November, 2012

Foot and Mouth Disease situation

Food and Agriculture Organization of the United Nations

Monthly Report

November 2012

INFORMATION SOURCES USED:

Databases:

OIE WAHID World Animal Health Information Database

FAO World Reference Laboratory for FMD (WRLFMD)

Other sources:

FAO/EuFMD supported FMD networks

FAO/EuFMD projects and field officers

* International Society for Infectious diseases*

ACKNOWLEDGEMENT:

Ministry of Agriculture Animal Industry and Fisheries. National Animal Disease Diagnostics and Epidemiology Centre (NADDEC), Uganda

SENASA

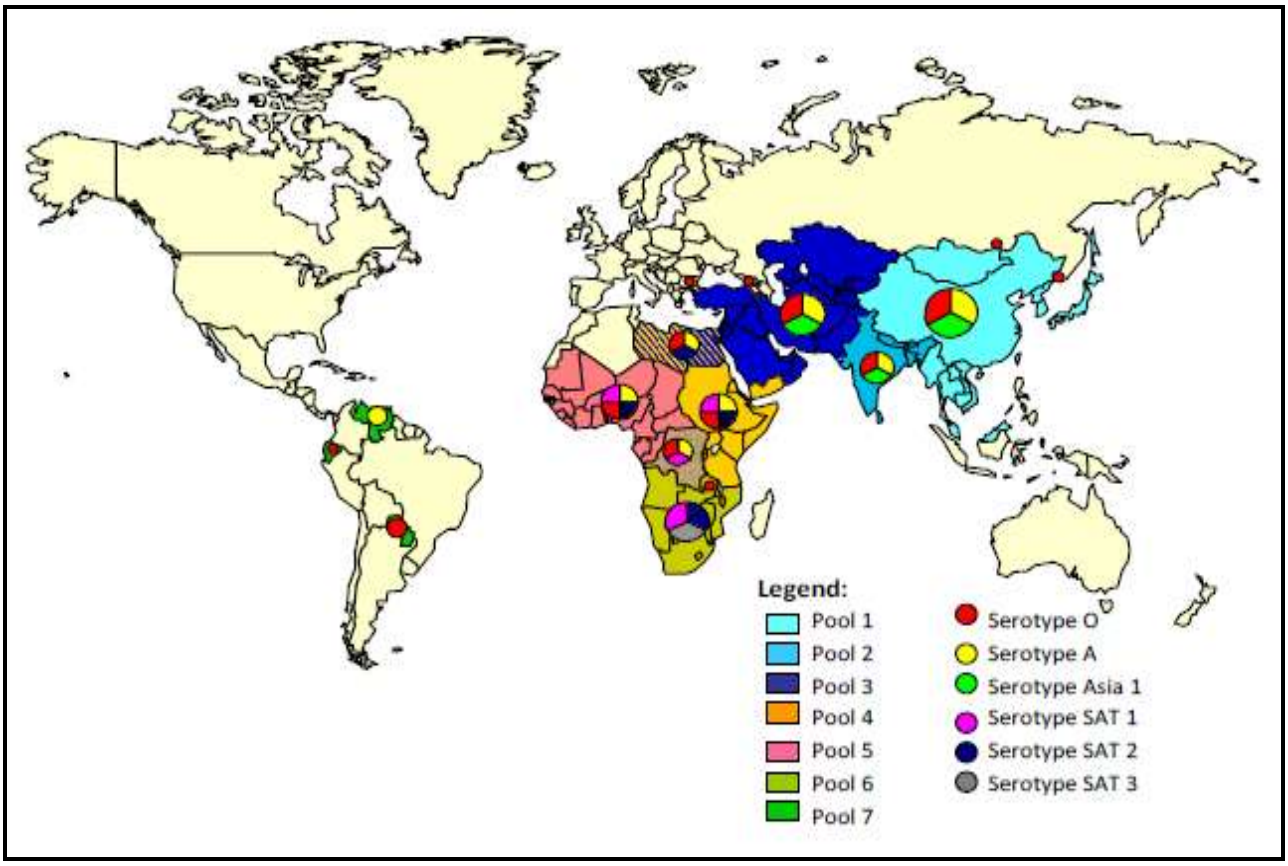
The sources for information are referenced by using superscripts.
The key to the superscripts is on the last page

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.

I. GENERAL OVERVIEW

Foot and mouth disease (FMD) distribution by Serotype and the seven virus pools, 2010-2012 (Map 1)

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).



Map 1: Foot and mouth disease virus pools distribution, 2010-2012

Table 1: List of countries representing each virus pool

POOL	REGION/COUNTRIES	SEROTYPES
1	**CENTRAL/EAST ASIA** (Cambodia, China (People's Rep. of), China (Hong Kong, SAR),China (Taiwan Province), Japan, Korea (DPR), Korea (Rep. of), Lao PDR, Malaysia, Mongolia, Myanmar, Russian Federation, Thailand, Viet Nam)	**O, A, Asia 1**
2	**SOUTH ASIA** Bangladesh, Bhutan, India, Nepal, Sri Lanka	**O, A, Asia 1**
3	**WEST EURASIA & MIDDLE EAST** (Afghanistan, Armenia, Azerbaijan, Bahrain, Bulgaria, Egypt, Georgia, Iran, Iraq, Israel, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Libya, Oman, Pakistan, Palestine Autonomous Territories, Qatar, Saudi Arabia, Syrian Arab Republic, Tajikistan, Turkey, Turkmenistan, Uzbekistan)	**O, A, Asia 1**
4	**EASTERN AFRICA** (Burundi, Comoros, Congo D. R., Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Rwanda, Somalia, North Sudan, South Sudan, Tanzania, Uganda, Yemen)	**O, A, SAT 1, SAT 2**
5	**WEST/CENTRAL AFRICA** (Benin , Burkina Faso, Cameroon, Cape Verde, Central Afr. Rep., Chad, Congo D. R., Congo R., Cote d'ívoire, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea Biss., Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Sao Tome Principe, Senegal, Sierra Leone, Togo)	**O, A, SAT 1*, SAT 2**
6	**SOUTHERN AFRICA** (Angola, Botswana, Congo D. R., Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe)	**{O, A}**, SAT 1, SAT 2, SAT3**
7	**SOUTH AMERICA** (Ecuador, Paraguay, Venezuela)	**O, A**

* NOT CONFIRMED IN THE PAST 30 YEARS IN DOMESTIC ANIMALS

** ONLY IN NORTH ZAMBIA AS OVERSPILL FROM POOL 4

Egypt and Libya are indicated as being in multiple pools, since they have evidence of FMDV originating from 2 or more pools in the recent past (4 years).

II. HEADLINE NEWS

POOL 1

China[1] – reoccurrence of FMD serotype O in Dalian City of Liaoning

Chinese Taipei[1] – serotype O outbreak in Dongshih Township, YUN-LIN on pig farm

Cambodia[9] - 3 FMD outbreaks in October 2012

Thailand[9] - 1 FMD outbreak in September caused by type O and 4 outbreaks in October

POOL 2

Nepal[2] – FMD outbreak in Lalitpur district

POOL 3

Turkey[2] – In Anatolia region, serotypes O, A and Asia 1 are still circulating.

Pakistan[20] – 281 FMD outbreak January – June 2012

Iran[2] - type A outbreaks continue to dominate; recent vaccine matching indicates a poor match with A Iran 05; there are reports of outbreak on vaccinated premises, but the clinical signs are mild

POOL 4

Rwanda[2] – FMD outbreaks in Kayonza and Gatsibo districts

Kenya[7] – serotype A outbreak in the county of Nakuru
– serotype SAT 2 outbreak in Bahati

POOL 5

Nigeria[4] - FMDV serotypes A and O were detected in recent samples

POOL 6

Zimbabwe[17] - outbreak in Gokwe North, where endemic FMD has been established, is still Smoldering
- In Mwenezi/Pezvi region, recurrent outbreaks occur

POOL 7

No new events have been reported for this reporting period.

III. DETAILED POOL ANALYSIS

Only 24 countries have submitted samples to World Reference Laboratory (WRL) during 2012. 5 out of them have submitted samples only from previous years and not from 2012. According to the proportion of samples from which no virus/genome was detected, it is evident that selection and management of samples may be challenging in some cases (Figure 1).

