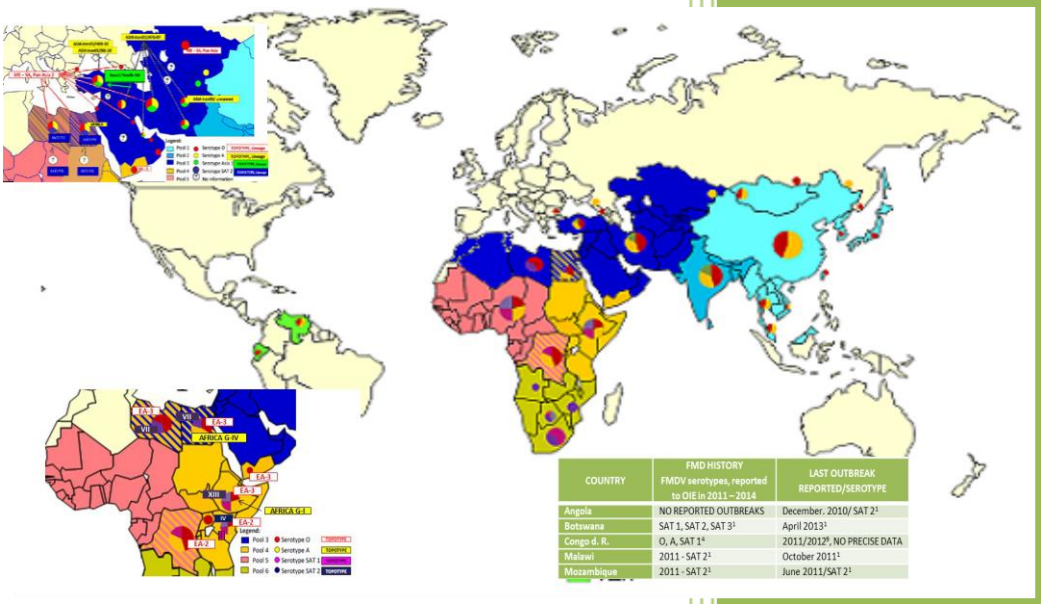
2015

Foot-and-Mouth Disease Situation
Monthly Report October 2015



COUNTRY	FMD HISTORY FMDV serotypes, reported to OIE in 2011 – 2014	LAST OUTBREAK REPORTED/SEROTYPE
Angola	NO REPORTED OUTBREAKS	December. 2010/ SAT 2[1]
Botswana	SAT 1, SAT 2, SAT 3[1]	April 2013[1]
Congo d. R.	O, A, SAT 1[4]	2011/2012[9], NO PRECISE DATA
Malawi	2011 - SAT 2[1]	October 2011[1]
Mozambique	2011 - SAT 2[1]	June 2011/SAT 2[1]

EuFMD

eufmd
european commission for the control of foot-and-mouth disease

Foot-and-Mouth Disease Situation
Food and Agriculture Organization of the United Nations
Monthly Report

October 2015

Guest Editor
Dr. Graham Belsham
(National Veterinary Institute, Technical University of Denmark, Lindholm)

#INFORMATION SOURCES USED:

Databases:
OIE WAHID World Animal Health Information Database
FAO World Reference Laboratory for FMD (WRLFMD)
FAO Global Animal Disease Information System (EMPRES-i)

Other sources:
FAO/EuFMD supported FMD networks
FAO/EuFMD projects and field officers

The sources for information are referenced by using superscripts.
The key to the superscripts is on the last page.

Please note that the use of information and boundaries of territories should not be considered to be the view of the U.N. Please, always refer to the OIE for official information on reported outbreaks and country status.

Contents

Guest Editor's comments

I was pleased to be asked to contribute, as Guest Editor, to this month's EuFMD Monthly Report. The focus of my work has largely been on the biology of FMDV itself, rather than the disease in the field. However, through interactions within projects in Africa (Uganda and Kenya) and in Asia (especially Pakistan and Afghanistan), I have been made aware of the importance of knowing about the FMD viruses that are circulating in different parts of the world. I also now know something of the practical difficulties in obtaining this information in a timely manner. Furthermore, it clearly takes time and effort to assemble the information, e.g. for these Monthly Reports. Hence, it is important that this is done in a manner which provides the most useful information for others. The best reports, provide information about the location of outbreaks, the animals involved, the serotype (and ideally lineage) of the virus responsible for the disease and an indication of the size of the susceptible animal population in the region. In contrast, reports of FMD based on clinical signs alone have to be treated with more caution. The identification of serotypes by serology alone can also be difficult within endemic regions. There can be cross-reactivity in the assays and unknown previous exposure to virus or vaccine. Thus, knowing the nature of the evidence used to determine serotypes is very important. Optimally, some characterization of the virus responsible for an outbreak is required. However, the transportation of samples from FMDV-infected animals, in an appropriate manner, is clearly a complex and expensive process. However, starting a vaccination process without knowing at least the serotype of the virus responsible for the disease is, at best, likely to be a waste of resources. For example, a multivalent rather than monovalent vaccine may be selected for use. At worst, the outbreak may be due to a different virus serotype than the chosen vaccine and hence no protection will be achieved. This can lead to the perception that vaccines are ineffective. These points are made to highlight well-known issues that are important for the improved control of the disease globally.

It is an impressive achievement that it is now 46 months since the last outbreak of FMD occurred within the whole of South America. While vaccination still occurs in some countries, then it is not possible to be sure that all virus circulation has stopped but maintaining the absence of disease is clearly an important step along the pathway to freedom from disease without vaccination.

It is now over 11 years since the last outbreak of FMD due to serotype C virus was reported. However, there have been some reports of serological evidence for the presence of serotype C virus infection. In the absence of other supporting data (e.g. virus isolation or antigen ELISA), then such observations have to be treated with significant caution. On the other hand, evidence for the recent presence of SAT 3 FMDV in Uganda, after a gap of over 15 years, was published earlier this year (Dhikusooka et al., (2015) Emerg Infect Dis. 21, 111-114). The data indicates that the SAT 3 virus has continued to circulate silently in that country, presumably in the African buffalo, during this time. It has been possible to detect anti-SAT3 (and anti-SAT1 and anti-SAT2) antibodies in such animals during this period. Thus demonstrating freedom from virus circulation can be a real challenge.

The spread of the O/ME-SA/Ind-2001 lineage of FMDV across North Africa was highlighted by Don King's Editorial in June 2015. I did not notice much focus on this virus lineage in this month's Report. However, I note that 5 outbreaks due to serotype O FMDV (unspecified lineage) have occurred in Morocco at the end of October. Morocco had experienced its last outbreak of FMD in 1999 and is, of course, only just across the water from Europe (Spain). Thus, Europe has virus circulation very close to its borders in both Turkey and in North Africa and, while this is the case, there has to be a real risk of virus spread across its borders.

