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Development of a Progressive Control Strategy for foot and mouth disease (FMD)

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FOOD & AGRICULTURE ORGANISATION OF THE UNITED NATIONS

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Acronyms used in this report

ALOP	– appropriate (acceptable) level of protection
CBT	– commodity-based trade
ELISA	– enzyme-linked immunosorbent assay
ETB	–Ethiopian birr
FAO	– Food & Agriculture Organisation of the United Nations
FMD/FMDV	– foot and mouth disease/virus
GDP	– gross domestic product
GoE	– Government of Ethiopia
HACCP	– hazard analysis critical control points
KEVAVAPI	– Kenya Veterinary Vaccines Production Institute
MoA	– Ministry of Agriculture
NAHDIC	– National Animal Health & Investigations Center, Sebeta
NSP	– non-structural protein
OIE	– World Organisation for Animal Health
NVI	– National Veterinary Institute, Debre Zeit
PCP-FMD	– Progressive Control Pathway for FMD
PD_{50}	– protective dose 50%
SPS-LMM	– Sanitary & Phytosanitary Standards and Livestock & Meat Marketing Project
TAHC	– OIE's Terrestrial Animal Health Code
TCP	– Technical Cooperation Programme
WRL	– World Reference Laboratory for FMD
WTO	– World Trade Organisation

Summary

A consultancy was conducted in Ethiopia on behalf of the FAO in January to early March 2014 with the aim ofdeveloping a proposed strategy and recommendations for future foot and mouth disease (FMD) control. Terms of reference for the consultation required that particular attention be paid not only to the management of FMD but also to maintenance and widening of access to export markets for domestic livestock and meat.

The consultation consisted of a desk-top study into the occurrence and impact of FMD in Ethiopia as well as *in situ*visits and interactionwith people, institutions and locations of importance identified by FAO and Ethiopia's Directorate of Animal Health. Consultation included both public and private sector organisations and their representatives as well as with a wide range of people whoattended two workshops held in Addis Ababa in January and February 2014.

On the basis outlined above, a strategy for future FMD management in Ethiopia was developed and is recommended for consideration by the Government of Ethiopia and other relevant organizations in the country.

A two-phase strategy is proposed whereby immediate attention would be directed towards minimizing the economic impacts of FMD on live animal and meat exports (Phase 1), and a medium-term objective (Phase 2) aimed at ensuring that the tools necessary to influence the distribution and prevalence of FMD infection in susceptible animal populations in the country will be firmly established. It is estimated that Phase 2 is likely to require 4-5 years to implement fully.

There are a number of immediate opportunities available for achievement of progress with respect to Phase 1, i.e. the existence of non-geographic international standards for trade in live animals and animal products, beef particularly, that can be exploited immediately and these are identified in the report. An important outstanding issue is how the new quarantine systems under construction to serve the Djibouti and Berbera/Bosasso export rotes will be incorporated into overall FMD risk management.It was not possible to address this issue fully during the consultancy because the detailed bio-security plans are still under consideration by various official bodies in Ethiopia. However, it does appear that some modification of existing plans may be necessary to achieve the required levels of bio-security.

The three management tools required for successful management of FMD (i.e. implementation of Phase 2) are:

(1)improved diagnostic and surveillance capacity,

(2)an effective animal movement control system incorporated into an overall animal identification and traceability system that caters for animal health control, and

(3) provisionof more effective vaccines together with effective distribution and administration procedures.

The major elements of these requirements are identified in the report together with recommendations on practical application. It is emphasized that these elements require planning and investment to achieve and will take time to implement.

1. Introduction

The major objective of this consultancy – as defined by the terms of reference (ToRs–see Appendix A) – was to develop and recommend a foot and mouth disease (FMD) control strategy for Ethiopia bearing in mind the vision of the National Authorities. Further objectives were to ensureEthiopia's continued access to current livestock and livestock product markets in the Arabian Peninsula and North Africa and also, if possible, to higher priced markets in West Africa, South-East Asia and Eastern Europe.

In order that the FMD control strategy developedconforms to international norms and standards the ToRs required that the process be guided by the 'Progressive Control Pathway for FMD' (PCP-FMD – FAO/OIE, 2010). The PCP-FMDdocument sets out a methodology, involving 5sequential steps, wherebya country as a whole or zone within the country can be recognised by the World Organisation for Animal Health (OIE) as being free from FMD (where vaccination against the disease is not practiced). Ethiopia is currently at Stage 1 of the process and at a planning session for Eastern African countries held in Nairobi in 2012, it was scheduled that Ethiopia progress to Stage2 (i.e. implement risk-based control) by 2014.