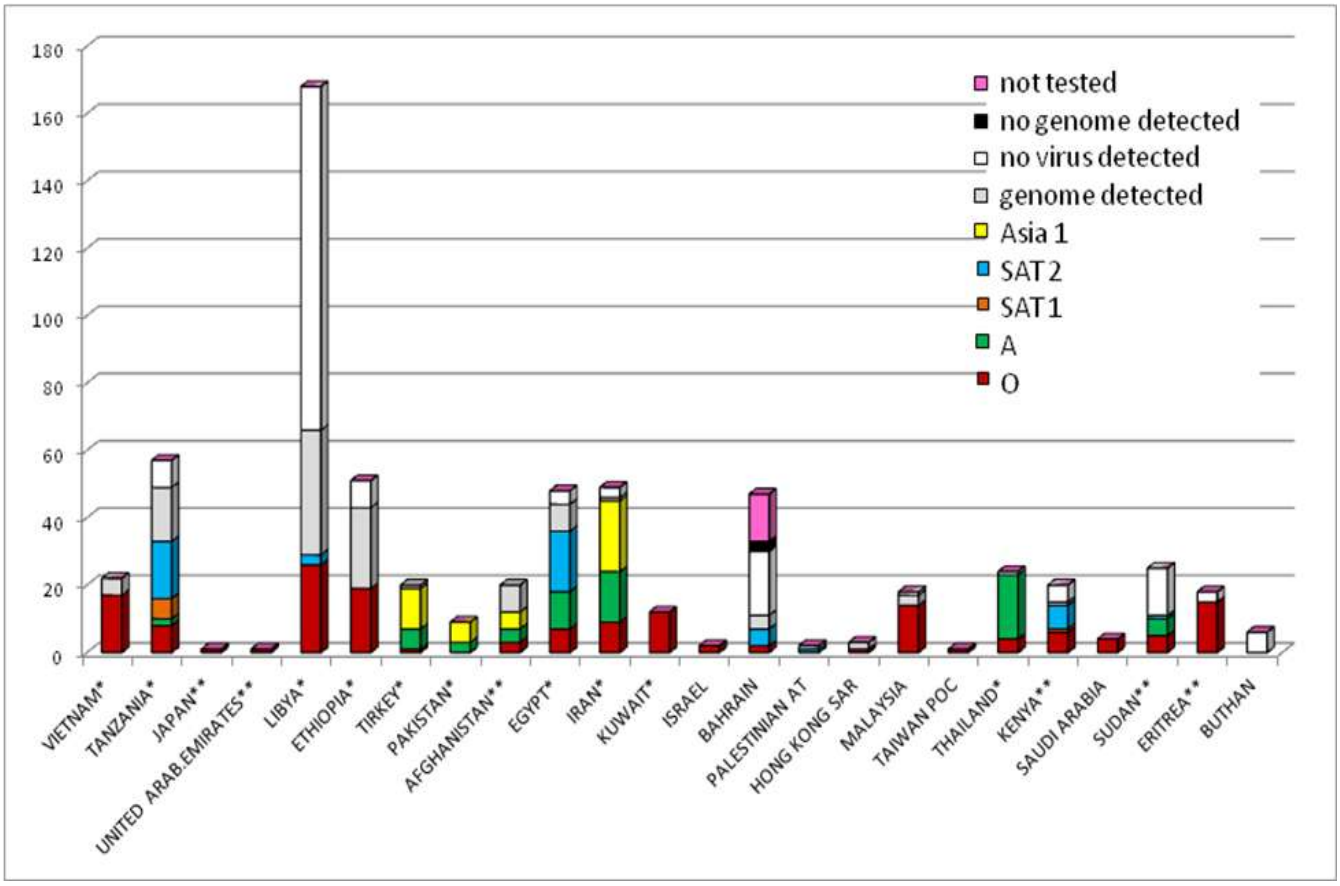


Figure 1: Profile of samples submitted to WRL

* - submitted samples from previous years and 2012
** - submitted samples from years before 2012

P O O L 1

CENTRAL / EAST ASIA

China (People's Rep. of)[1] - FMD was reported on a pig farm, located in Dalian City of Liaoning (Map 2). The disease was clinically manifested with reported 100% morbidity and mortality rates. FMDV type O was confirmed at National Foot and Mouth Disease Reference Laboratory by ELISA, RT-PCR and virus isolation.

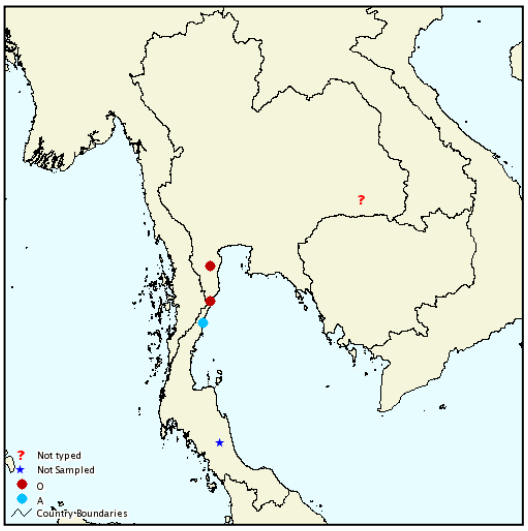
Map 2: FMD outbreak in Dalian City (November 2012)

Chinese Taipei[1] – FMD outbreak caused by serotype O has been reported on a pig farm in Dongshih Township, YUN-LIN (Map 3). The disease was discovered during the active surveillance and confirmed at Animal Health Research Institute (National laboratory) by NSP ELISA, while RT-PCR and virus isolation were negative. The monitoring and epidemiological investigation of the index farm and surrounding farms (31 pig farms, and 4 goat farms within 3-km radius of the index farm) have been done and no clinical or epidemiological evidence of infection was found.

Map 3: FMD outbreak in Dongshih Township (November 2012)

Cambodia[9] - in October 2012, 3 FMD outbreaks have been recorded. Samples for laboratory investigations were not taken. From the beginning of 2012, in Cambodia, there have been reported 18 outbreaks and none of them was confirmed by laboratory methods (Map 4).

Map 4: FMD outbreak in Cambodia, 2011-2012



Thailand[2, 9] - one FMD outbreak in September caused by type O and 4 outbreaks in October (one caused by type A, 2 by type O and one not sampled) have been reported (Map 5). Since beginning of 2012, 20 outbreaks of FMD (9 serotype A, 4 serotype O, 2 not sampled, 5 not typed) in Thailand have been recorded, with the apparent peak in April[9]. The most affected category has been beef cattle, then dairy cattle, buffaloes and swine (Table 2)[2]. Comparing to previous years, in 2012 outbreaks ended faster, approximately within 3 weeks[2].

Map 5: FMD outbreak in Thailand September - Ocrober-2012

Table 2: Categories affected by FMDV

SPECIES	SUSCEPTIBLE	CASES	DEATH
BEEF CATTLE	2 498	198	16
DAIRY CATTLE	12 766	90	0
BUFFALOES	499	20	2
SWINE	19	2	15
TOTAL	15 732	310	33

The most common way of FMD spreading in Thailand is animal movement and during last 2 years by fomites (Figure 2)[2].

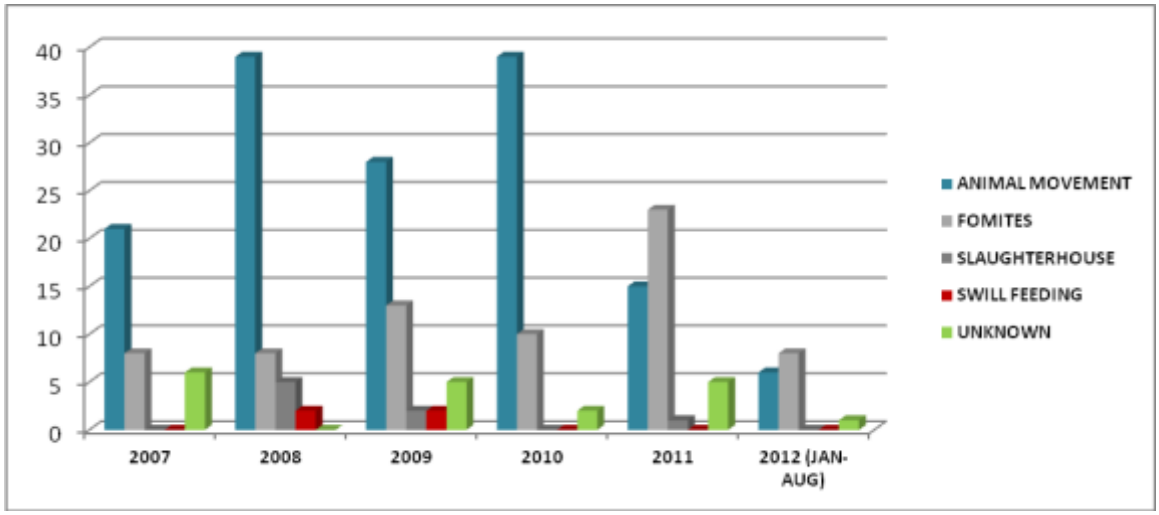


Figure 2: Causes of FMD outbreaks 2007-2012

Hong Kong[3, 11] - phylogenetic analysis of VP1 sequences reveals that all Hong Kong FMDV serotype O isolates are classified into three lineages: HK-A and HK-B in Cathay topotype, and HK-C in SEA topotype (Map 6)[11].

Map 6: FMDV type O lineages circulating in East Asia

Although HK-B lineage viruses share a common ancestor with strains that have caused outbreaks in Taiwan and Philippines, there is no consolidated evidence demonstrating the order of introduction events among these regions[11].

HK-C lineage is the latest FMDV isolated in Hong Kong. This virus is likely adopted from bovine into porcine. The VP1 sequences of HK-C strains show high homology to isolates from Vietnam, Thailand, Lao and other South-east Asia countries. HK-C strains are closely related[11].

As local pigs confer immunity mainly against Cathay topotype viruses, due to the vaccines specific to ME-SA and Cathay topotype which were used, introduction of HK-C viruses have led into an unexpectedly high severity and rapid spreading rate of the disease.
Regression analysis projects that the time of divergence from the most recent common ancestor of HK-A and HK-B are 1964±12 and 1987±9 years, respectively[11].
FMD situation in recent years is given in Table 3.

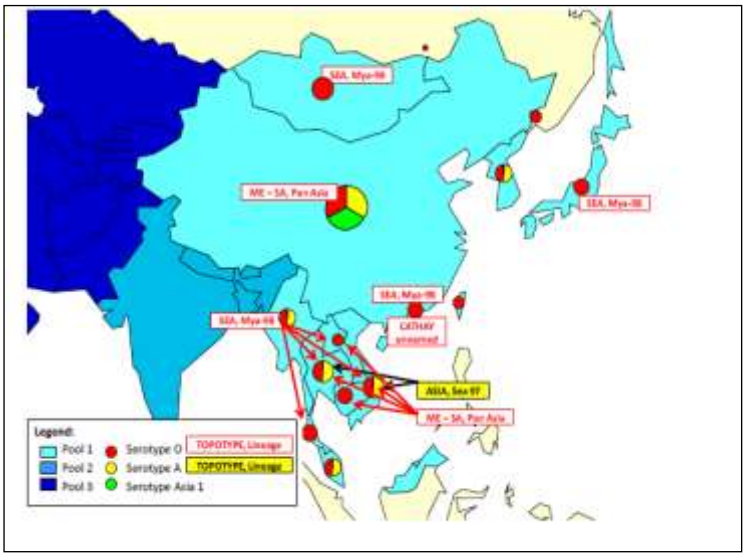
Table 3: FMD situation 2010-2012[3]

YEAR	2010	2011	2012
No OF CASES	4	3	1
LOCATION	NEW TERRITORIES		
SPECIES/SEROTYPE	PIG/O		

Mongolia[12] - serum samples from 36 calves and 57 adult gazelles (Procapra gutturosa) and from adult domestic animals sympatric with the gazelles, including 138 sheep (Ovis aries), 140 goats (Capra aegagrus hircus), 139 Bactrian camels (Camelus bactrianus), and 138 cattle (Bos taurus) collected during 2005-2008, were tested for NSP antibodies.
Overall, 2.0% (95% CI 0.7-3.3%, n=555) of the four livestock species were antibody positive for nonstructural proteins of FMDV, whereas 30.3% (95% CI 26.5-34.1%, n=555) had antibodies for structural proteins. Seven out of 57 free ranging gazelle calves (7.5%, 95%CI 1.6-12.4%) were NSP positive. None of 36 adult gazelles sampled in 2008 was NSP antibody positive. The

episodic nature of FMD outbreaks on the Eastern Steppe, Mongolia, with evidence of FMDV exposure in gazelles only during or following concurrent outbreaks in livestock, suggests that FMDV spills over into the gazelle population during livestock outbreaks.