Graham Belsham

I. GENERAL OVERVIEW

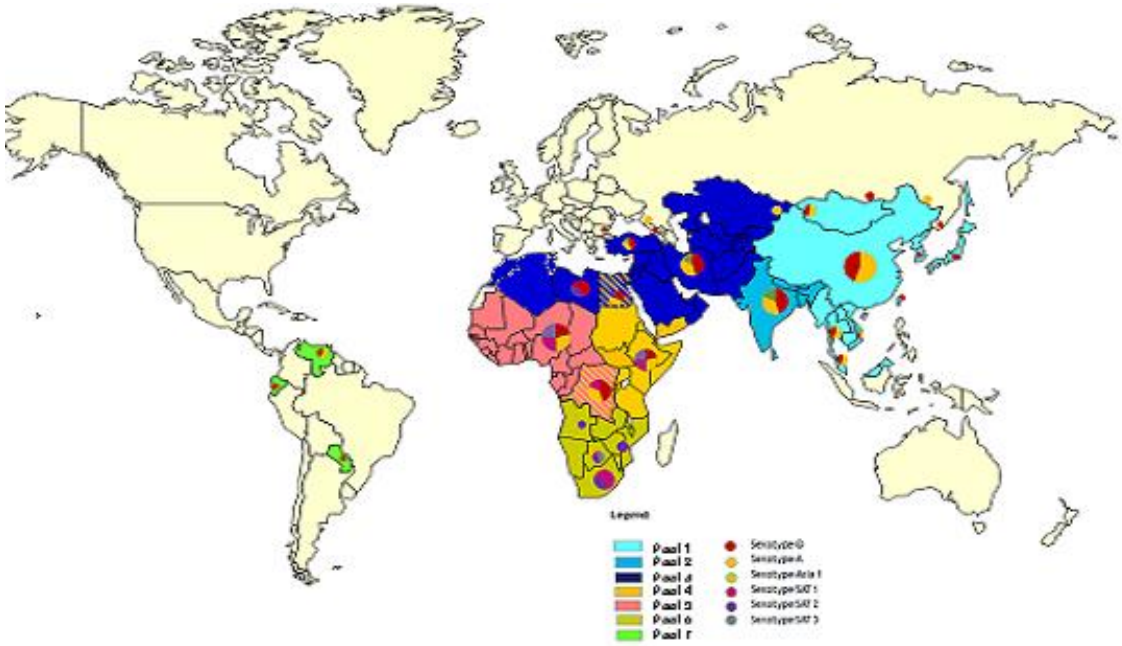
Pools represent independently circulating and evolving FMDV genotypes; within the pools, cycles of emergence and spread occur that usually affect multiple countries in the region. In the absence of specific reports, it should be assumed that the serotypes indicated below are continuously circulating in parts of the pool area and would be detected if sufficient surveillance was in place (Table 1).

Table 1: List of countries representing each virus pool for the period 2011 – 2015

POOL	REGION/COUNTRIES – colour pools as in Map	SEROTYPES
1	**SOUTHEAST ASIA/CENTRAL ASIA/EAST ASIA** Cambodia, China (People's Rep. of), China (Hong Kong, SAR), China (Taiwan Province), Korea (DPR), Korea (Rep. of), Laos PDR, Malaysia, Mongolia, Myanmar, Russian Federation, Thailand, Viet Nam	**O, A and Asia 1**
2	**SOUTH ASIA** Bangladesh, Bhutan, India, Nepal, Sri Lanka	**O, A and Asia 1**
3	**WEST EURASIA & MIDDLE EAST** Afghanistan, Algeria, Armenia, Azerbaijan, Bahrain, Bulgaria, **Egypt**, Georgia, Iran, Iraq, Israel, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, **Libya**, Morocco, Oman, Pakistan, Palestine Autonomous Territories, Qatar, Saudi Arabia, Syrian Arab Republic, Tajikistan, Tunisia, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan	**O, A and Asia 1**
4	**EASTERN AFRICA** Burundi, Comoros, **Congo D. R.**, Djibouti, **Egypt**, Eritrea, Ethiopia, Kenya, **Libya**, Rwanda, Somalia, Sudan, South Sudan, Tanzania, Uganda, Yemen	**O, A, SAT 1, SAT 2 and SAT 3**
5	**WEST/CENTRAL AFRICA** Benin, Burkina Faso, Cameroon, Cape Verde, Central Afr. Rep., Chad, **Congo D. R.**, Congo, Côte d'Ivoire, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea Biss., Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Sao Tome Principe, Senegal, Sierra Leone, Togo	**O, A, SAT 1 and SAT 2**
6	**SOUTHERN AFRICA** Angola, Botswana, **Congo D. R.,** Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe	**{O, A}*, SAT 1, SAT 2 and SAT 3**
7	**SOUTH AMERICA** Ecuador, Paraguay, Venezuela	**O and A**

Egypt, Libya and **Congo D. R.** (highlighted in bold) are indicated as being in multiple pools, since they have evidence of FMDV originating from 2 or more pools in the past four years. * ONLY IN NORTH ZAMBIA AS SPILL-OVER FROM POOL 4

Foot-and-mouth disease (FMD) virus pools: world distribution by serotype in 2011-2015



II. HEADLINE NEWS

POOL 1- SOUTHEAST ASIA/CENTRAL ASIA/EAST ASIA

China (Hong Kong, SAR) [1] **–** FMDV isolates from Hong Kong, SAR matched the vaccine strain employed in the vaccine matching strain differentiation (VMSD) tests conducted by the WRLFMD.
The serotyping, genotyping and VMSD tests carried out by the WRLFMD that are cited in this report will be described in detail in the WRLFMD Quarterly Report (October - December, 2015).

Mongolia [2] – A FMD outbreak for which serotyping is pending occurred on the 2nd October 2015 in Bayan-Ulgii, Mongolia on a mixed species farm.

Russia [3]**-**The Russian Research Institute for Animal Health (FGBI-ARRIAH) detected FMDV serotype O in five bovine and sheep samples.

Vietnam [4] – The Southeast Asia and China Foot and Mouth Disease Campaign reported six new outbreaks in different areas of the country that occurred during October, with the detection of FMDV O.

POOL 2 - SOUTH ASIA

India [5]- The Indian Council of Agricultural Research - Project Directorate on Foot and Mouth Disease, Mukteswar, India tested bovine and buffalo clinical samples for FMDV antigen and/or RNA detecting serotype O.

POOL 3 - WEST EURASIA & MIDDLE EAST

Morocco [2] – Following the absence of FMD in the country since 1999, an outbreak was detected on the 23rd October 2015 due to FMDV O in Sidi Bennour, Centre, initially involving a mixed species farm. A total of five outbreaks were registered up to the 1st of November.

Pakistan [6]- The Progressive Control of Foot and Mouth Disease Project reported that sixty-two FMDV outbreaks occurred during October 2015 within which serotypes A, Asia 1 and O were detected.

Saudi Arabia [1, 2] - FMDVs were isolated from two bovine epithelial/tongue samples collected on the 15th September 2015 in Izdahair District, Riyadh, Saudi Arabia, in the course of an outbreak that was detected two days before on a bovine and sheep farm. The viruses were genotyped as A/Asia/unnamed by the WRLFMD and are most closely related to FMD viruses from India.

POOL 4 - EASTERN AFRICA

Kenya [7] **-** The Foot-and-Mouth Disease Laboratory, Embakasi, Kenya detected FMDV serotypes A, SAT 1 and SAT 2 among the ten bovine samples collected from different counties of Kenya.

POOL 5 - WEST/CENTRAL AFRICA

$Niger [1]**-** FMDV serotype O was detected by the WRLFMD from the four bovine samples collected in May 2015 in Niger.

POOL 6 - SOUTHERN AFRICA

$Botswana [1] – FMDV serotype SAT 1 was detected by the WRLFMD from the two bovine samples collected in June 2015 in Botswana.

[$]**Mozambique** [1] **-** FMDV serotype SAT 1 was detected by the WRLFMD from the two bovine samples collected in May 2015 in Mozambique.

[$]**Namibia** [1] **-** FMDV serotypes SAT 1 and SAT 2 were detected by the WRLFMD from the six bovine samples collected in May 2015 in Namibia.

Zambia [1] – FMD outbreaks were diagnosed on clinical basis on the 11th of October in at least twelve cattle herds in Shangombo, Western, Zambia. Serotyping for these outbreaks is pending.

[$]**Zimbabwe** [1, 2] – FMDV serotype SAT 2 was detected by the WRLFMD from the three bovine samples collected in April 2015 in Zimbabwe.
The FMD outbreak that started in June 2015 in Matabeleland North, Zimbabwe and for which serotyping is pending is reported as continuing during September and October 2015 with new episodes of the disease occurring again in cattle.

POOL 7 - SOUTH AMERICA

Latin America [2]- No outbreaks reported.

COUNTER
****** 46 MONTHS SINCE THE LAST OUTBREAK IN SOUTH AMERICA WAS REPORTED***
****** 134 MONTHS SINCE THE LAST SEROTYPE C OUTBREAK WAS REPORTED***
[$]Samples were sent via Botswana Vaccine Institute

III. DETAILED POOL ANALYSIS

A. POOL 1 – *SOUTHEAST ASIA/CENTRAL ASIA/EAST ASIA*

China (Hong Kong, SAR) [1]

Two FMDVs isolated in Hong Kong, SAR from pigs in April 2015 and genotyped as O/CATHAY/unnamed matched with a r_1-value of 0.48 with the vaccine strain O/Russia/2000 employed in the VMSD test conducted by the WRLFMD.