In order to produce this report a wide range people were consulted – see Appendix B. This included interaction with people who attended the two workshops held in Addis Ababa in January and February 2014 which were part of this consultation.

Despite the fact that FMD is endemic throughout Ethiopia (see below), the country has well established access to live animal and meat markets – in particular for live sheep and goats, goat and sheep meat and live cattle – in the Arabian Peninsula and North Africa. Ethiopia has increased its export performance significantly in recent years (Farmer, 2010). This is primarily due to the fact that the export markets are located in countries that themselves are endemically infected with FMD. This situation, however, is not secure because, for example, in January 2006 a FMD outbreak in Egypt attributed to imports from Ethiopia resulted in a total ban on livestock imports of all types into Egypt. This is but one example of various trade bans instituted by countries in the Arabian Peninsula as a result of outbreaks of transboundary animal diseases (TADs) in the Horn of Africa (HoA) over the past two decades.

The market channels for live animals and meat in Ethiopia have been well described; they are numerous and complex and further complicated by intricate export requirements and financial arrangements (Rich et al., 2008; Farmer, 2010). In 2010 it was estimated that 80-90% of live animal trade was 'unofficial' (i.e. essentially illegal). More recently the Ethiopian Government (GoE) has begun to institute measures that discourage illegal trade and thereby to turn the imbalance between formal and informal trade around.

Under the GoE's current five-year Growth and Transformation Plan (2010/11 – 2014/5 -) ambitious targets have been set for increases in live animal and meat exports with the objective of increasing external income derived from these exports, reaching total external income of $ 1 billion by 2015(Ethiopian Ministry of Finance & Economic Development, 2010). This would constitute a 400% increase over export levels achieved in 2010/11. It is clear, however,that these targets will not be reached in the time-span allocated. Nevertheless, this ambitious plan demonstrates the intention of

The Federal Democratic Republic of Ethiopiato achieve dramatic improvement in foreign earnings by the livestock sector. It is axiomatic that such plans be supported by appropriate investment in the value chains involved in order to meet the set targets. Part of the FMD control plan is to contribute to identification of future investment requirements.

A strategy for FMD control in Ethiopia was developed in 2006 by the Department of Animal Health (Ministry of Agriculture and Rural Development), as it was named at that time, but that is now outdated. In 2010 a document on the FMD situation and a proposed control strategy for Ethiopia was drafted by Drs M. Sahle& T. Rufael. It is assumed that that the proposals outlined in that document have not been fully adopted. However, that document was used as a reference point in this study.

Per capita income in Ethiopia is lower than the regional average (and one of the lowest in the world at $ 410) but, on the other hand, the economy has grown by an average of 10.6% per annum over the last decade whereas the rate of economic growth of countries in that region has averaged only 4.9%. Agriculture contributes 46-47% to Ethiopia's GDP; by some margin the largest component of the country's economy (http://www.wikipedia.org/wiki/Economy_of_Ethiopia#Agriculture). Livestock production, valued at around ETB 70 billion (US $ 3.6 billion) per annum contributes about 41% of agricultural GDP (http://www.worldbank.org/en/ethiopia/overview).

1.1 Livestock production systems and export trade patterns in Ethiopia

Ethiopia has the largest cloven-hoofed livestock population in Africa, totalling between 90-115 million animals, depending on the source of information. This number is approximately the same as the human population which numbers around 94 million (http://www.indexmundi.com/ethiopia). Accuracy as far as livestock is concerned is compromised because precise figures in pastoralist areas are unavailable (Tegegne et al., 2013).

Livestock in Ethiopia are raised in two major production systems: (1) mixed crop-livestock production in highland areas (>1500 m; around 39% of the country's surface area) where about 80% of cattle, 75% of sheep and 27% of goats (and 88.8% of the human population) are located and (2) lowland areas where pastoralist production is practiced (about 61% of the surface area of the country - www.fao.org/wairdocs/ilri/x5461e/x5461e0.2.htm). Despite the relatively small number of cloven-hoofed livestock in lowland areas, the lowlands provide an important source of livestock for trade purposes and are a crucial source of income for pastoralists.

In the highland areas, oxen used by about 80% of farmers to provide draught power, play a pivotal role in crop production; draught power isclaimed to contribute as much 26.4% to the value of crop production in Ethiopia (Behnke, 2010).These oxen, which are mostly purchased as bull calves from lowland areas, have a working life of 6-8 years, where after they are sold to butchers for local meat consumption.