FMD in most central and eastern Asia countries is endemic (Map7). Brunei and Japan are the only countries in this region with the free FMD status where vaccination is not practiced.
There is a zone covering the provinces of Sabah and Sarawak in Malaysia which is designated as FMD free without vaccination. In China, the main threat comes from O/Mya-98 strain and PanAsia strain. The O/Mya-98 strain mainly affects pigs, although cattle and goat/sheep can also show clinical signs in some field cases. However, the PanAsia strain mainly affects cattle. Epidemiological analysis indicates that animal movements associated with trade are the main factors for the spread of the FMD and for transmission between provinces in China. Both Mya-98 and PanAsia strains of FMDV sequences from PR China had a close relationship with those sequences from outbreaks in Southeast Asia nations[6]. FMD history in past 2 years is given in Table 4.



Map 7: FMD distribution by serotypes 2010 – 2012

Table 4: Pool 1 FMD history 2010-2012

COUNTRY/6 MONTHS REPORTING TO OIE	FMD HISTORY (past 2 years)	LAST OUTBREAK REPORTED/TYPE	OIE FMD STATUS
CAMBODIA, 2011	201, 2012 – NOT TYPED[1]	OCT 2012/NOT TYPED[1]	DISEASE PRESENT
CHINA (PEOPLE'S REP. OF), 2011, ½ 2012	2011, 2012 – O[1]	NOV 2012/O[1]	DISEASE PRESENT
CHINA (HONG KONG, SAR) , 2011	2011 – O[1, 5] 2012 – O[3]	NOV 2012/O[3]	DISEASE PRESENT
CHINA (TAIWAN PROVINCE), NO OIE DATA	2011 - 2011 – O[5] 2012 – O[1]	NOV 2012/O[1]	UNKNOWN
JAPAN, 2011	2011, 2012 - NO REPORTED OUTBREAKS[1]	JULY 2010/O[1, 5]	FREE WITHOUT VACCINATION
KOREA (DPR), 2011	2011 – O[1, 5]	MARCH 2011/O[1]	½ 2011-PRESENT 2/2011 – NOT REPORTED
KOREA (REP. OF), 2011	2011 – O[1, 5]	APR 2011/O[1]	½ 2011-PRESENT 2/2011 – NOT REPORTED
LAOS PDR, NO SUBM. REPORTS	2011, 2012 - NO REPORTED OUTBREAKS[1]	OCT 2010/O[1]	UNKNOWN
MALAYSIA,	2011 – O, A[1, 5]	JUN 2012/O[1]	FMD FREE ZONE WHERE

2011, ½ 2012	2012 – O, A[1, 5]		VACCINATION IS NOT PRACTISED
MONGOLIA, 2011	2012 - O[10]	2012/O[10]	½ 2011 – LIMITED ON ONE OR MORE ZONES, 2/2011 -NOT REPORTED
MYANMAR, 2011	2011 – O[1]	FEB2012/O[9]	DISEASE PRESENT
RUSSIAN FEDERATION, 2011	2011 – O[1] 2012 – O[1]	MAR 2012/O[1]	½ 2011 – NOT REPORTED, 2/2011 - DISEASE PRESENT
THAILAND, 2011, ½ 2012	2011 – O, A[1, 5] 2012 – O, A[1, 5]	OCT 2012/A, O[1]	DISEASE PRESENT
VIET NAM, 2011	2011 – O[1, 5] 2012 – O[5]	MAR 2012/O[5]	DISEASE PRESENT

P O O L 2

SOUTH ASIA

Nepal[2] – FMD outbreak occurred in Lalitpur district (Map 8) where cattle population is estimated to be 337,785. Outbreak was confirmed by NSP ELISA and NSP Penside test. Virus serotype was not determined. The first case was reported in the village Champi, and few days after in the village Bungamati (Figure 3).

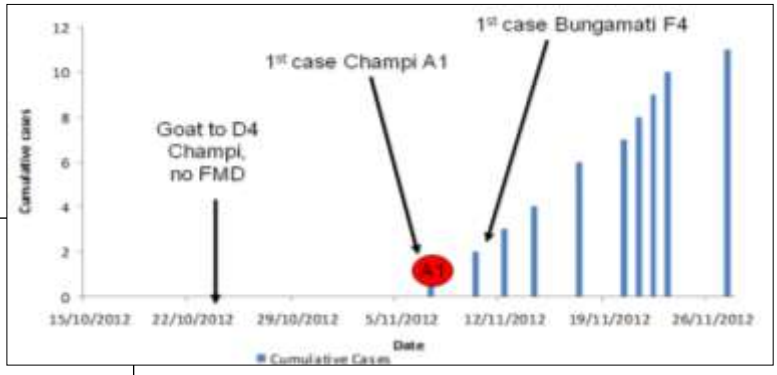
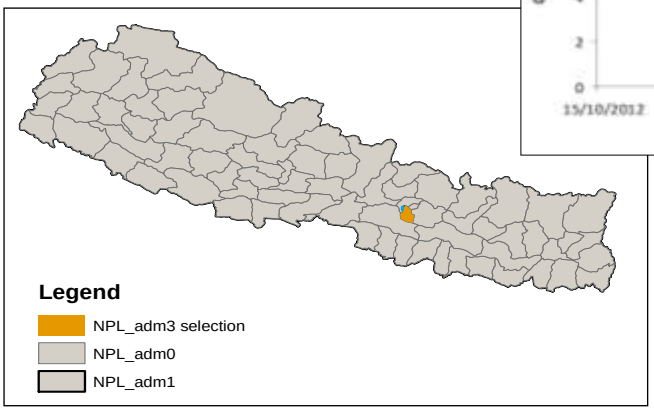
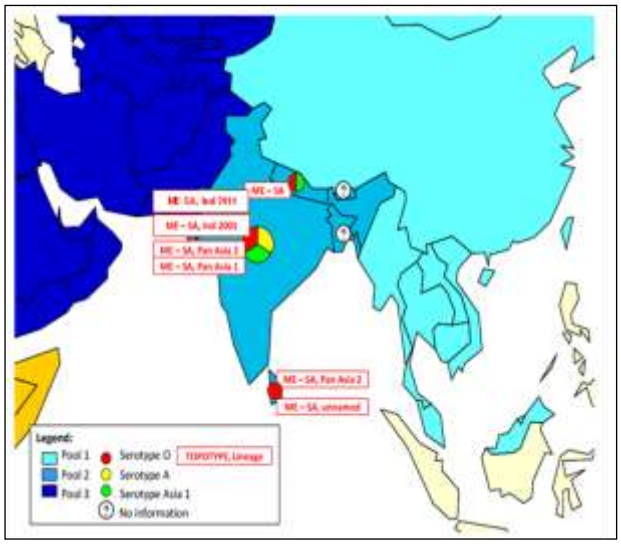


Figure 3: Epidemic curve



Map 8: FMD outbreak in Lalitpur district, Nepal, November 2012



Map 9: FMD distribution by serotypes 2010 – 2012

South Asia is known to be FMD endemic area but very limited data on serotypes is available (Map 9).

The PD-FMD at Mukteswar (FMD Reference laboratory for South Asia) is active in this region and is requested to provide information on FMD circulation that will assist improved understanding of virus circulation.
FMD history in past 2 years is given in Table 5.

Table 5: Pool 2 FMD history 2010-2012

COUNTRY	FMD HISTORY (past 2 years)	LAST OUTBREAK REPORTED/TYPE	OIE FMD STATUS
BANGLADESH, 2011	2011 – O, A, Asia 1[6]	NOT AVAILABLE	½ 2011DISEASE PRESENT, 2/2011-LIMITED TO ONE OR MORE ZONES
BHUTAN, 2011	2011, 2012 – NO REPORTED OUTBREAKS[1]	MAY 2010/NOT TYPED[1]	DISEASE PRESENT
INDIA, 2011	2011 – O, A, Asia 1[1]	SEP 2012/NOT TYPED[3]	LIMITED TO ONE OR MORE ZONES
NEPAL, 2011	2011 – O, A, Asia 1[1, 6] 2012[2]	NOV2012/NOT TYPED[2]	DISEASE PRESENT
SRI LANKA, 2011	2011 – O[1, 5]	JUN 2011/O[1]	½ 2011 - DISEASE PRESENT 2/2011 – NOT REPORTED

POOL 3
WEST EURASIA & MIDDLE EAST

Pakistan[20] – The project "Progressive Control of Foot and Mouth Disease in Pakistan (GCP/PAK/123/USA) has been launched by FAO in collaboration with the Government of Pakistan and financial assistance of United States Department of Agriculture. FMD is endemic in the country and a large number of outbreaks continue to take place throughout the year (Map 10).

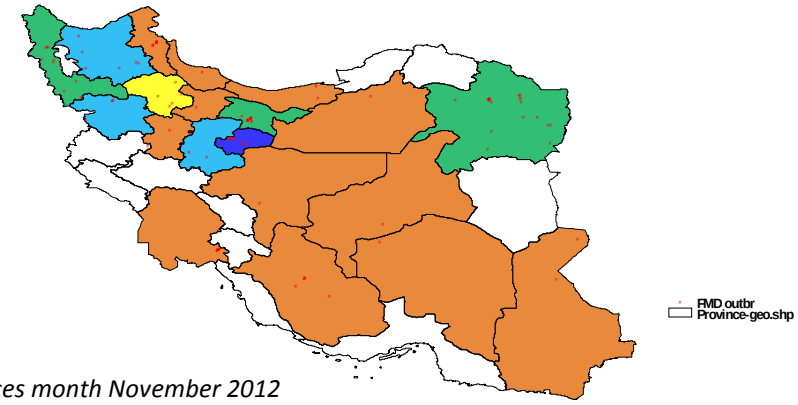
From January to June 2012, 281 outbreak have been recorded (Table 6) . The analysis of these outbreaks clearly shows that FMDV serotypes A, O and Asia 1 are present in Pakistan. Dairy colonies particularly the Landhi Cattle Colony Karachi continues to be the a hot spot of FMD in Pakistan.