Mongolia [2]

A FMD outbreak for which serotyping is pending occurred on the 2nd October 2015 in Bayan-Ulgii, Mongolia on a farm in which cattle, sheep and goats, the species present, were all clinically involved. The location of the outbreak could represent a threat for spread to neighbouring countries as in the area there is intensive animal movement.

Preliminary laboratory diagnosis was carried out on the 15th October by State Central Veterinary Laboratory (National laboratory) on bovine and sheep samples. The laboratory methods employed were non-structural protein (NSP) ELISA and reverse transcription - polymerase chain reaction (RT-PCR). As reported in the chapter relative to the Russian Federation, Arriah has confirmed that the serotype involved in FMDV O.

Summary of the animals involved and location of outbreak are reported in Table 2 and Map 2.

Source of the outbreak is unknown and the control measures being applied are movement control inside the country, screening, disinfection, quarantine and zoning. Affected animals are not being treated while vaccination is being carried out in response to the outbreak as reported in Table 3

Table 2: summary of the number of cattle involved in the FMD outbreak reported in October 2015 in Bayan-Ulgii, Mongolia.

Species	Susceptible	Cases	Deaths	Destroyed	Slaughtered	Apparent morbidity rate	Apparent mortality rate	Apparent case fatality rate	Proportion susceptible animals lost*
Cattle	285	18	0	0	0	6%	0%	0%	0%
Sheep	1,588	62	0	0	2	4%	0%	0%	0%
Goats	965	10	0	0	0	1%	0%	0%	0%
Total	**2,838**	**90**	**0**	**0**	**2**	**3%**	**0%**	**0%**	**0%**

*Removed from the susceptible population through death, destruction and/or slaughter

Map 2: Location of FMD outbreak reported in October 2015 in Bayan-Ulgii, Mongolia.

Table 3: summary of vaccination activities carried out in FMD outbreak reported in October 2015 in Bayan-Ulgii, Mongolia.

Administrative division	Species	Number Vaccinated
BAYAN-ULGII	Cattle	12,188
	Goats	34,976
	Sheep	42,513
	Total	**89,677**

Russian Federation [3]

FGBI-ARRIAH reported the detection of FMDV serotype O in samples, consisting of pathological material collected from cattle and sheep, kindly provided by the State Central Veterinary Laboratory of the Ministry of Food and Agriculture of Mongolia. The laboratory has carried out the genotyping of a FMDV O strain identifying it as belonging to the Pan Asia genetic lineage. Work is in process for the study of the antigenic relationship between FMDV serotype O epidemic isolates and FMDV vaccine strains. During October 18,936 sera were examined for post vaccination monitoring purposes.

Ongoing activities reported by the laboratory are studies on the immunobiological properties of FMDV serotype O and the provision of support in the form of materials and advice respectively to the Federal Service for Veterinary and Phytosanitary Surveillance of the Ministry of Agriculture of the Russian Federation and to the Veterinary services of the Russian Federation Subjects.

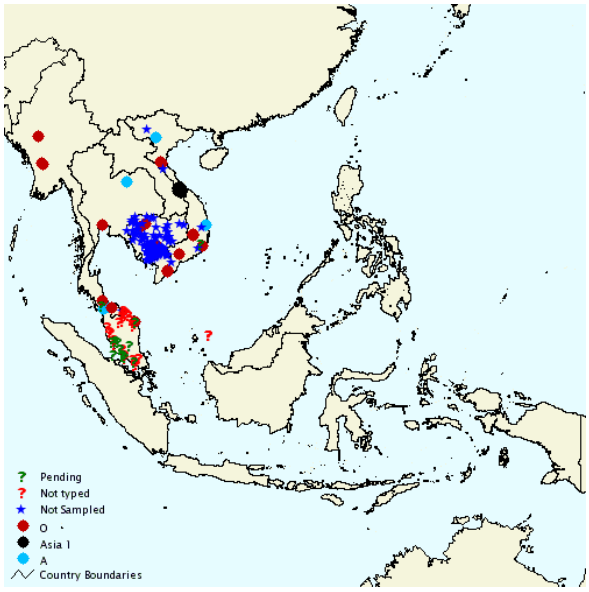
SEACFMD [4]

Southeast Asia and China Foot and Mouth Disease Campaign registered in October 2015, six new FMD outbreaks all located in Vietnam and details of these are given in the paragraph relative to the country. The number of ongoing FMD outbreaks and the countries in which they are occurring are listed in Table 4. Location of outbreaks is presented in Map 3.

Table 4: Distribution of FMD outbreaks reported as ongoing during October 2015 in countries of the Southeast Asia area.

Countries	Number of ongoing FMD outbreaks
Cambodia	120
Myanmar	3
Malaysia	46
Thailand	7
Viet Nam	31
Total	**207**

Map 3: Location of FMD outbreaks reported as ongoing during October 2015 in the countries of the Southeast Asia area listed in Table 4 (SEACFMD).



Vietnam [4]

Further to the 25 ongoing FMD outbreaks, six new events occurred in different areas of the country with the detection FMDV O in one of them. A summary of the animals involved and location is reported in Table 5 and Map 4

Control measures applied are movement control inside the country, quarantine, disinfection of infected premises and modified slaughter that was adopted only on one farm (see Table 5). In none of the outbreaks was vaccination reported to have been used.

Table 5: summary of the species involved in the FMD outbreaks reported in October 2015 in different provinces of Vietnam.

Province	N° of Outbreaks	Species involved	N° of animals present	N° of Cases	Virus identification
NINH THUAN	1	Cattle	112	40	serotype O using indirect Elisa
	1		59	36	Pending
	1		34	22	not sampled
PHU YEN	1		743	14	
TIEN GIANG	1		2	2	
YEN BAI	1	Buffaloes	1,128	38	
		Cattle	428	33	
		Swine	2,137	12*	
Total	**6**		**4,643**	**185**	

* destroyed

Map 4: Location of FMD outbreaks reported as ongoing during October 2015 in the countries of the Southeast Asia area listed in Table 5 (SEACFMD).

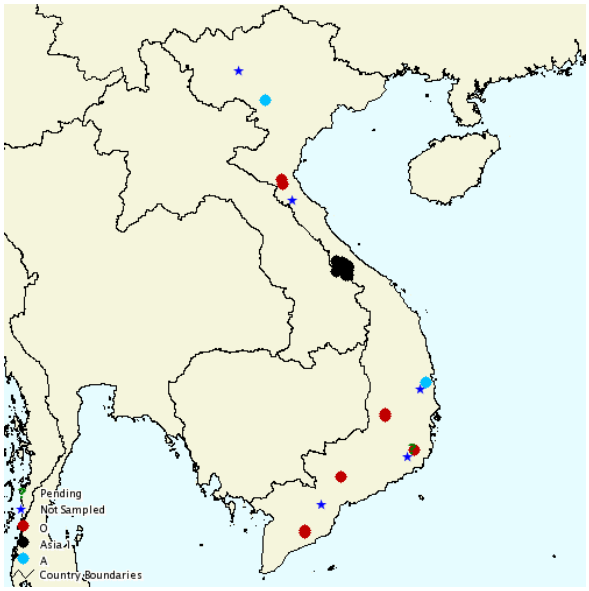


Table 6: Summary of the history of FMD Pool 1, 2012 – 2014, for geographic distribution see Map 5 below.