Dairy production is a major farming activity in highland areas although there are few large-scale commercial dairies; most dairy farmers have small numbers of indigenous breed cows as part of mixed farming operations. Of the approximately 10 million dairy animals in Ethiopia, less than 0.5 million are so-called 'improved'; essentiallyFriesian cross-bred animals. Milk production is consequently low; in 2009 it was estimated that the average milk yieldper cow was 1.54 litres per day. Furthermore, the annual increase in milk production is lower than the annual growth of the human population (Tegegne et al., 2013). This possibly explains why milk consumption in Ethiopia is considerably below global and African averages as well as the fact that there is no surplus production for export. Milk is also a vital foodstuff for pastoralists but their cattle likewiseindividually produce little milk on average.

The highland and lowland livestock production systems in Ethiopia are not clearly separable because, apart from the practice of highland farmers purchasing bull calves from lowland areas mentioned above, most official live animal exports (cattle, sheep & goats) are sourced from the pastoral areas of south and south-east Ethiopia and channelled across the highlands to Djibouti in the north-east for sale to buyers in the Arabian Peninsula. In the case of cattle, most exported animals –consisting almost exclusively of 3-5 year old bulls – are first fattened for 2-3 months in about 200 feedlots located in highland areas in the centre of the country (Aklilu& Catley, 2010).Sheep and goats, while they follow essentially the same route, are not currently fattened.

In the case of meat exports (mostly sheep & goat meat),9 accredited export abattoirs, three of which are not currently operational, are located in highland areas. All 6 currently operational abattoirs deal only in sheep and goat carcasses. This means that all exported meat is derived from highland locations although the animals are predominantly sourced in lowland areas. From these abattoirs the meat is flown out as chilled meat. Currently, little or no beef is exported because, it is contended,input costs are high, rendering the product uncompetitive in target markets (Rich et al., 2008; Rich et al., 2009;GebreMarium et al., 2013).

The major current value chains for live animal and meat exports are depicted in Figs. 1-4.

1.2 The situation with respect to wildlife susceptible to FMD in Ethiopia

There is evidence to indicate that current lineages of FMD viruses originated from a common progenitor, probably associated with African buffalo (so-called SAT 'X'), around 1000 years ago (N. J. Knowles, personal communication, 2013). The inference is that FMD is a long-standing infection of wildlife in Africa. The Eurasian lineage (serotypes O, A, C & Asia 1) were probably also ultimately derived from SAT 'X'.

The most significant African buffalo (*Synceruscaffer*) populations (in the low thousands; accurate figures are unavailable) are those in the Omo, Mago and Gambela regions of Ethiopia where migration from Sudan reinforces the local populations. These present the biggest potential problem as far as FMD is concerned. Serological evidence of infection in buffalo has been reported but details are lacking (Sahle et al., 2004).

Antelope susceptible to FMD, according to Dr Richard Kock (personal communication, 2014), are present in Ethiopia assmall, fragmented populations restricted to certain zones in lowland areas. Some significant populations like lesser kudu,dikdik,Soemerring's gazelle, waterbuck, oryx, eland,tiang (a subspecies of topi) and warthog are present in southern lowland areas. White-eared cob and Nile lechweoccur in the Gambella region adjacent to southern Sudan (EWCA, HOARE/C, SDPASE & WCS, undated; Magaze et al., 2012). There are also some small populations of endangered endemic species like the mountain nyala in the Bali region along with Menelik's bushbuck, Swayne's hartebeest and Walia ibex aroundAwassa.

It is unlikely that wildlife other than buffalo in the south-west of the country contribute significantly to FMDV maintenance in Ethiopia because their numbers and distribution are limited. However, this is an issue that requires further detailed investigation.

1.3 Nature and effects of FMD

Foot and mouth disease is a contagious but generally non-lethal viral disease of cloven-hoofed animals caused by 7 serotypes of the genus *Aphthoviris*.One of these serotypes, Asia 1, has so far not been identified in Africa. Mostanimals infected by these viruses in Africa recover uneventfully 2-3 weeks after infection and manysuffer only mild or unapparent disease (Thomson &Bastos, 2004). Although cloven-hoofed animals are invariably susceptible to the infection, the clinical effects of the disease vary with the species of animal, the viral strain concerned and epidemiological circumstance. So, while intensively farmed cattle and pigs in temperate climates may suffer severe clinical effects of FMD infection, in most parts of sub-Saharan Africa that is not the case. However, there are exceptions and the FMD outbreak in Tigray in 2011/2012 seems to have been an example. Sheep and goats generally develop milder and less apparent disease than cattle. Where detailed studies have been conducted, antelopespecies, such as impala in the Kruger National Park in South Africa, have been found to suffer a high proportion of subclinical infections; that is certainly also the case for African buffalo infected with the SAT serotypes of FMD virus (see below –Thomson et al., 2003; Thomson &Bastos, 2004; Vosloo et al., 2009).