Map 10: Distribution od FMD outbreaks

Table 6: Serotyping of FMD Outbreaks by ELISA (January-June 2012)

PROVINCE	TOTAL OUTBREAKS	OUTBREAKS DUE TO SEROTYPES					ELISA NEGATIVE OUTBREAKS
		O	A	ASIA 1	O+ASIA 1	O+A	
PUNJAB	79	35	3	16	12	1	12
SINDH	109	59	7	6	6	1	30
KHYBER PUKHTUNKHWA	46	8	0	12	9	0	17
BALOCHISTAN	17	7	1	0	0	2	7
FEDERALLY ADMINISTERED TRIBAL AREAS	3	3	0	0	0	0	0
AZAD JAMMU & KASHMIR	10	8	2	0	0	0	0
GILGIT-BALTISTAN	6	0	1	2	0	0	3
ISLAMABAD	11	5	0	5	0	0	1
TOTAL	281	125	14	41	27	4	70

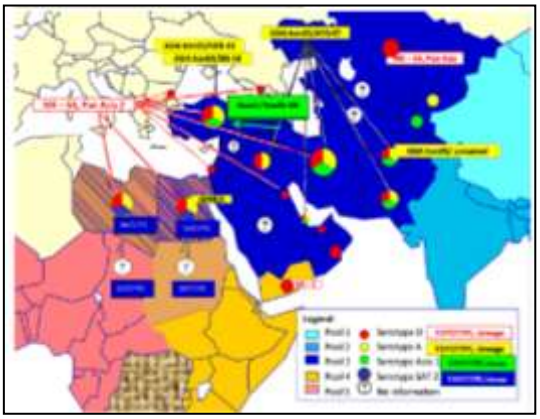
Iran[2] – During November 2012, 81 FMD outbreak in Iran were reported (Map 11), with continuing dominance of serotype A (Table 7). In the country, as according the WRL and CVL R1 value results , there were low matching with A field strain and vaccine Strain (A 05), it was supposed to have a epidemic condition due to this serotype, but epidemiological data shows that this serotype induced low virulent outbreaks in affected epi units but sill induced outbreaks in some recently vaccinated herds.



Map 11: FMD outbreaks by provinces month November 2012

Table 7: FMD Sample results

		NEGATIVE	UNSUITABLE	POSITIVE			
				TOTAL POSITIVE	A	O	Asia1
MONTH	No SAMPLES	No.	No.	No.	No.	No.	No.
NOV. (CVL+WA)	33	7	3	23	22	1	0
OCT. 2012 (CVL)	57	11	7	39	31	3	5
SEP. 2012 (CVL+ WA)	16+6	0	6	16	9+6	1	0
AUG. 2012(CVL + W.A)	23+13*	7+10	6	10+3	9+3	1+0	0
JULY 2012 (CVL + W.A)	*50 + 27**	14+8	4 +1	36 +18	16 +15	4 +2	12+1
JUN-12	*18*	8	6	4	1	1	2
MAY-12	*38*	12	2	24	6	7	11
APR. 2012 WEST AZERBAIJAN SNL	*16**	6	0	10	0	3	7
MAR-12	*52*	18	9	25	1	6	18
FEB. 2012	*47*	17	2	28	7	5	16
JAN. 2012	*82*	29	12	41	6	15	20
DEC. 2011	*115*	15	15	85	22	15	48
NOV. 2011	*65*	14	8	43	18	13	12
OCT. 2011	*35*	9	5	21	7	2	12
SEP. 2011	*46*	13	7	26	14	1	11



FMD history in past 2 years is given in Table 8 and Map 12.

Map 12: FMD distribution by serotypes 2010 – 2012

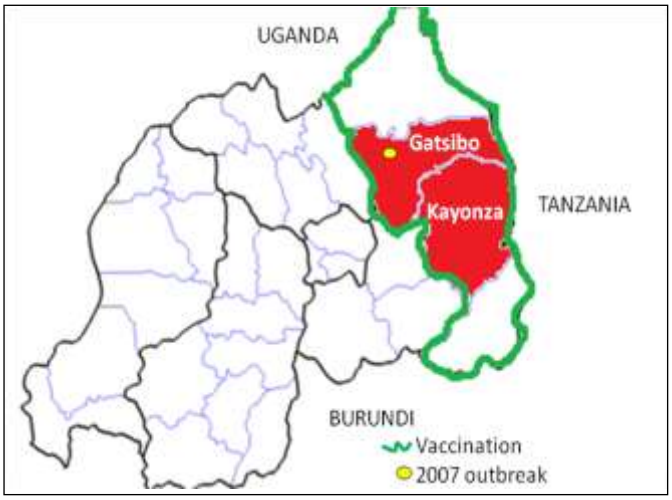
Table 8: Pool 3 FMD history 2010-2012

COUNTRY	FMD HISTORY (past 2 years)	LAST OUTBREAK REPORTED/TYPE	OIE FMD STATUS
AFGHANISTAN, 2011	2011 – O, A, Asia 1[1, 5]	DEC 2011[1]	DISEASE PRESENT
ARMENIA, 2011 MONTHLY REPORTS REGULARLY SUBMITTED TO EUFMD	2011, 2012 – NO REPORTED OUTBREAKS[1]	NOT AVAILABLE	NOT REPORTED IN THIS PERIOD
AZERBAIJAN, 2011 MONTHLY REPORTS REGULARLY SUBMITTED	2011, 2012 – NO REPORTED OUTBREAKS[1]	JUN 2001[1]	NOT REPORTED IN THIS PERIOD

TO EUFMD			
BAHRAIN, 2011	2011 – O, A, Asia 1[5] 2012 – O[5]	MAR 2012/O[5]	LIMITED TO ONE OR MORE ZONES
BULGARIA, 2011, ½ 2012	2011 – O[1, 5]	JUN 2011/O[1]	½ 2011 – DISEASE PRESENT, 2/2011, 2012 - NOT REPORTED IN THIS PERIOD
EGYPT, 2011, ½ 2012	2011 – A, O[1, 5] 2012 – SAT 2[1, 5]	JUN 2012/SAT 2[1]	2011 – NOT REPORTED, 2012 - DISEASE PRESENT
GEORGIA, 2011 MONTHLY REPORTS REGULARLY SUBMITTED TO EUFMD	2011, 2012 – NO REPORTED OUTBREAKS[1]	2002[1]	NOT REPORTED IN THIS PERIOD
IRAN, 2011	2011, 2012 – O, A, Asia 1[5]	JUN-JULY 2012/O, A, Asia 1[5]	DISEASE PRESENT
IRAQ, 2011	2011 – O,A[1]	DEC 2011[1]	DISEASE PRESENT
ISRAEL, 2011	2011 – O[1] 2012 – O[5]	MAR 2012/O[5]	DISEASE PRESENT
JORDAN, 2011	2011, 2012 – NO REPORTED OUTBREAKS[1]	2006[1]	NOT REPORTED IN THIS PERIOD
KAZAKHSTAN, 2011	2011 – O, A[1] 2012 – O, A[5]	MAY 2012/O[10]	DISEASE PRESENT
KUWAIT, 2011	2011, 2012 – O[5]	FEB 2012/O[5]	DISEASE PRESENT
KYRGYZSTAN, 2011	2011 – O, A[1]	NOV 2011/O, A[1]	LIMETED TO ONE OR MORE ZONES
LEBANON, 2011	2011, 2012 – NO REPORTED OUTBREAKS[1]	03/2010[1]	NOT REPORTED IN THIS PERIOD
LIBYA, NO SUBM. REPORTS	2011 – O[5] 2012 – O, SAT 2[5]	APR 2012[1, 5]	DISEASE PRESENT
OMAN, 2011	2011 - NO DATA AVAILABLE	DEC 2011[1]	DISEASE PRESENT
PAKISTAN, 2011	2011 – Asia 1, O 2012 – A, Asia 1[5]	JAN 2012/Asia 1, A[5]	LIMITED TO ONE OR MORE ZONES
AUTONOMOUS TERRITORIES PALESTINE, 2011	2011 – O, A, Asia 1[1] 2012 – SAT 2[1, 5]	APR 2012/SAT 2[5]	LIMETED TO ONE OR MORE ZONES
QATAR, 2011	NO DATA AVAILABLE		½ 2011 – NOT REPORTED, 2/2011DISEASE PRESENT
SAUDI ARABIA, 2011	2012 – O[5]	JULY 2012/O[5]	DISEASE PRESENT
SYRIAN ARAB REPUBLIC, 2011	2011, 2012 – NO REPORTED OUTBREAKS[1]	03/2002[1]	NOT REPORTED IN THIS PERIOD
TAJIKISTAN, 2011	2011 – Asia 1[1]	NOV 2011/Asia 1[1]	½ 2011 – NOT REPORTED, 2/2011 - DISEASE PRESENT
TURKEY, 2011, ½ 2012 MONTHLY REPORTS REGULARLY SUBMITTED TO EUFMD	2011 – Asia 1, A, O[5,1] 2012 – Asia 1, A[5], O[1]	JUN 2012/O, A, Asia 1[1]	DISEASE PRESENT
TURKMENISTAN NO SUBM. REPORTS	NO DATA AVAILABLE		UNKNOWN
UZBEKISTAN NO SUBM. REPORTS	NO DATA AVAILABLE		UNKNOWN

POOL 4
EASTERN AFRICA

Rwanda[2] - Foot and Mouth Disease outbreaks in Kayonza and Gatsibo districts have been reported in November 2012 (Map 13). The both districts are located in Eastern Province which has the highest cattle population in the country (cattle population in Rwanda is estimated to be 1.300,000 with more than 60% in the Eastern province). The last occurrence of FMD in the Eastern province was in 2007 in one farm located in Kabarore sector, Gatsibo district. In four districts, Nyagatare, Gatsibo, Kayonza and Kirehe, considered to be at highest risk, vaccination campaign has been started with trivalent, SAT 1, SAT 2 and O, vaccine.



Map 13: FMD outbreak in Kayonza and Gatsibo districts

Uganda[13, 14] – 121 FMD outbreaks during the period 2001-2010 have been analyzed. The highest number of FMD outbreaks occurred in Central Region (34%), followed by Eastern (19%), Southwestern (17%), Northern (13%), Western (13%), Northeastern (3%), and Northwestern (1%). Within Central Region, the highest number of outbreaks were reported in Luwero district (Figure 4)[13].