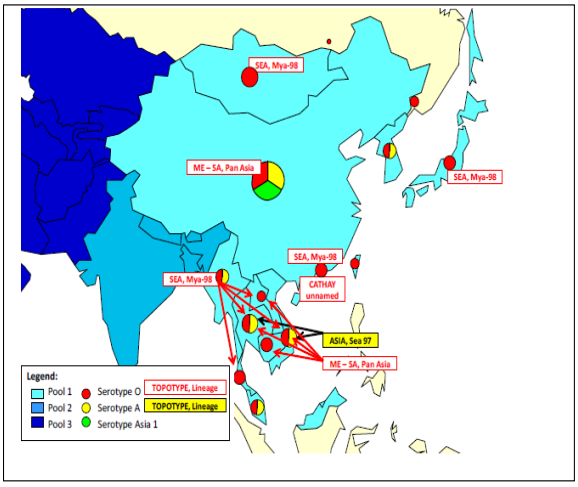
COUNTRY	FMD HISTORY FMDV serotypes, reported to OIE between 2012 – 2014	LAST OUTBREAK REPORTED/SEROTYPE#	Comment
Cambodia	O, 2013-2014/NOT SAMPLED	Sep 2015/O, Aug 2014/ not typed, June 2014/not typed	See text Typing required
China (People's Rep. of)	2012-2013/O, 2013/A,	Apr 2015/O, May 2015/A	Typing required
China (Hong Kong, Sar)	O	Apr 2015/O	See text
China (Taiwan Province)	2012-2013/O,	Jun 2015/A	Typing required
Korea (DPR)	2012-2013/DISEASE ABSENT	May 2014/not confirmed, July 2014/O	Follow-up needed
Korea (Rep. of)	2012-2013/DISEASE ABSENT	April 2015/O	Follow-up needed
Laos PDR	2012/DISEASE PRESENT WITH QUANTITATIVE DATA BUT WITH AN UNKNOWN NUMBER OF OUTBREAKS	Mar 2015/A and O	See text
Malaysia	2012 –2013/O 2013/NOT TYPED	Sep2015/O	See text Typing required
Mongolia	2013/A	Sept 2013/A, May 2015/O, Oct 2015/O	
Myanmar	2012-2013/O	Sep 2015/O, July 2014/ not typed	See text Typing required
Russian Federation	2012/O, 2013/A	March 2015/O and A	See text
Thailand	O, A and NOT TYPED	Sep 2015 /A, Feb 2015/O, Sept 2014/not typed	See text

Vietnam	O, NOT SAMPLED 2013- 2014/A,	Apr 2015/A, Sep 2015/ Asia 1 Oct 2015/O, Oct 2015/not typed	See text

Map 5: FMD distribution by serotype and topotype in South East Asia, 2010 – 2014 (EuFMD).

Conjectured circulating FMD viral lineages in Pool 1 per 2014 [14]:

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



B. POOL 2 – South Asia

India [5]

The ICAR-PDFMD, Mukteswar, India, detected serotype O from among the 21 cattle and five buffalo clinical samples examined using FMDV antigen and/or RNA detection.

The number of sera tested for FMDV antibodies were 27,331, examined for epidemiological studies. FMD diagnosis was carried out using indigenous diagnostic kits developed at PDFMD.

The laboratory was also involved in the provision of expert advice to the Government, to national and local authorities and in research studies and in collaborations with international organisations.

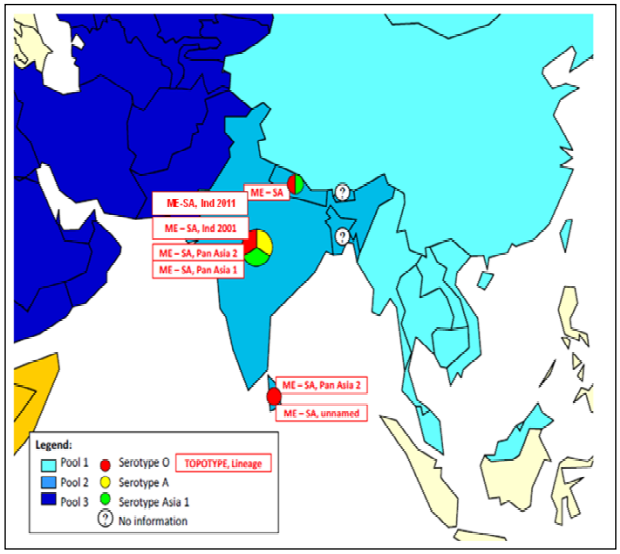
Table 7: Summary of the history of FMD Pool 2, 2012 – 2014, for geographic distribution see Map 6 below.

COUNTRY	FMD HISTORY FMDV serotypes, reported to OIE between 2012 – 2014	LAST OUTBREAK REPORTED/SEROTYPE[#]	Comment
Bangladesh	DISEASE PRESENT BUT WITHOUT QUANTITATIVE DATA	Not available	Follow –up needed
Bhutan	NOT TYPED, 2013/NOT SAMPLED 2013-2014/O	Not available	Follow –up needed
India	O, A, NOT SAMPLED 2012-2013/Asia 1 2013/NOT TYPED	Mar/Asia 1, Apr 2015/A, Oct 2015/O	See text
Nepal	O, 2012-2103/Asia 1	Apr 2014/O	Follow-up needed
Sri Lanka	2012 – 2013/O	Sept 2014/O	Follow-up needed

Map 6: FMD distribution by serotype and topotype in South Asia, 2011 – 2014 (EuFMD).

Conjectured circulating FMDV lineages in Pool 2 per 2014 [14]:

- O/ME-SA/Ind-2001 (the O/ME-SA/Ind-2011 lineage that emerged during 2011 has not been recognized 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)



C. POOL 3 – West Eurasia & Middle East

Morocco [2]

Five FMD outbreaks due to serotype O occurred between the 23rd October and the 1st November 2015 in Sidi Bennour, Settat and El Jadida, Centre, Morocco, on cattle and sheep farms with the animals showing clinical signs of the disease. Previous reports of the FMD were last registered in the country in April 1999.

The Casablanca Regional Laboratory for Analysis and Research (National laboratory) confirmed the first diagnosis on the 29th October examining bovine samples by ELISA and RT-PCR. Summary of the animals involved and location of the disease are given in Table 8 and Map 7.

The source of the outbreak is unknown and control measures being applied are disinfection, quarantine, surveillance outside containment and/or protection zone, stamping out, official destruction of animal products, official disposal of carcasses, by-products and waste, surveillance within containment and/or protection zone.

Vaccinations are being conducted in the Administrative Unit of Centre and a summary of this activity is given in Table 9.

Table 8: summary of the number of cattle involved in the FMD outbreaks reported between the 23rd October and 1st November 2015 in Centre, Morocco.

Species	Susceptible	Cases	Deaths	Destroyed	Slaughtered	Apparent morbidity rate	Apparent mortality rate	Apparent case fatality rate	Proportion susceptible animals lost*
Cattle	52	16	0	52	0	31%	0%	0%	100%
Sheep	74	0	0	74	0	0%	0%	-	100%
Total	**126**	**16**	**0**	**126**	**0**				

*Removed from the susceptible population through death, destruction and/or slaughter

Map 7: Location of FMD outbreaks reported between the 23rd October and 1st November 2015 in Centre, Morocco.

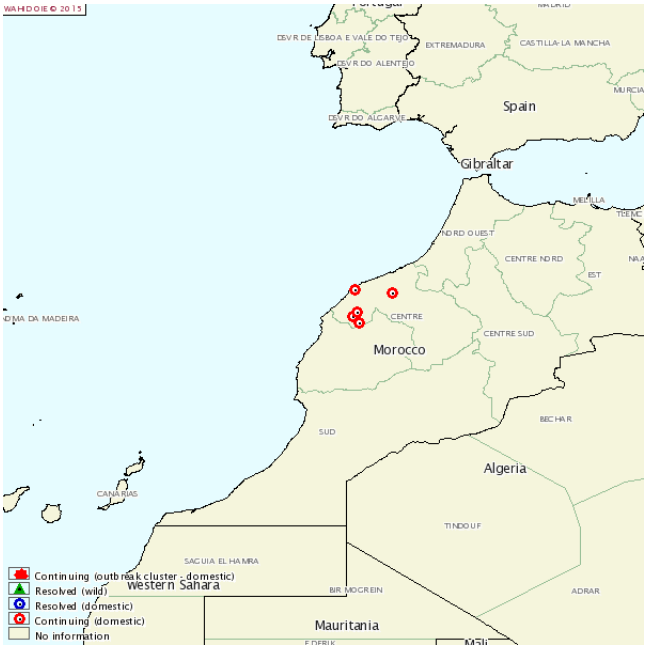


Table 9: summary of the vaccination activities carried out in the FMD outbreaks reported between the 23rd October and 1st November 2015 in Centre, Morocco.