Furthermore, in hot and dry climatic conditions where stocking rates are generally low, the infection often spreads slowly, even within herds (G. R. Thomson, personal observation). This is in contrast to the rapid spread frequently commented upon in intensive production systems located in more temperate climates. This difference in behaviour between FMD viruses in Europe and Africa has long been known, although poorly recognised, having first been commented upon by du Toit (1932) following his investigation into the first FMD outbreak that occurred in southern Africa after the Great Rinderpest Pandemic that decimated cattle and buffalo populations over the period 1896-1908.

A further factor in relation to transmission of FMD is the role of pigs in the spread of FMDVs originating from meat and meat products derived from domestic livestock. This was historically a frequent method of FMD transmission in Europe and Asia because back-yard pig keeping was common and such pigs were usually fed on kitchen waste that sometimes contained pieces of infected meat (Thomson &Bastos, 2004). However, where pigs are not present such as most countries of the Arabian Peninsula/Middle East transmission of FMD by infected meat is essentially impossible because the available hosts are ruminants exclusively. In countries with significant pig populations the approach has been to either require that swill fed to pigs is heated to destroy FMD and other viruses or, more common in recent years, to ban swill feeding altogether. This issue has been explained at length in a risk analysis conducted on behalf of the European Commission (2006). This is an issue that can be exploited by Ethiopia in relation to meat exports to the Arabian Peninsula and Middle Eastern countries.

2. Overall FMD situation in Ethiopia specifically & the Horn of Africa (HoA) generally

Although outbreaks of FMD in Ethiopia's livestock were apparently not officially reported before 1957, it is likely that the disease in livestock has been present in the country historically (Roeder et al, 1994; Ayelet, 2009).

Table 1 shows outbreaks of FMD recorded in Ethiopia between 1997 and 2012, indicating that significant numbers of outbreaks occurred in all those years with more than 100 outbreaks being recorded in 2012. In 2011, and 2012 particularly, there was widespread occurrence of outbreaks caused by a number of lineages of serotype O virus in various parts of the country but particularly Tigray, Amhara, Oromiya, Addis Ababa and SNNP (National Animal Health & Investigation Centre, 2012/3). In Tigray the disease affected a number of species more severely than is usually the case (Discussion during the consultancy workshop held in Addis Ababa in February 2014).

Table 1: Outbreaks of FMD diagnosed in Ethiopia: 1997-2012

Year	Number of outbreaks	Comment
1997	12	
1998	75	
1999	198	
2000	?	12579 cases reported
2001	88	
2002	33	
2003	22	
2004	54	
2005	24	No typing
2006	8	No typing; results for 6 months only
2007	22	No typing
2008	18	No typing
2009	34	Data for 6 months only; O, A, SAT2
2010	57	
2011	85	
2012	167	

Data from Handistatus II & WAHID (OIE – www.oie.int)

It has been well established on the basis of a significant number of cross sectional serological surveys that FMD occurs in cattle throughout Ethiopia, i.e. in both highland and lowland areas (Rufael et al., 2008; Gelaye et al., 2009; Molla et al., 2010; Bayissa et al., 2011; Mekonnen et al., 2011; Mohamoud et al., 2011; Ayelet et al., 2012; NAHDIC, 2012/3; Duguma et al., 2013; Legesse et al., 2013; Yahya et al., 2013).

All the aboveinvestigationsattempted to estimatethe prevalence of FMD infection based on ELISAs designed to detect antibodies directed against the non-structural proteins of FMDVs, i.e. so-called non-structural (NSP)protein tests. In general these tests reflect antibody responses to recent infection but are not serotype specific. Furthermore, because different studies were conducted using a variety of test kits the results are not directly comparable. Overall, however, the prevalence rate in cattle was close to 17% and, where measured, herd prevalence exceeded 50%. The available evidence suggests thatprevalence of infection wasgenerally higher in lowland areas than in the highlands (Mekonnen et al., 2011; Ayelet et al., 2012). This is probably explained by greater mobility and therefore higher contact rate between cattleherds in pastoral areas.

