TUR/5/2009 MSD B921	A/ERI/98 A/IND/17/82 A/Iran/2005 A/Iran/87 A/Iran/96 A/Iraq/24/64 A/MAY/97 A/SAU/4/91 A/SAU/4/95 A/TUR/2006		IND/8/79 Shamir	RHO/12/78	ZIM/7/83 ERI 3218	
ARRIAH*	O1 Manisa PanAsia PanAsia-2	A22 N°550 A22 Iraq/64 A/Iran/97 A/TUR/06 A/Kyrg/07		Tadjikistan/2011			
LVRI*	Mya98/BY/2010 O/China 99	AF72 Re-A/WH/09		Asia-1/JSL/06			
OVI*					KNP/196/91 SAR/9/81 BOT/1/06 ZAM/1/06	KNP19/89 ZIM/7/83	KNP 10/90
BVI					SAT1/Botswana	SAT2/Zimbabwe	SAT3/Zimbabwe
PD-FMD†	O/IND/R2/1975	A/IND/40/2000		Asia1/IND/63/1972			
RRL-SEA	O/189/87	Sakolnakorn/97 A/Lopburi/12 A/118/87		Petchaburi/85			
SENASA*	O1 campos	A24 Cruzeiro A Arg/2001	C3 Indaial				
PANAFTOSA*	O1 campos	A24 Cruzeiro A Arg/2001	C3 Indaial				

* Capacity to undertake in-vivo vaccine matching trials
† Vaccine potency trials undertaken in India by ICAR Institute and DADF Govt. of India

- The work-plan for priority activities within the Network for 2014 was discussed (see agreed points on the next page below).

Acknowledgements

The meeting acknowledged the OIE and FAO for providing financial support for delegates to travel to the meeting and EuFMD for providing support to WRLFMD. The OIE/FAO FMD Laboratory Network warmly thanks Dr Tritsadee Chaosuancharoroen (Director) and Akarin Mogthaisong from The Department of Livestock Development, Thailand and for hosting the evening meal and providing logistical assistance with organisation of the venue and visa paperwork. Lastly (but certainly not least!), the secretariat of the OIE/FAO FMD Laboratory Network is grateful for the support and guidance of Dr Somjai Kamolsiripichaiporn (RRL-Pakchong) and Dr Joy Gordoncillo (OIE Sub-Regional Representation for Southeast Asia) without which it would not have been possible to organise this meeting.

Work Plan for 2014: Priorities:

- With assistance from OIE and FAO will obtain and analyse samples into the network from under-sampled endemic pools
- Vaccine matching
    - WRLFMD to prepare (and prioritise) a list of vaccine antigens for each virus pool
    - To identify who has antigens and antisera available for members of the Network
    - To consider how vaccine matching data generated by members of the Network are presented
- To consider undertaking a PT for vaccine matching tests
    - Harmonisation of approaches
    - Exercise to focus on Asia-1 to be initiated during 2014
- Network partners will support to the generation of PVM guidelines
    - Preparation of documentation outlining PVM guidelines
    - Reference reagents for PVM
- Network partners will continue to provide training in laboratory diagnostic methods
- Network partners will provide a central resource of expertise and advice regarding FMD control, vaccines and diagnostics
- To facilitate interactions with field teams and epidemiologists to optimize the interpretation of laboratory results as well as vaccine strain selection and vaccination strategies.
- To enhance real-time exchange of data between partners, possibly in each of the pools
    - Not just at the annual meeting
    - Possibly via regular teleconference or other forum??
    - The network endorses the concept of Open-FMD
        - Network is keen to influence the content
        - Network will provide volunteer labs to evaluate prototype system
- To examine opportunities to transfer the expertise accumulated from FMD control in South America into other FMD endemic regions.
- WRLFMD to coordinate the preparation of an Annual Report
    - Agreed timelines for preparation of 2013 report:
        - Final summaries: January 2014
        - Draft Report: February 2014
        - Report Published: March 2014
- WRLFMD to organise an Annual meeting (location to be agreed after discussion with OIE and FAO)
    - Agreed that (where possible) this should be hosted by a member lab of the network

Meeting Delegates:

Name	Email address
Alexey Mishchenko	mischenko@arriah.ru
Aniket Sanyal,	aniket.sanyal@gmail.com
Arshad Javed	Javed.Arshad@fao.org
Charles Nfon	Charles.nfon@inspection.gc.ca
Chris Morrissy	Chris.Morrissy@csiro.au
Consuelo Carrillo	Consuelo.Carrillo@aphis.usda.gov
David Lefebvre	David.Lefebvre@coda-cerva.be
Donald King	donald.king@pirbright.ac.uk
Eduardo Maradei	emaradei@yahoo.com
Filip Claes	filip.claes@fao.org
Hussaini Ularamu	ularamuhussaini@yahoo.co.uk
Jijun He	hejijun1979@163.com
Joseph Domenech	j.domenech@oie.int
Kingkarn Boonsuya Seeyo	noko2519@yahoo.com; rrl@dld.go.th
Kurt Zuelke	Liz.Middleton@csiro.au
Livio Heath	HeathL@arc.agric.za
Mpolokang Elliot Fana	efana@bvi.co.bw
Muhammad Afzal	MuhammadImam.Afzal@fao.org
Ngo Thanh Long	ngothanhlong60@gmail.com
Onkabetse George Matlho	gmatlho@bvi.co.bw
Panithan Thongta	ekkpasang3dld@hotmail.com
Qiang Zhang	qzhang1616@sohu.com
Rompruke Udon	romphrukeudon@yahoo.com
Rossana Allende	rallende@paho.org
Samia Metwally	Samia.Metwally@fao.org
Santina Grazioli	santina.grazioli@izsler.it
Somjai Kamolsiripichaiporn	somjaik@dld.go.th
Svetlana Kremenchugskaya	kremenchugskaya@arriah.ru
Wilai Linchongsubongkoch	wilaifmd@loxinfo.co.th
Wilna Wosloo	Wilna.Vosloo@csiro.au