Administrative division	Species	Total Vaccinated	Details
CENTRE	Cattle	10,000	Vaccine produced from an antigen against FMD virus prepared from the virulent type O strain covering serotypes O Manisa and O 3039

Pakistan [6]

In the PCFMD Project ongoing in Pakistan 64 FMD outbreaks were reported for the month of October due to serotypes A, Asia 1 and O with the latter being the predominant serotype. A summary of the distribution of the outbreaks per province and serotype is reported in Table 10.

Table 10: summary of the outbreaks reported in Pakistan during October 2015

Province	Number Outbreaks	N° of outbreaks due to FMDV Serotype(s)			
		O	A	Asia-1	Mixed serotypes
Sindh	48	17	8	3	20
Azad Jammu and Kashmir	1	1	-	-	-
Khyber Pakhtunkhwa	1	-	1	-	-
Punjab	12	5	7	-	-
Total	**62**	**23**	**16**	**3**	**20**

Vaccination within the Project against FMD was carried out on 41,679 animals applying different strategies and in different production systems and a summary of these activities is reported in Table 11.

Table 11: summary of the animals vaccinated in the different livestock production units, during October 2015, in Pakistan

Province	Ring Vaccination	Cost sharing basis	Government Livestock Farms/ Yaks/ Cholistan desert farming system	
Sindh	400	27,554	-	
Khyber Pakhtunkhwa	-	-	500	
Punjab	1,275	11,025	800	
Azad Kashmir	125	-	-	
Total	**1,800**	**38,579**	**1,300**	**41,679**

*Farmers of dairy colonies are actively participating in a cost-sharing vaccination program.

Saudi Arabia [1, 2]

A FMD outbreak caused by serotype A was detected on clinical basis on 13th September 2015, in Ar Riyad, Saudi Arabia, on a farm in which cattle and sheep were present. The outbreak was confirmed by the WRLFMD using reverse transcriptase real time PCR (rRT-PCR) on the 16th October 2015. The described outbreak was declared resolved on the 7th October 2015.

Summary of the animals involved and location of the disease are given in Table 12 and Map 8.

The source of the outbreak is unknown and control measures being applied are quarantine, movement control inside the country and vaccination in response to the outbreak. Following the detection of the outbreak, a total of 45,000 cattle and sheep were vaccinated. Information of the type of vaccine employed is not available.

Other suspect samples were collected and sent to the Central Veterinary Laboratory in Riyadh and to the WRLFMD.

The WRLFMD detected FMDV serotype A in the two sets of cattle epithelium/tongue samples respectively collected on the 2nd September and 9th October 2015. Genotyping of the field isolates of the first set of samples identified these as A/Asia/unnamed with most closely field related virus to both represented by IND/249/2004 (H0832582) with a sequence identity (seq. id.) of 93.43%, while most closely related reference virus, is represented by A22/IR0164 (AY593763) with a seq. id of 84.66%.

Other closely related filed viruses with a minimum seq. id of 92.96% were all isolated in India or Bhutan, between 2002 and 2005.

Most recent reported outbreaks of serotype A in Saudi Arabia were by the WRLFMD in 2011 however genotyping for this isolate is not available. Genotyping for the same serotype was last reported in 2006 by the WRLFMD for an and the strain, A/SAU/15/2005 was identified as A/ASIA/unnamed with closest field strain virus, A/IRN/7/2005 having a seq. id. of 99.22%.

Relative to strains are the following articles that provide background information on the FMDV A strains circulating in Asiaian subcontinent to which the above mentioned viruses are related: J.Gen. Virol. (2011), 92, 873–879, Vet Mic 158 (2012) 405–409.

Table 12: summary of the number of cattle involved in the FMD outbreak reported on 13th September 2015 in Ar Riyad, Saudi Arabia.

Species	Susceptible	Cases	Deaths	Destroyed	Slaughtered	Apparent morbidity rate	Apparent mortality rate	Apparent case fatality rate	Proportion susceptible animals lost*	Slaughtered
Cattle	93	93	0	0	0	100%	0%	0%	0%	0
Sheep	30	30	0	0	0	100%	0%	0%	0%	0
Total	123	123	0	0	0	100%	0%	0%	0%	0

*Removed from the susceptible population through death, destruction and/or slaughter

Map 8: Location of FMD outbreak reported on 13th September 2015 in Ar Riyad, Saudi Arabia.

Table 13: Summary of the history of FMD Pool 3, 2012 – 2014, for geographic distribution see Map 9 below.

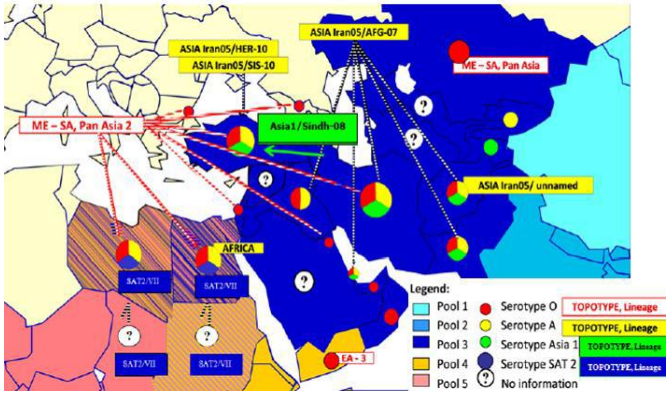
COUNTRY	FMD HISTORY FMDV serotypes, reported to OIE in 2012 – 2014	LAST OUTBREAK REPORTED/SEROTYPE#	Comment
Afghanistan	2013/O, A, Asia 1, NOT TYPED 2012/SEROTYPE NOT REPORTED	2014/A, Asia 1, O	Follow –up needed
Algeria	2014/O	Apr 2015/O	Follow –up needed
Armenia	2012-2013/DISEASE ABSENT	2006/A	Follow –up needed
Azerbaijan	DISEASE ABSENT	2007/0	Follow –up needed
Bahrain	2012 /O	Oct 2014/O	Follow –up needed
Egypt	2012, 2014/SAT 2 2012 - 2014/O, A	April 2014/Sat 2, Jan-April 2015/A & O	Follow –up needed
Georgia	DISEASE ABSENT	2001/ASIA 1	Follow –up needed
Iran	O, A, 2012-2013/Asia 1	Jun 2013/Asia 1, Apr 2014/O, A	Follow –up needed
Iraq	2012-2013/O, A	Dec 2013/A, O	Follow –up needed
Israel	2012-2013/O	Nov 2013/O	Follow –up needed
Jordan	DISEASE ABSENT	2006/A	Follow –up needed
Kazakhstan	2012/O 2012 –2013/A	Aug 2012/O, Jun 2013/ A	Follow –up needed
Kuwait	2012/O 2013 – 2014/ DISEASE ABSENT	Jan 2012/O	Follow –up needed
Kyrgyzstan	2012-2013/O, A	Apr 2013 /O, A, Aug 2014/NOT TYPED	Typing required
Lebanon	DISEASE ABSENT	2010/not typed	Follow –up needed
Libya	NO DATA AVAILABLE	Oct 2013/O	Follow –up needed
Morocco	No outbreaks reported for that period	Oct 2015/O	See text (last reported

			outbreak in 1999 due to FMDV O)
Oman	2012-2013/O	May 2015/SAT 2	Follow –up needed
Pakistan	DISEASE LIMITED TO ONE OR MORE ZONES	Oct 2015/A, Asia 1 and O	See text
Autonomous Territories Palestine	O, 2012-2013 - SAT 2	Mar 2013/Sat 2, Nov 2014/O	Follow –up needed
Qatar	2012-2013/O	Dec 2013/O	Follow –up needed
Saudi Arabia	2013/O	Mar 2014/O, Sept 2015/A	See text
Syrian Arab Republic	DISEASE ABSENT	2002/ A & O	Follow –up needed
Tajikistan	2012/NOT TYPED 2013/DISEASE ABSENT	Nov 2011/Asia 1, Nov 2012/ NOT TYPED	Follow –up needed
Tunisia	2014/O	Oct 2014/O	Follow –up needed
Turkey	Asia 1, A, O, NOT TYPED	Nov 2014/O, Feb 2015/ A and Asia 1	Follow –up needed
Turkmenistan	NO DATA AVAILABLE	Not available	Follow –up needed
United Arab Emirates	2012/DISEASE ABSENT 2013-2014/O	Jan 2014/O	Follow –up needed
Uzbekistan	NO DATA AVAILABLE	Not available	Follow –up needed

Map 9: FMD distribution by serotype and topotype for West Eurasia and Middle East, 2012 – 2014 (EuFMD).