It needs to be appreciated that infections with high basic reproductive numbers (R_0–as is generally the case for FMD) tend to exhibit periodicity in the rate at which infections occur in a given population, i.e. the prevalence rate varies over time in a given location (Anderson & May, 1971). Therefore, the reported prevalence rates should not be interpreted as indicative of a constant rate. Nevertheless, these studiesshow that infection with FMDVs is common in cattle populations throughout Ethiopia.

A number of NSP antibody studies, similar to those conducted on cattle, have also been conducted on small domestic ruminants, pigs and camels; a few white-eared cob were also tested. The results for small domestic ruminants are shown in Table 2.

Table 2: Results provided by NAHDIC on cross-sectional serological studies in small ruminants based on NSP tests.

Address		Animal Species	No of samples	No of positive	% positive	Test used
Region	Districts					
Gambella	Lare	Small ruminants	313	6	1.9	CHEKIT FMD 3ABC Bo-Ov
	Itang	Small ruminants	226	1	0.4	CHEKIT FMD 3ABC Bo-Ov
	Abobo	Small ruminants	106	2	1.9	CHEKIT FMD 3ABC Bo-Ov
	Gambella	Small ruminants	123	1	0.8	CHEKIT FMD 3ABC Bo-Ov
B/Gumuz& Oromia	Asossa; K/Wollega W/Wollega	Goats	309	9	2.9	3ABC blocking ELISA
		Sheep	246	13	5.3	3ABC blocking ELISA
Oromia	Borana	Caprine	11	11	100	,,
	East Shewa, Adama	caprine	246	128	52	Piro chek-FMD 3ABC ELISA
Somali	Liben	caprine	144	6	4.2	,,
	Shinile	shoats	435	19	4.4	Piro chek-FMD 3ABC ELISA
	Liben(Moyale)	Caprine	16(Tissue and swab)	14	87.5	FMD Antigen detection
Tigray	All zones	caprine	800	18	2.3	Piro chek-FMD 3ABC ELISA
Afar	-	shoats	500	41	8.2	Piro chek-FMD 3ABC ELISA
Amhra	Wollo, Harbu	shoats	401	89	22.2	Piro chek-FMD 3ABC ELISA
SNNP	S/Omo	Shoats	652	63	9.7	Piro chek-FMD 3ABC ELISA
	Walita	caprine	49	11	22.4	Piro chek-FMD 3ABC ELISA
	Bench maji	Caprine	18(Tissue and swab)	14	77.8	FMD Antigen detection ELISA

These indicate that the prevalence of FMDV infection in sheep and goats was generally below 10% but in a few instances rates werehigher. In general, high infection rates were associated with small numbers of tested animals although in one instance that number was close to 50. Sero-postivity would be expected to be lower in small ruminantsthan in cattle if only because sheep and goats are less susceptible to infection than cattle (Thomson &Bastos, 2004).

Two small groups of pigs in Oromiya and Amhara were found to have sero-positivity rates exceeding 50% which is interesting but difficult to interpret because pigs are only present in small numbers in a limited number of locations in Ethiopia (data not shown). For that reason pigs likely play only a minor role in the persistence and spread of FMDVs in Ethiopia. That is not to say they could not become important in some locations where numbers of pigs are apparently on the increase.

None of the 16 white-eared cob tested were positive; the same applied tonearly all the camels examined. The latter finding is to be expected since dromedary (as opposed to bactrian) camels are considered to be insusceptible to infection with FMD viruses (OIE, 2013a).

In the last decade four serotypes of FMD virus (FMDV) have been identified in Ethiopia (O, A, SAT 2 & SAT 1) with serotypes O, A & SAT2 predominating.Within these serotypes at least 8 genotypes have been identified (Ayelet et al., 2009; Table 3). Furthermore, there are other genotypes current in other East African countries that could presumably enter the country in the near future because most border areas are populated by pastoralistcommunitiesand wildlife are also relatively abundant (Annual &Quarterly Reports of the WRL, Pirbright Laboratory, UK – http://www.wrlfmd.org/ref_lab_reports/OIE-FAO).Movement of pastoralists and wildlife are difficult to monitor, much less manage.