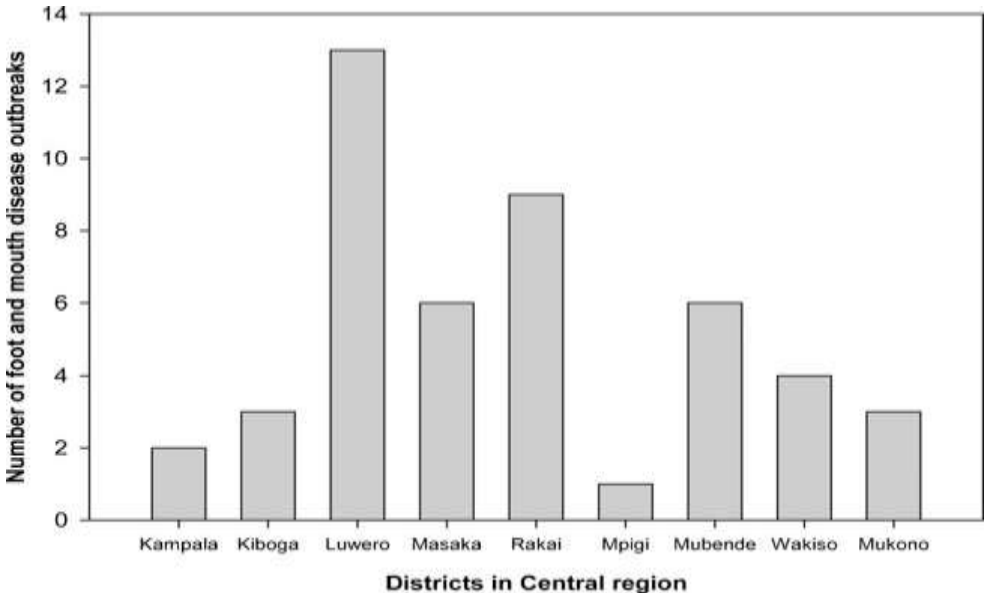


Figure 4: FMD outbreaks in Central region districts

Correlating with the number of outbreaks, Central Region received the highest percentage (43%) of FMDV vaccine doses, followed by Southwestern (35%), Western (9%), Eastern (7%), Northern (3%), Private Farms (2%), Northeastern (1%), and lastly, Northwestern Region (0.3%). However, a different trend was observed in Eastern and Northern regions, where low percentages of FMD vaccine doses were distributed (7% - Eastern and 3% - Northern), despite high percentages of FMD outbreaks (18% - Eastern region and 13% - Northern) (Map 14).

The number of outbreaks correlated with cattle population: Southwestern (Mbarara) and central regions (Nakasongola and Kiboga), which had the highest cattle population, also reported the highest number of outbreaks and received the largest quantities of FMD vaccines during the study period. The exceptions were the Northeastern region with high cattle numbers but reported few outbreaks and likewise received low amounts of FMD vaccines, and the northern region which had a low cattle population but reported high numbers of FMD outbreaks and paradoxically received low quantities of FMD vaccine doses (Map 14)[13].

The proportion of cattle vaccinated per year ranged from 2.1 to 21.2% (Figure 3).

The minimum time from onset of FMD outbreaks to intervention or response through vaccination ranged from 1 to 40 weeks with an average of 7.5 weeks [13] (Figure 5).

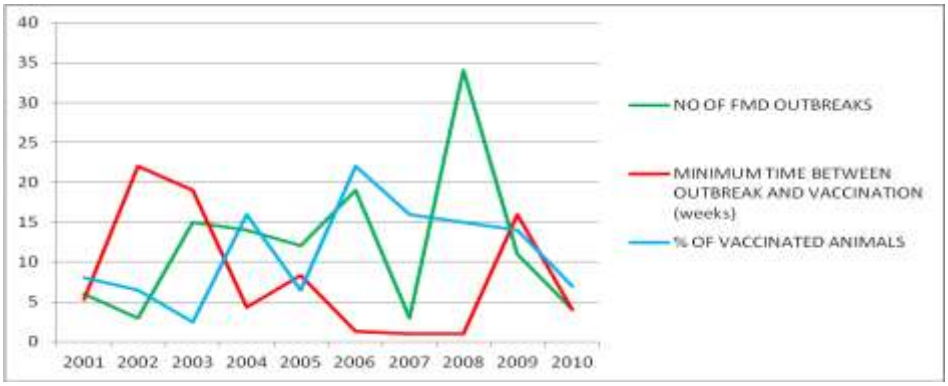
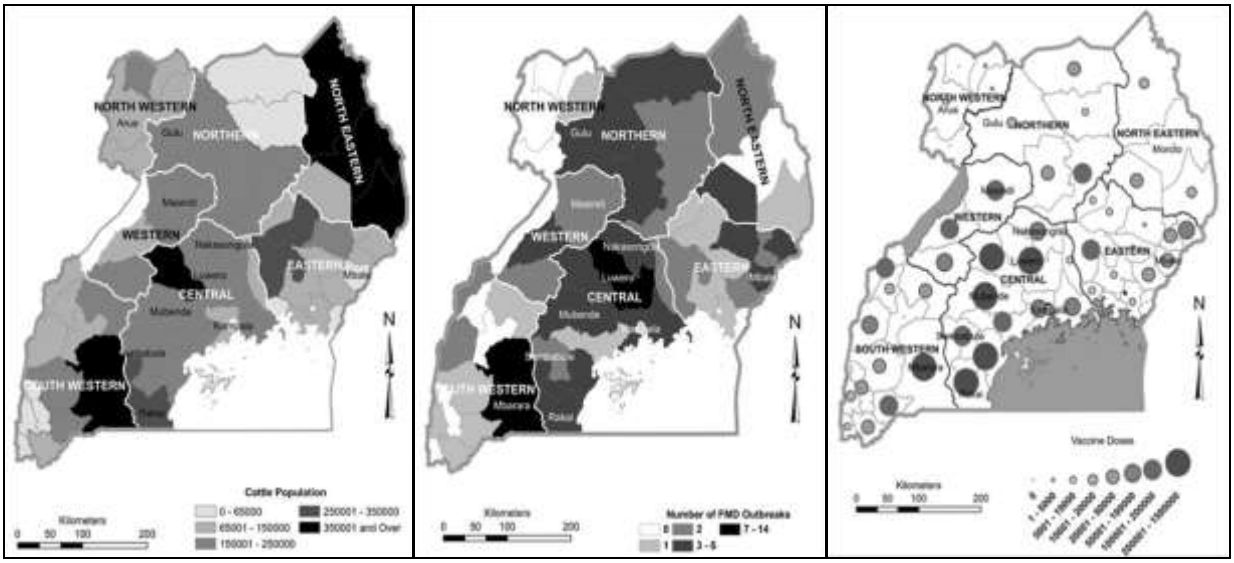


Figure 5: Relations between number of outbreaks, proportion of vaccinated animals and minimum time between outbreak and response



Map 14: Number of outbreaks, cattle population and proportion of vaccinated by regions

Serotyping (O, A, SAT 1, SAT 2) was done for nine out of the 121 (7.4 %) FMD outbreaks.

From 2001 to 2010, 93 % of the vaccines doses were of trivalent composition and included serotypes O/SAT1/SAT2; 0.5 % contained serotypes A/O/SAT2; 0.7 % were quadrivalent (O/A/SAT1/ SAT2), and 5.7 % were bivalent (O/SAT1)[13].

In Uganda, to promote disease control and livestock trade, four disease control zones (DCZ's) were mapped and earmarked to eventually become disease free zones by 2020. However, due to projected resource limitations only two zones (DCZ 1 and DCZ 2) are due for initial consideration[14].
Map 15 and 16 show the location of earmarked Disease Control Zones and the relative location of occurrence of FMD outbreaks (January – July, 2012) along the "cattle corridor" districts [14].

Map15: Disease Control Zones in Uganda

Map 16: location of FMD outbreaks

Occurrence of FMD outbreaks (January – July, 2012) was summarized from the reports at the Ministry of Agriculture Animal Industry and Fisheries, Uganda. Outbreaks were mapped relative to the location of the high cattle density "South West – North East" stretch along the country (the cattle corridor) and the DCZ's (Table 9).

Table 9: FMD outbreaks in Uganda in 2012[14]

DATE OF OUTBREAK	DISTRICT	PARISH	VILLAGE	SUBCOUNTY	DATE OF LAST CLINICAL CASE	EXPECTED DATE OF LIFTING QUARANTINE RESTRICTIONS
13/03/2012	Kaberamaido	Omid	Amaret	Anyara	Current	
16/03/2012	Alebtong	Angoltok		Abako	Current	
20/03/2012	Amuria		Ojepai, Iyalakwe and Okutoi	Obalanga and Amuria Town Council	Current	
16/04/2012	Nakasongola		Nambajju	Nabiswera	Current	
27/04/2012	Adjumani			Pacaara and Adropi	Current	
06/06/2012	Nwoya	Labyei ward, Ywaya	Pajaa, Olony and Okir	Anaka and Anaka T/Council	Current	

07/06/2012	Isingiro	Kakamba and Nsheenyi		Ngarama and Ruborogota	Current	
08/06/2012	Ntungamo	Nyakarilo	Nyakabingo	Ngoma	Current	
11/06/2012	Rakai	Kyebisagazi	Kyalugaba	Kakuuto	Current	
13/06/2012	Kiruhura	Kataraza and Rurambira	Merumeru and Akashensero	Nkungu and Nyakashashara	Current	
13/06/2012	Kyegegwa	Sweswe, Bugibuli and Kabweza	Sweswe	Kyegegwa	Current	
20/08/2012	Rukungiri	Karuhembe	Kigyeza LC 1	Kebisoni s/c Rubabo County	Current	
20/08/2012	Bukwo	Kapswama, Pisho, Nyalit and Kapteka		Chesower and Tulel	Current	
28/09/2012	Kabale	Kyoogo and Kigara		Kamwezi	Current	
19/11/2012	Buvuma			Busamuzi, Nailambi and Buvuma Town Council	Current	

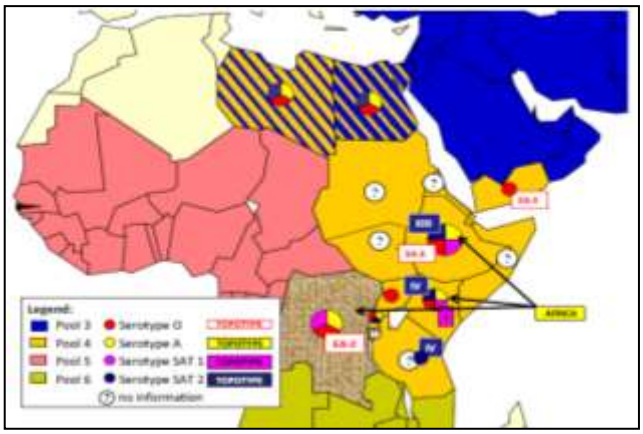
FMD outbreaks by month were reported in 11 out of 111 districts; March (Kaberamaido, Alebtong and Amuria), April (Nakasongola and Adjumani), June (Nwoya, Isingiro, Ntungamo, Rakai, Kiruhura and Kyegegwa). With exception of Adjumani and Nwoya districts, affected districts lie along the cattle corridor and are closely related to disease control zones 1 and 2.