Conjectured circulating FMDV lineages in Pool 3 per 2014 [14]:

- O/ME-SA/PanAsia-2 (predominantly from ANT-10 and FAR-09 sub-lineages)
- O/ME-SA/Ind-2001 (recent incursion per 2013/14 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).



D. POOL 4 – Eastern Africa

Ethiopia [8]

The National Animal Health Diagnostic and Investigation Center (NAHDIC), Ethiopia, using the FMD NSP 3ABC ELISA examined for the presence of FMD antibodies 1,540 sera that were collected from small ruminants FMD surveillance purposes from different part of country, with 26 samples (1.7%) reacting positively, that is a low seroprevalence of FMD in these animals.

Kenya [7]

The Foot-and-Mouth Disease Laboratory, Embakasi, Kenya using FMD Ag detection ELISA and/or RT-PCR detected FMDV serotype A in 3 samples, SAT1 in a set of 3 other samples and SAT2 in 1 sample from among the 10 bovine samples collected in various counties of Kenya.

$Uganda [1]

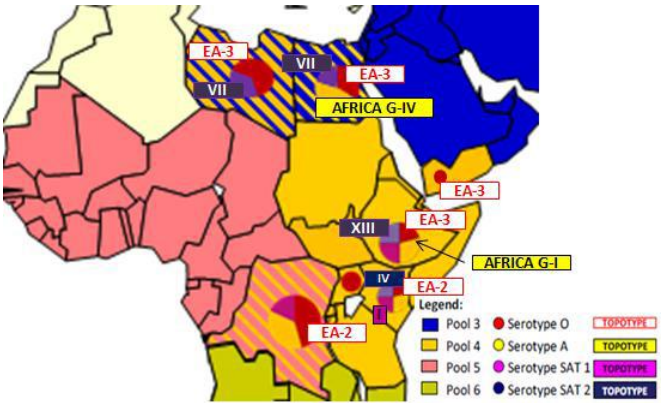
Of the two bovine samples collected in July 2014 tested by the WRLFMD for the presence of FMDV genome, only one resulted positive in rRT-PCR, while both samples were negative for serotyping using ELISA and cell culture methods.

Table 14: Summary of the history of FMD Pool 4, 2012 – 2014, for geographic distribution see Map 10 below.

COUNTRY	FMD HISTORY FMDV serotypes, reported to OIE in 2012 - 2014	LAST OUTBREAK REPORTED/SEROTYPE#	Comment
Burundi	NO DATA AVAILABLE	Aug 2013 / not available	Typing required
Comoros	NO DATA AVAILABLE	2010	Follow –up needed
Congo d. R.	NO DATA AVAILABLE	Jun 2013/not typed	Typing required
Djibouti	DISEASE ABSENT	Not available	Follow –up needed
Egypt	2012, 2014/SAT 2 2012 - 2014/O, A	April 2014/Sat 2, May 2014/A, Oct 2014/O	Follow –up needed
Eritrea	2012/O	Jan 2012/O	Follow –up needed
Ethiopia	O, 2012/A, SAT 2	Sept 2015/SAT 2, Aug 2015/O, Jun 2014/A and SAT 1, Jan 2015/confirmation pending,	See text
Kenya	O, SAT1, SAT2, 2012 – 2013/A, 2012/NOT TYPED	Oct 2015/ A, SAT1 and SAT 2, Apr 2015/O	See text
Libya	NO DATA AVAILABLE	Oct 2013/ O, Sat 2/Apr 2012	Follow-up needed
Rwanda	2012-2013/A, O, SAT1, SAT 2	Nov 2012/not typed	Typing required
Somalia	2012/NOT SAMPLED 2013 – 2014/ NO DATA AVAILABLE	2011	Follow –up needed
Sudan	O, 2013/SAT 2, 2013-2014/NOT TYPED	2013/O, SAT2	Follow –up needed
South Sudan	NO DATA AVAILABLE	2011	Follow –up needed
Tanzania	2012/O 2012-2013/A, SAT 1, SAT 2	May 2015/O Apr2013/ A, SAT 1, SAT2	Follow –up needed
Uganda	2012/O, SAT 1 2012-2013/NOT TYPED	May 2014/O Nov 2014/SAT1, Jan 2015/A, and 3, July 2015/ SAT 2 and untyped	See text
Yemen	2012/O, 2013 – 2014/ DISEASE PRESENT BUT WITHOUT QUANTITATIVE DATA	2009/O	Follow –up needed

Map 10: FMD distribution by serotype and topotype for East Africa. 2011 – 2014 (EUFMD)

East Africa is known to be endemic for FMD, but currently available data are limited.



Conjectured circulating FMDV lineages in Pool 4 per 2014 [14]:

- O (topotypes EA-2 (Kenya, Tanzania, DR Congo, Uganda), EA-3 (Ethiopia, Eritrea, Sudan, Egypt) and EA-4 (Ethiopia, Kenya, Uganda).
- O/ME-SA/Ind2001 (in Libya, Tunisia and Algeria)
- 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) 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 and recently in 2014)

E. POOL 5 – West / Central Africa

Cameroon [9]

The Laboratoire National Vétérinaire (LANAVET) tested using NSP ELISA 50 bovine serum samples of which 30 resulted positive.

The laboratory personnel were involved in the field investigations of outbreaks. The institution has ongoing collaborative partnerships with the Ohio State University and Plum Island Laboratory, USA.

Niger [1]

FMDV serotype O was detected by the WRLFMD in one of the four bovine epithelium samples collected in May 2015 in Niger, while in another sample FMDV genome was detected.

Previous reports of FMDV serotype O in the country were in 2005 with the detection of 0/WA/unnamed in bovine samples.

Ghana [10] **and Senegal** [11]

The Accra Veterinary Laboratory, Ghana and Laboratoire National de l'Elevage et de Recherches Vétérinaires (ISRA-LNERV), Dakar, Senegal reported that no samples were examined for FMD during October 2015.

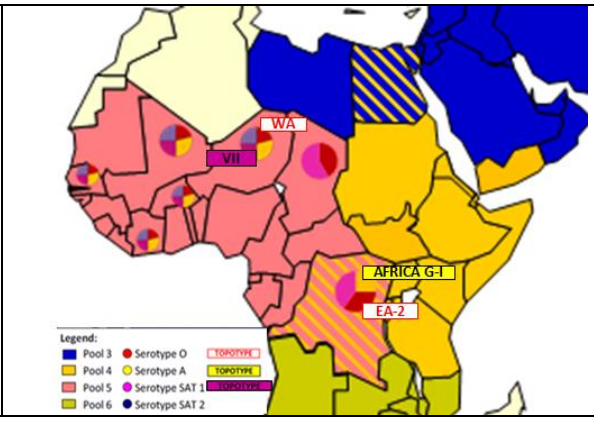
ISRA-LNERV has signed a collaborative project with ANSES for genotyping field strains collected in Senegal and in the sub region.

Table 15: Summary of the history of FMD Pool 5, 2012 – 2014, for geographic distribution see Map 11 below.