Current FMDV outbreaks in Uganda: Buvuma District (November, 2012), Kabale District (September, 2012), Rukungiri (August, 2012), Bukwo (August, 2012)[14].

Most 6/11 (54.5%) FMD outbreaks (by July, 2012) occurred during the dry season month of June. Seasonal livestock migrations across national borders especially on the Southern border, trade patterns and livestock migration within the country, and in some cases interaction with wildlife in the national parks probably play a significant role in the epidemiology of FMD in Uganda. DCZ's can be a good baseline for endemic countries to progress to FMD freedom along the Progressive Control Pathway[14].

Kenya[7] – serotype A outbreak has been reported in the county of Nakuru, where O and SAT 2 serotypes usually occur. The last occurrence of FMDV serotype A was in 2009 in Kenya.

Serotype SAT 2 outbreak has been confirmed in Bahati.



Map17: FMD distribution by serotypes 2010 – 2012

East Africa is known to be FMD endemic area but with limited available data (Map 17).

FMD history in past 2 years is given in Table 10.

Table 10: Pool 4 FMD history 2010-2012

COUNTRY	FMD HISTORY (past 2 years)	LAST OUTBREAK REPORTED/TYPE	OIE FMD STATUS
BURUNDI, 2011	2011 – O, A, SAT 1, SAT 2[7]	2011[7]	UNKNOWN
COMOROS, 2011	2011 - DISEASE SUSPECTED BUT NOT CONFIRMED[1]	2010[1]	SUSPECTED NOT CONFIRMED
CONGO D. R. , 2011	2011, 2012 O, A, SAT 1[7]	2011/2012[7], NO PRECISE DATA	LIMITED TO ONE OR MORE ZONES
DJIBOUTI, 2011	2011 – ABSENT[1]	NOT AVAILABLE	NOT REPORTED IN THIS PERIOD
EGYPT , 2011, ½ 2012	2011 – A, O[1, 5] 2012 – SAT 2[1, 5]	JUN 2012/SAT 2[1]	2011 – NOT REPORTED, 2012 - DISEASE PRESENT
ERITREA, NO SUBM. REPORTS	2011 – O[5]	DEC 2011/O[5]	UNKNOWN
ETHIOPIA, 2011	2011 – A, SAT 1, O[5, 7] 2012 – O[5]	2012/O[5]	DISEASE PRESENT
KENYA, 2011	2011 – O, SAT 1, SAT 2[1, 5] 2012 – SAT 2, A[7]	NOV 2012/A, SAT2[7]	DISESE PRESENT
LIBYA , NO SUBM. REPORTS	2011 – O[5] 2012 – O, SAT 2[5,7]	APR 2012[1, 5]	DISEASE PRESENT
RWANDA, NO SUBM. REPORTS	2011 – ABSENT[7] 2012 – NOT TYPED[2]	NOV 2012/NOT TYPED[2]	UNKNOWN
SOMALIA, 2011	2011 – NO DATA AVAILABLE	2011[1]	DISEASE PRESENT
NORTH SUDAN, 2011	2011 – A, O[1]	DEC 2011[1]	DISEASE PRESENT
SOUTH SUDAN, 2011	2011, 2012 – O, SAT 1, SAT 2, A[7]	2011[7]	DISEASE PRESENT
TANZANIA, 2011	2011 – SAT 1(buffalo), SAT 2 (cattle), O[7], SAT3[1, 5] 2012 – A, O, SAT 1, SAT 2[5]	MAY-JULY 2012/A, O, SAT 1, SAT 2[5]	DISEASE PRESENT
UGANDA, 2011	2011 – O, A, SAT 1, SAT 2, SAT3[7, 2, 1] 2012[14]	NOV 2012[14]	DISEASE PRESENT
YEMEN, NO SUBM. REPORTS	NO AVAILABLE DATA		

POOL 5
WEST/CENTRAL AFRICA

Nigeria[4, 15] - Four hundred and forty-eight (448) sera from six border states and two other states lying on the major cattle trek routes in Nigeria were screened for FMD antibodies, including samples collected during suspected field outbreaks (2009-2011) (Map 18)[15].

Map 18: States from samples for FMD testing were taken

Based on these samples, FMD overall prevalence is 64.73%, ranging from 27.84% in Bauchi to 82% in Yobe state (Table 11).

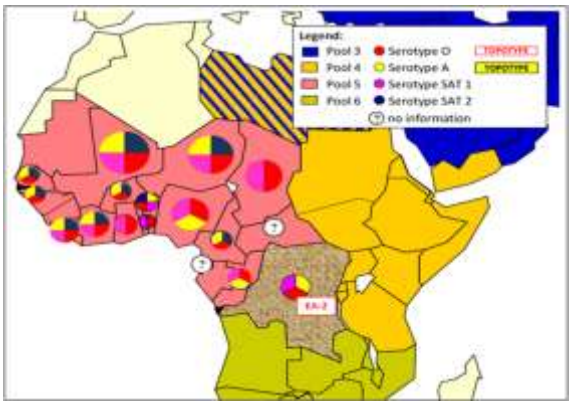
Table 11: FMD prevalence by states

STATE	NO OF SERA TESTED	SEROPREVALENCE RATE (%)	LOWER AND UPPER LIMITS AT 95% CI
ADAMAWA	50	68.00	54.13, 79.30
PLATEAU	40	80.00	64.99, 89.76
BORNO	100	67.00	57.28, 75.46
YOBE	72	**82.00**	71.38, 89.27
TARABA	68	73.50	61.92, 82.62
SOKOTO	30	63.33	45.45, 78.19
OGUN	9	77.77	44.28, 94.66
BAUCHI	79*	27.84	19.12, 38.63
KADUNA	90**	0.00	0.00, 0.04
TOTAL (EXCLUDING PIGS)	**448**	**64.73**	**60.20, 69.02**

* 24 samples from sheep and 55 samples from goats
** pigs

72.62% of cattle tested positive on FMD non-structural protein antibodies.
For the small ruminants, sheep and goats, seroprevalence was 41.66 and 21.81% respectively. None of tested pig sera was positive for FMD NS antibodies.
Based on the risks of infection, in a typical population of cattle, sheep and goat in Nigeria, cattle will be at the highest risk of infection by FMD followed by sheep while goats remain the least risk group. Using the state by state analysis, it was shown that there is no difference between the risk of infections at the Border States compared to those states along the trek-routes.
Routine vaccination against FMD is not practiced in Nigeria[15].

During October and November 2012, at NVRI, FMDV types A and O were detected, by ELISA, in recent samples which will be sent to WRL for confirmation and sequencing[4].



Foot and mouth disease is endemic in West Africa (Map 19). In Gabon, Sierra Leone, Mauritania, Guinea, Guinea Biss. FMD has not been reported at least in the last 3 years.

FMD history in past 2 years is given in Table 12.

Map19: FMD distribution by serotypes 2010 – 2012

Table 12: Pool 5 FMD history 2010-2012

COUNTRY	FMD HISTORY (past 2 years)	LAST OUTBREAK REPORTED/TYPE	OIE FMD STATUS
BENIN, 2011	2011 – A, O, SAT 1, SAT 2[4, 1]	DEC 2011/O, A, SAT 1, SAT 2[1]	DISEASE PRESENT
BURKINA FASO, 2011	2011, 2012 – O, A, SAT 2[4]	NO PRECISE DATA, DEC 2011[1]	DISEASE PRESENT
CAMEROON, 2011	2011 – O, A, SAT 2[4,1]	2012[4]	DISEASE PRESENT
CAPE VERDE , NO SUBM. REPORTS	NO DATA AVAILABLE		
CENTRAL AFR. REP. 2011	NO DATA AVAILABLE		DISEASE PRESENT
CHAD, NO SUBM. REPORTS	2011, 2012 – A, SAT 1[4]	2011/2012[4], NO PRECISE DATA	UNKNOWN
CONGO D. R. , 2011	2011, 2012 O, A, SAT 1[4]	2011/2012[4], NO PRECISE DATA	LIMITED TO ONE OR MORE ZONES
CONGO R., NO SUBM. REPORTS	NO DATA AVAILABLE		
COTE D'ÍVOIRE, 2011	2011 – SAT 1, A[1], O, SAT 2[4]	2011[4]	LIMITED TO ONE OR MORE ZONES
EQUATORIAL GUINEA, 2011	NO DATA AVAILABLE		DISEASE SUSPECTED, NOT CONFIRMED
GABON, 2011	2011 – ABSENT[1]	NO IN 2006-2012 PERIOD[1]	NEVER REPORTED
GAMBIA, NO SUBM. REPORTS	2011, 2012 –O, A, SAT 2[9]	2011/2012[9], NO PRECISE DATA	DISEASE PRESENT
GHANA, 2011	2011 – O, A, SAT 1, SAT 2[4, 1]	DEC 2011[1]	DISEASE PRESENT
GUINEA BISS., 2011, ½ 2012	2011, 2012 – ABSENT[1]	NO IN 2009-2012 PERIOD[1]	NOT REPORTED IN THIS PERIOD
GUINEA, 2011, ½ 2012	2011, 2012 – ABSENT[1]	NO IN 2007-2012 PERIOD[1]	NOT REPORTED IN THIS PERIOD
LIBERIA, NO SUBM. REPORTS	2011, 2012 – A, SAT 2[4]	2011/2012[4], NO PRECISE DATA	UNKNOWN
MALI, 2011	2011/2012 – O, A, SAT 1, SAT 2[4, 1]	2011/2012[4], NO PRECISE DATA	LIMITED TO ONE OR MORE ZONES

MAURITANIA, 2011	2011, 2012 – ABSENT[1]	NO IN 2007-2012 PERIOD[1]	NOT REPORTED IN THIS PERIOD
NIGER, 2011	2011/2012 – O, A, SAT 1, SAT 2[4, 1]	NO PRECISE DATA, OCT 2011[1]	LIMITED TO ONE OR MORE ZONES
NIGERIA , 2011, ½ 2012	2011/2012 – O, A[4, 1]	OCT/NOV 2012/A, O[4]	DISEASE PRESENT
SAO TOME PRINCIPE, NO SUBM. REPORTS	NO DATA AVAILABLE		
SENEGAL, 2011	2011/2012 – O, A, SAT 2[4, 1]	NO PRECISE DATA, DEC 2011[1]	DISEASE PRESENT
SIERRA LEONE, 2011	2011, 2012 – ABSENT[1]	OCT 1958[1]	NOT REPORTED IN THIS PERIOD
TOGO, 2011	2011, 2012 – O, SAT 1[1, 4, 1]	FEB 2012[4]	DISEASE PRESENT

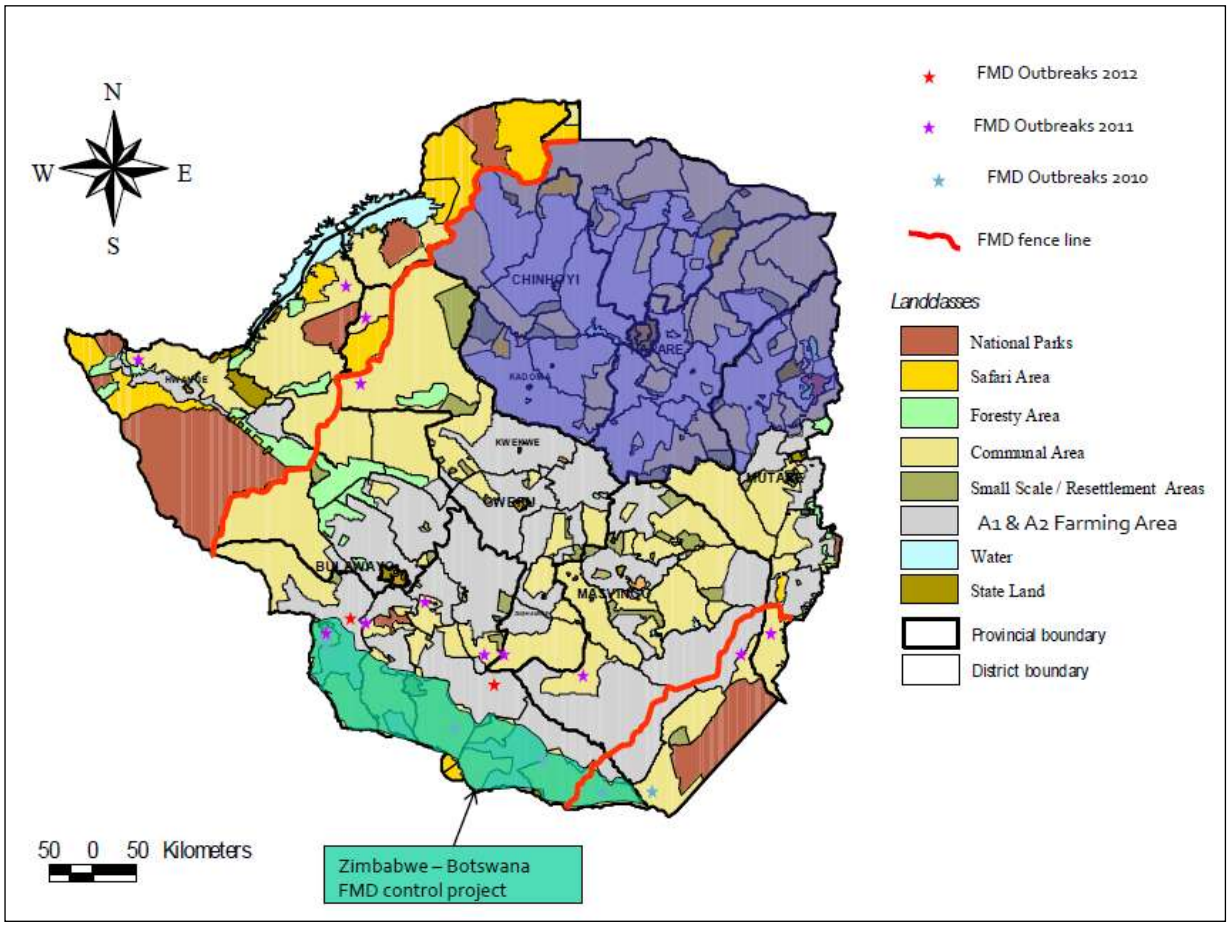
P O O L 6

SOUTHERN AFRICA

Zimbabwe[16, 17] - Gokwe North Outbreak is still continuing having established endemic FMD infection in cattle[17].

In Mwenezi/Pezvi region, recurrent outbreaks occur (Map 20)[17].

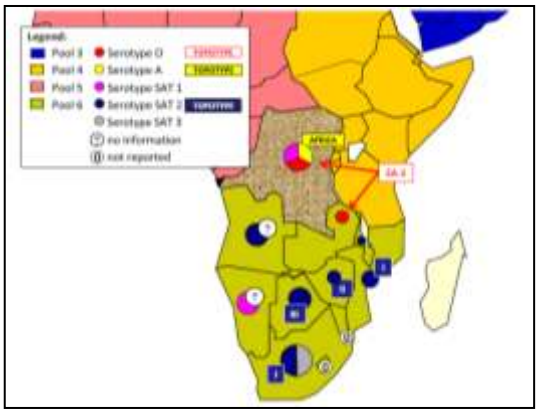
Disruption of fence with ingress of cattle into the south of the conservancy represents a major FMD risk factor. Contractual grazing of cattle and movement of cattle to and from Chipinge is a major risk circumventing the vaccination cordon. Porous borders and illegal trans boundary movements of livestock is probably one of the most difficult FMD risk factors to resolve.



Map 20: FMD outbreaks 2010-2012[17]

Vaccination barrier is established to prevent spread of FMD from Binga and Gokwe. The vaccine cordon around Gonarezhou is of limited efficacy if only done 1x/year and without meaningful movement control

There is currently no certainty as to where FMD may appear next in Zimbabwe. Vaccine cordons and fences are ineffectual in reducing country wide risk without effective surveillance, livestock identification, movement and border control[17].



Map 21: FMD distribution by serotypes 2010 – 2012

Swaziland and Lesotho are the countries free from FMD in which vaccination is not practiced. Also, there is the zone in both, Botswana and Namibia, FMD free where vaccination is not practiced, since 2010 and 1997 respectively (Map 21).

FMD history in past 2 years is given in Table 13.

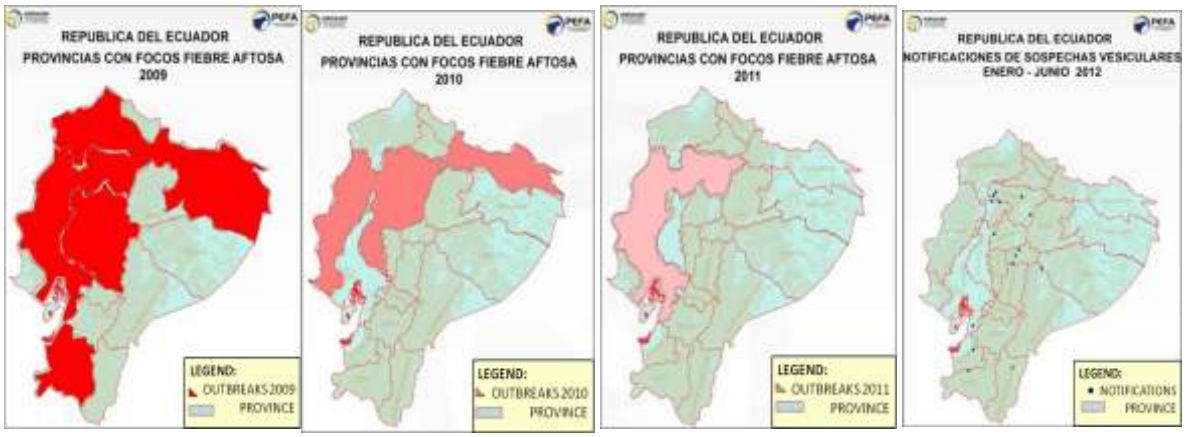
Table 13: Pool 6 FMD history 2010-2012

COUNTRY	FMD HISTORY (past 2 years)	LAST OUTBREAK REPORTED/TYPE	OIE FMD STATUS
ANGOLA, NO SUBM. REPORTS	NO REPORTED OUTBREAKS	DEC. 2010/ SAT 2[1]	UNKNOWN
BOTSWANA, 2011	2011 – SAT 2[5] SAT 2[1] 2012 – SAT 2[1]	OCT 2012/ SAT 2[1]	FMD FREE ZONE WHERE VACCINATION IS NOT PRACTISED
CONGO D. R. , 2011	2011, 2012 O, A, SAT 1[4]	2011/2012[9], NO PRECISE DATA	LIMITED TO ONE OR MORE ZONES
MALAWI, 2011	2011 – SAT 2[1]	OCT 2011[1]	DISEASE PRESENT
MOZAMBIQUE, 2011	2011 – SAT 2[1]	JUN 2011/SAT 2[1]	DISEASE PRESENT
NAMIBIA, 2011	2011 – SAT 1[1] 2012 – SAT 1[1]	JAN 2012/SAT 1[1]	FMD FREE ZONE WHERE VACCINATION IS NOT PRACTISED
SOUTH AFRICA, 2011	2011 – SAT 1[1] SAT 2[1] 2012 – SAT 2[1]	APR 2012/SAT 2[1]	DISEASE PRESENT
ZAMBIA, 2011	2012 – SAT 2[1]	JAN 2012/SAT 2[1]	DISEASE PRESENT
ZIMBABWE, 2011	2011 – SAT 2[1] 2012/NOT TYPED[16]	2012/NOT TYPED[16]	DISEASE PRESENT

POOL 7
SOUTH AMERICA

Ecuador[2, 18] - Since beginning of 2012, after reformulation of the Project, Ecuador has reported no FMD outbreaks and achieved good vaccination coverage (Map 22)[2].