Country	FMD history FMDV serotypes, reported to OIE in 2012 – 2014	Last outbreak reported/serotype#	Comment (Genotyping would be useful for this region)
Benin	A, O, SAT 1, SAT 2	Jun 2014/O, A, SAT 1, SAT 2	Follow –up needed
Burkina Faso	SEROTYPES NOT REPORTED	2013/ not available	Follow –up needed

Cameroon	SEROTYPES NOT REPORTED	Apr 2014/ A, Nov 2014/O, SAT 2, May 2014/SAT 1, Jun 2014, Jan 2015 and July-Aug 2015/untyped	See text Serotyping and genotyping required
Cape Verde	NO DATA AVAILABLE	Not available	Follow –up needed
Central Afr. Rep.	DISEASE PRESENT BUT WITHOUT QUANTITATIVE DATA	Not available	
Chad	2012 – 2013/SEROTYPES NOT REPORTED	Not available	
Congo D. R.	2012 – 2013/A, O, SAT 1	Jun 2013/not typed	Typing required
Congo R.	NO DATA AVAILABLE	Jun 2013/not typed	Typing required
Cote D'Ívoire	2012/A, NOT SAMPLED 2013/ SEROTYPES NOT REPORTED	Jun 2013/not typed	Follow –up needed
Equatorial Guinea	DISEASE SUSPECTED BUT NOT CONFIRMED	Not available	Follow –up needed
Gabon	NO DATA AVAILABLE	Not available	
Gambia	NO DATA AVAILABLE	2012/O	
Ghana	2012 – 2014/SEROTYPES NOT REPORTED	2014/not available	See text Follow –up needed
Guinea Biss.	DISEASE ABSENT	No data available	Follow –up needed
Guinea	2012-2013/ DISEASE ABSENT	2014/not available	
Liberia	NO DATA AVAILABLE	Not available	Follow –up needed
Mali	2012/DISEASE ABSENT 2013/ SEROTYPES NOT REPORTED	2011/2012, no precise data	
Mauritania	2012-2013/NO REPORTED OUTBREAKS	Dec 2014/SAT 2	Follow –up needed
Niger	2012 – 2014/NOT SAMPLED	2014/not sampled, May 2015/O	See text
Nigeria	2012 – 2014/NOT SAMPLED	Sept 2015/SAT 1, Sept 2014/0, SAT 2 and Feb 2015/ A	See text Genotyping required Follow –up needed
Sao Tome Principe	2012/DISEASE ABSENT, 2013/NO DATA AVAILABLE	Not available	Follow –up needed
Senegal	2012, 2014/NO DATA AVAILABLE 2013/DISEASE ABSENT,	2014/ SAT 1 Feb 2015/ A and O	See text Follow –up needed
Sierra Leone	DISEASE ABSENT	Oct 1958	Follow –up needed
Togo	O, SAT 1, 2013/NOT TYPED	2012/O	Follow –up needed

Map 11: FMD distribution by serotype and topotypes for West Africa, 2011 – 2014 (EuFMD)

Conjectured circulating FMDV lineages in Pool 5 per 2014 [14]: ▪ Serotype O (topotypes WA, EA-3 (Nigeria)) ▪ Serotype A (topotype AFRICA, genotypes IV and VI) ▪ Serotype SAT 1 (?) ▪ Serotype SAT 2 (topotype VII)	

F. POOL 6 – <u>SOUTHERN AFRICA</u>

Botswana [1]

FMDV serotype SAT 1 was detected by the WRLFMD from the two bovine epithelium samples collected in June 2015 in Botswana. The samples were collected during the series of outbreaks that involved cattle herds in Chobe, Botswana.

Mozambique [1]

FMDV serotype SAT 1 was detected by the WRLFMD from one of the two bovine epithelium samples collected in May 2015 in Mozambique. The samples refer to outbreaks reported in a village in Gaza, Mozambique.

Namibia [1]

Of the six samples collected during May 2015 in Namibia, FMDV serotype SAT 1 was detected by WRLFMD in a culture isolate while SAT 2 was detected in the five bovine epithelium samples.

Episodes of FMD in the country that respectively started this year in January in Kavango, in which the virus was not typed, in May in Ohangwena that was due to SAT 2 and in July in Zambezi are being contained. The virus from the latter episode has now been serotyped as SAT 1.

RSA [12]

The Agricultural Research Council - Onderstepoort Veterinary Institute conducted 3,438 tests in Liquid-phase blocking ELISA for the detection of antibodies against serotypes SAT-1, SAT-2 and SAT-3, as well as, 125 tests using NSP ELISA.

Zambia [1]

FMD was observed on the 11th of October affecting at least twelve cattle herds in Shangombo, Western, Zambia, that is on the border with Angola.

Diagnosis was carried out on the 26th of October on clinical basis and using ELISA 3ABC in which the samples were confirmed as positive. Serological analysis was conducted by Central Veterinary Research Institute (CVRI) (National laboratory) while real-time PCR is being conducted by the Botswana Vaccine Institute (OIE Reference Laboratory) with results pending.

Summary of animals involved and location of outbreak are reported in Table 16 and Map 12.

Source of outbreak was reported as due to the illegal movement of animals. Control measures instituted are livestock movement bans, movement control inside the country, surveillance outside containment and/or protection zone, surveillance within containment and/or protection zone. Vaccination will also be implemented.

Table 16: summary of the number of cattle involved in the FMD outbreak reported in October 2015, in Shangombo, Western, Zambia.

Species	Susceptible	Cases	Deaths	Destroyed	Slaughtered	Apparent morbidity rate	Apparent mortality rate	Apparent case fatality rate	Proportion susceptible animals lost*
Cattle	71,500	187	0	0	0	0.26%	0.00%	0.00%	0.00%

*Removed from the susceptible population through death, destruction and/or slaughter

Map 12: Location of FMD outbreaks reported in October 2015, in Shangombo, Western, Zambia.

Zimbabwe [1, 2]

FMDV serotype SAT 2 was detected by the WRLFMD in one of the three bovine samples collected in April 2015 in Zimbabwe with the detection of only FMDV genome in the other two samples.

Three new outbreaks of FMD were reported between 18th September and 1st October in Matabeleland North, and Mashonaland West Zimbabwe, following the first event that occurred in June 2015 and for which serotyping is pending.

Laboratory diagnosis was carried out on the 3rd October by the Central Veterinary Laboratory (National laboratory) using solid-phase blocking ELISA, while virus isolation is underway by the Botswana Vaccine Institute (OIE Reference Laboratory).

Summary of animals involved and location of outbreak are reported in Table 17 and Map 13.

Source of outbreaks is due to illegal movement of animals, contact with infected animal(s) at grazing/watering and with wild species. The outbreaks occurred in the district borders with neighbouring infected areas where healthy cattle drink water in Munyati River that is at Gokwe North or mixing while grazing at Gokwe South are exposed to infected animals. Affected districts are under quarantine and two rounds of vaccinations were carried out in the infected areas and in a 20km wide protection barrier area to prevent further spread. Further to these measures, the following are being applied are surveillance outside containment and/or protection zone and control of wildlife reservoirs.

Table 17: summary of the number of cattle involved in the FMD outbreaks reported between September and October 2015, in in Matabeleland North, and Mashonaland West Zimbabwe.

Species	Susceptible	Cases	Deaths	Destroyed	Slaughtered	Apparent morbidity rate	Apparent mortality rate	Apparent case fatality rate	Proportion susceptible animals lost*
Cattle	6,935	17	0	0	0	0.25%	0.00%	0.00%	0.00%

*Removed from the susceptible population through death, destruction and/or slaughter

Map 13: Location of FMD outbreaks reported between September and October 2015, in in Matabeleland North, and Mashonaland West Zimbabwe.