Results of dataset analysis, containing 90 Ecuadorian isolates and 30 sequences from South American countries covering the period 1994–2008, showed that Ecuadorian strains tend to cluster together, with some Colombian and one sequence from Peru, suggesting Ecuador as independent ecotone for FMDV dynamics[2].
The province of Esmeraldas, in the border with Colombia and where most animal commerce is done, was found to be the most probable origin of the circulating strains, pointing to trans-boundary behavior of FMDV in South America and that intense flow of viral strains throughout the country is possibly coupled to animal movements and ecological factors[18].

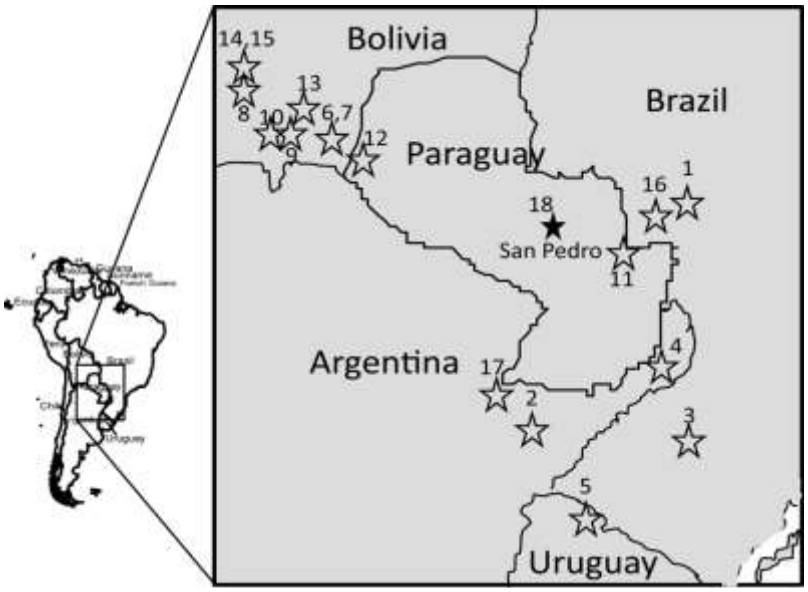


Map 22: Progress in FMD control over the last 4 years

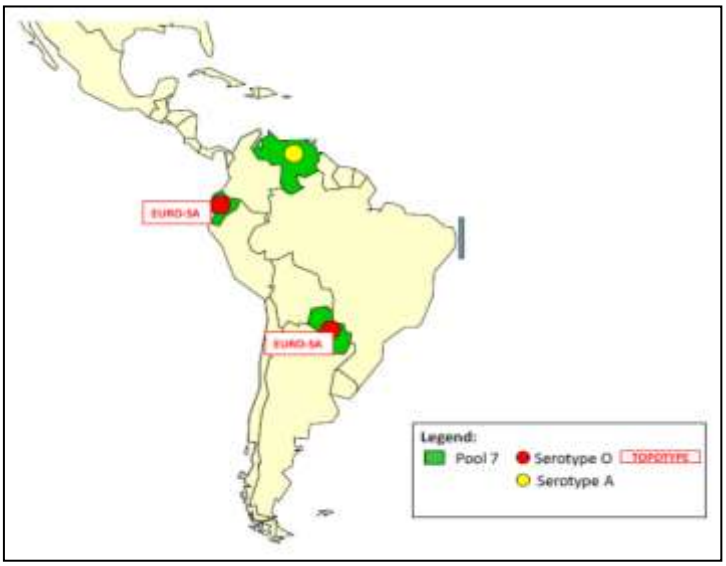
Paraguay[19] - Molecular, antigenic and vaccine matching studies, including protective response in vivo, were conducted with a foot and mouth disease type O virus isolated during the outbreak in September 2011 in San Pedro. Results from phylogenetic analysis of the complete VP1 gene sequence of the O/San Pedro/Par/11 virus showed that it clustered together with viruses responsible for emergencies in the Southern Cone between the years 2000 and 2006. This group shows a mean divergence of 8%, and represents a unique lineage assembling all viruses causing the emergencies in this region, separated from the lineages including Andean strains. This variant showed the closest genetic distance in the VP1 gene, between 94.8% and 93.2%, with viruses collected in Tarija, and Potosı´, Bolivia, between the years 2000, 2001, with isolate from Rio Grande do Sul, Brazil, 2000, with the strains of Pozo Hondo, Paraguay, and Chuquisaca and Potosı´, Bolivia in the year 2003, and with the virus from Corrientes, Argentina, in the year 2006 (Map 23).
When compared with the Paraguayan field virus, the strain used for the vaccine formulation, O1/Campos, recorded values of 18.6% nucleotide sequence differences and was placed in a

different group. In average all viruses from the Southern Cone group present a divergence value of 17.8% with respect to the strain O1/Campos, used for vaccine formulation.

Marked differences with the vaccine strain O1/Campos, including the loss of reactivity with neutralizing MAbs, were recognized. Levels of protective antibodies induced by the vaccine containing the O1/ Campos strain against the San Pedro virus and the virus responsible for the previous emergency in 2006 in the Southern Cone assessed by in vitro vaccine matching studies pointed to an insufficient protective response 30 days after vaccination (DPV), which was properly attained at 79 DPV or after revaccination.



Map 23: Geographic location of FMD outbreaks in the Southern Cone of South America. 1: O/MS/Bra/98; 2: O/ Corrientes/Arg/00; 3: O/RS/Bra/00; 4: O/Misiones/Arg/00; 5: O/Artigas/Uru/00; 6: O/Tarija/Bol/00(a); 7: O/Tarija/Bol/00; 8: O/Potosi/Bol/01; 9: O/Tarija/Bol/ 01(a); 10: O/Tarija/Bol/01; 11: O/Canindeyu/Par/02; 12: O/Pozo Hondo/Par/03; 13: O/Chuquisaca/Bol/03; 14: O/Potosı/Bol/03(a); 15: O/Potosı/Bol/03; 16: O/MS(1a)/Bra/05; 17: O/Corrientes/Arg/06; 18: O/SanPedro/Par/2011.



Map 24: FMD distribution by serotypes 2010 – 2012

Most South America countries are FMD free with (Uruguay)/without (Chile, Guyana) vaccination or with free zones with/without vaccination. Small areas of the continent are considered as endemic but clinical cases are rare (Map 24).

FMD history in past 2 years is given in Table 14.

Table 14: Pool 7 FMD history 2010-2012

COUNTRY	FMD HISTORY (past 2 years)	LAST REPORTED/TYPE	COUNTRY FMD STATUS[1]	CONTROL MEASURES
ECUADOR, 2011, ½ 2012	2011 – O[1]	AUG 2011/O[1]	2011 – DISEASE PRESENT, 2012 – NOT REPORTED	ROUTINE VACCINATION - CATTLE
PARAGUAY, 2011	2011 – O[1]	DEC 2011/O[1]	½ 2011 – NOT REPORTED, 2/2011 - LIMITED TO ONE OR MORE ZONES	ROUTINE VACCINATION – CATTLE, BUFFALOES
VENEZUELA, NO SUBM. REPORTS	2011 – O[8] A[8]	2011/O, A[8]	UNKNOWN	

The key to the superscripts is below:

1. WAHID Interface – OIE World Animal Health Information Database http://web.oie.int/wahis/public.php?page=home
2. Reports from FAO/EuFMD projects and field officers
3. Dr. Esther TO: Foot and Mouth Disease Hong Kong Situation, Update; Animal Management Division Agriculture, Fisheries and Conservation Department, 10 August 2012
4. FAO/EuFMD supported FMD networks (RESOLAB-FMD West Africa)
5. World Reference Laboratory for Foot and Mouth Disease (WRLFMD), www.wrlfmd.org
6. Conference on Scientific Developments and Technical Challenges in the Progressive Control of FMD in South Asia, New Delhi, India, 13-15 February 2012.
7. FAO/EuFMD supported FMD networks (EARLN-FMD Eastern Africa)
8. SENASA, Argentina
9. SEAFMD
10. Open session of the EuFMD, Jerez de la Frontera, Spain. 29-31 October 2012.
11. Raymond K. Hui, Frederick C. Leung (2012): Evolutionary trend of foot and mouth disease virus in Hong Kong, Veterinary Microbiology 159, 221–229
12. Bolortsetseg S, Enkhtuvshin S, Nyamsuren D, Weisman W, Fine A, Yang A, Joly DO (2012): Serosurveillance for foot and mouth disease in Mongolian gazelles (Procapra gutturosa) and livestock on the Eastern Steppe of Mongolia. J Wildl Dis. Jan;48(1):33-8.
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14. Ministry of Agriculture Animal Industry and Fisheries. National Animal Disease Diagnostics and Epidemiology Centre (NADDEC) P.o. BOX 513, Entebbe, Uganda
15. Lazarus, D. D., Schielen, W. J. G., Wungak, Y., Kwange, D. and Fasina, F. O. (2012): Sero-epidemiology of foot and mouth disease in some Border States of Nigeria, African Journal of Microbiology Research Vol. 6(8), pp. 1756-1761, 29
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Current status of the livestock sector in Zimbabwe, ACWG MEETING OF 31STMAY 2012
17. Chap Masterson: ZimbabweTrans-frontier Conservation Area (TFCA) Integrated Animal Disease Management Plan
18. Luiz Max Fagundes de Carvalho, Leonardo Bacelar Lima Santos, Nuno Rodrigues Faria, Waldemir de Castro Silveira (2012): Phylogeography of foot and mouth disease virus serotype O in Ecuador, Infection, Genetics and Evolution xxx (2012) xxx–xxx Article in press
19. Eduardo Maradei, Viviana Malirat, Claudia Perez Beascoechea, Elizabeth Oviedo Benitez, Andrea Pedemonte, Cristina Seki, Sabrina Galdo Novo, Cristina I. Balette, Ricardo D'Aloia, Jose´ L. La Torre, Nora Mattion, Jorge Rodrı´guez Toledo, Ingrid E. Bergmann (2012): Characterization of a type O foot and mouth disease virus re-emerging in the year 2011 in free areas of the Southern Cone of South America and cross-protection studies with the vaccine strain in use in the region, Veterinary Microbiology xxx (2012) xxx–xxx Article in press
20. Pakistan – FMD Bulletin, Vol 1 (1-2), January-June, 2012