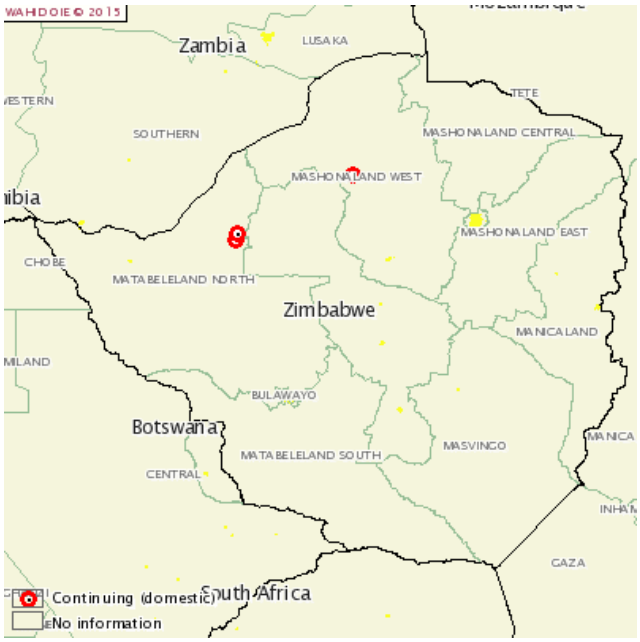
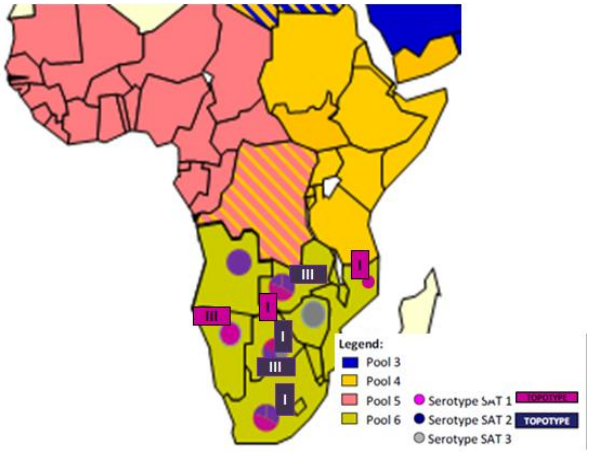


Table 18: Summary of the history of FMD Pool 6, 2012 – 2014, for geographic distribution see Map 14 below.

COUNTRY	FMD HISTORY FMDV serotypes, reported to OIE in 2012 – 2014	LAST OUTBREAK REPORTED/SEROTYPE#	Comment
Angola	2012/DISEASE SUSPECTED BUT NOT CONFIRMED 2013/DISEASE ABSENT 2014/NO DATA AVAILABLE	July 2015/ SAT 2	Follow –up and typing required
Botswana	2012-2014/SAT 2 2014/SAT 1	Jun 2015/typing pending July 2015/SAT 2, June 2015/SAT 1	See text Typing required
Congo D. R.	2012 – 2013/A, O, SAT 1	Jun 2013/not typed	Follow –up needed
Malawi	2012 -2013/NO REPORTED OUTBREAKS	Oct 2011, Sep 2015/typing pending	See text Follow –up needed
Mozambique	2012 -2013/DISEASE ABSENT, 2014/NO DATA AVAILABLE	July 2015/SAT 2, May 2015/ SAT 1	See text Follow –up needed
Namibia	2012-2013/SAT 1	May 2015/SAT 1, Jun 2015/SAT 2, July/typing pending	See text Typing required
South Africa	2012/SAT 2 2013/SAT 1	Aug 2013/SAT 1, Nov 2014/ SAT 2	See text Genotyping required
Zambia	2012/SAT 1, SAT 2	Jan 2013/SAT 1, SAT 2, Oct 2015/typing pending	See text Follow –up needed
Zimbabwe	2012-2013/SAT 2 2013/SAT 3 2014/SAT 1	Jun 2013/SAT 3, Sept 2014/SAT 1, Sep 2015/ SAT 2	See text

Map 14: FMD distribution by serotype and topotype for Southern Africa, 2011 – 2014 (EuFMD)



Swaziland and Lesotho are free from FMD without vaccination. There is a zone in both Botswana and Namibia, which has been FMD free without vaccination, since 2010 and 1997 respectively.

Conjectured circulating FMDV lineages in pool 6 per 2014 [14]:

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

G. POOL 7 – South America

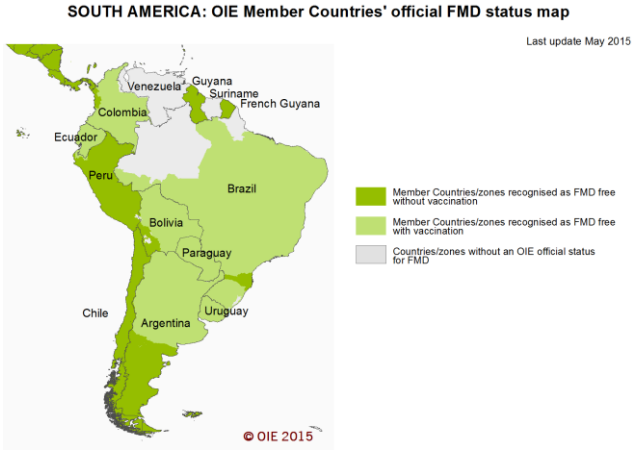
South America [2, 14]

The OIE FMD status of the countries in South America as reported in April 2015 is presented in Map 15.
Most South American countries are FMD free with vaccination (Uruguay) or without vaccination (Chile, Guyana) or with free zones with vaccination (Argentina, Bolivia, Brazil, Colombia, Peru and continental Ecuador) or without vaccination (Argentina, Bolivia, Brazil, Colombia, Peru) as described by the OIE maps (see: http://www.oie.int/en/animal-health-in-the-world/official-disease-status/fmd/en-fmd-carte/).
Small areas of the continent may still be considered as endemic but clinical cases are rare (Map 15). The FMD history between 2012 –2014 is given in Table 19.

Table 19: Summary of the history of FMD Pool 7, 2012 – 2014, for geographic distribution see Map 15 below

COUNTRY	FMD HISTORY FMDV serotypes, reported to OIE in 2012 2014	LAST OUTBREAK REPORTED/SEROTYPE#	Comment
Paraguay	DISEASE ABSENT	Dec 2011/O	
Venezuela	DISEASE ABSENT	2011/O, A	National situation needs verification

Map 15: FMD status for South America [2].



IV. OTHER NEWS:

[1]**The WRLFMD Quarterly Report April – June 2015** published the following table (Table 20) that contains a list of FMDV strains for FMD-Free countries antigen banks. The discussion of this table is within the report.
The WRLFMD is at present working to adopt a risk-based approach for identifying FMDV lineages and relate these to priority vaccines for use in Europe and other FMD-free settings.

Table 20: Recommendations by the WRLFMD® on FMD virus strains to be included in FMDV antigen banks (for FMD -free countries) – June 2015
Note: Virus strains 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/Sakolnakorn/97) 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

V. REFERENCES - Superscripts

1. World Reference Laboratory for Foot-and-Mouth Disease (WRLFMD), www.wrlfmd.org
2. WAHID Interface – OIE World Animal Health Information Database http://web.oie.int/wahis/public.php?page=home
3. Regional Reference Laboratory for FMD (ARRIAH, Russia) - (*Dr. Svetlana Fomina*)
4. SEAFMD, http://www.arahis.oie.int/reports.php?site=seafmd
5. Project Directorate on Foot and Mouth Disease (PD-FMD), Indian Council of Agricultural Research, Mukteswar, India (*Dr B. B. Dash*) FAO
6. Progressive Control of Foot and Mouth Disease in Pakistan, GCP/PAK/123/USA - (*Dr. Manzoor Hussain*, National Project Director and *Dr. Muhammad Afzal*, Project Coordinator)
7. National FMD Reference Laboratory, Embakasi, Kenya - (*Dr. Abraham Sangula, Dr. Kenneth Ketter*)
8. National animal health diagnostic and investigation center (NAHDIC), Ethiopia - (*Dr. Daniel Gizaw*)
9. Laboratoire National Vétérinaire (LANAVET) -Garoua, Cameroon - (*Dr. Simon Dickmu Jumbo)*
10. ACCRA Veterinary Laboratory, Ghana - (*Dr. Joseph Adongo Awuni*)
11. Laboratoire National de l'Elevage et de Recherches Vétérinaires (LNERV, Senegal) – (*Dr. Momar Talla Seck* – Mme Monique A. Gomis)
12. ARC-Onderstepoort Veterinary Institute, Republic of South Africa - (*Dr LE Heat - Ms E Kirkbride*)
13. 42a Reunión Ordinaria de la Comisión Sudamericana para la Lucha contra la Fiebre Aftosa, Quito, Ecuador, 16-17 April, 201.http: //ww2.panaftosa.org.br/cosalfa42/
14. OIE/FAO FMD Reference Laboratory Network, Annual Report 2014