Table 3: Serotypes and genotypes of FMDV identified in Ethiopia in the last decade

O	EA-3 & EA-4	EA-4 relatively new, first isolated in Uganda
A	G-VII , (G-II)	G-II - historic
SAT 2	IV, XIII & XIV	VII present in Eritrea
SAT 1	IX	Only so far detected in south-west

A deficiency in the understanding of FMD in Ethiopia is that so far few, if any, studies have been directed at understanding the detailed interaction between various FMDVsand animal product value chains. This is clearly a direction in which future surveillance needs to be directed.

3. Factors that influence the management of FMD

3.1 Presence or otherwise of endemic FMD in the country or zone concerned

It is clearly recognised that different strategies need to be employed for the management of FMD in long-standing endemic situations as opposed to those where the disease has recently been introduced (OIE, 2013b).

The PCP-FMD is specifically designed to guide measures in the former circumstance (FAO/OIE/EUFMD, 2011). This document istherefore relevant to the current endemic FMD situation in Ethiopia.

3.2 Availability of finance, expertise and infrastructure required to manage FMD and its trade impacts effectively

Ethiopia has a major problem in this respect because the three essential tools for managing FMD in endemic situations are lacking:

(1) adequate diagnostic and surveillance capacity;

(2) the ability to actively manage animal movement (i.e. movement control of animals susceptible to FMD within the country & across the country's borders) in order to prevent or at least reduce contact between infected and susceptible animal populations;and

(3) availability of sufficient quantities of vaccines of adequate quality (i.e. potency & safety)andthat 'match' the circulating field viruses which the vaccines are intended to protect against.

These deficiencies are well known to the relevant government authorities in Ethiopia and some are in the process of being addressed. For example, a large modern building is under construction and nearing completion at the NAHDIC campus at Sebata, i.e. where the new microbiology unit will be housed. This unit will include a new FMD diagnostic and surveillance laboratory. It is presumed that this new facility will be adequately equipped, staffed and funded to enable Ethiopia's diagnostic and surveillance capacity for FMD to be expanded and thereby meet the need for more targeted surveillance related to individual livestock-based value chains. However, in the interim the capacity remains limited particularly because the existing laboratory is unable to isolate viruses. Fortunately, considerable assistance in this respect has been provided by the FAO World Reference Laboratory for FMD (Pirbright Laboratory, UK) and this valuable association needs to be maintained.

Likewise, consultations are taking place on developing a plan to improve animal identification, traceability and livestock movement control in Ethiopia. Proposals in this regard are currently being developed by consultants (e.g. J. Truit& M. Bradfield – personal communication, 2014). However, even when these plans are finalised, they will take time to implement effectively.Particularly important is that the strategy designed to implement animal traceability takes movement control for animal disease management into account.

Undoubtedly, the major problem for FMD control in Ethiopia is that both the quantity and quality of available vaccines are inadequate. For example, in 2013 only about 512 000 doses of tri- and bivalent vaccine were made available to livestock producers. The vaccines made available in 2013 were a combination of vaccine manufactured by the NVI at Debre Zeit and vaccine imported fromcommercial producers, i.e. Indian Immunologicals and KEVAVAPI (Kenya).Such a quantity of vaccine, assuming it were potent and safe and matches the major variants of FMDVs circulating in the country (not safe assumptions because testing of vaccine used in Ethiopia is currently inadequate – see below),would not even be sufficient to adequately protect the cross-bred national dairy herd.

It is clear from discussions conducted at NVI during this consultancy that the vaccine manufacturing process currently adopted by the NVI is unsuitable for the production of potent vaccine. This is a specialised subject and requires a dedicated investigation but in brief the deficiencies are the following:

- A production system (cell culture propagation system based on roller bottles) that is difficult to scale up for production of quantities of vaccine needed for such a large livestock population;
- Lack of capacity to concentrate the antigens produced from cell culture harvests;
- Unavailability of a reliable means to measure antigenic mass incorporated into vaccine currently produced (this is also an impediment to meaningful vaccine strain selection);
- Vaccine virus inactivation using formaldehyde;
- Absence of a system for adequately assuring the quality of either locally manufactured or imported vaccine.

The above deficiencies arefundamental and further compounded by the fact that it is clear from discussion around this consultation that vaccination schedules currently applied and/or advocated in the country will not achieve high levels of herd immunity in vaccinated herds even were the quantities and quality of vaccine adequate. This applies particularly to poor understanding that to establish a good primary immunological response to FMD vaccine it is necessary that two doses of vaccine be administered 2-8 weeks apart to naive animals. The ideas that mass bi-annual vaccination is sufficient to induce good immunity in cattle herds has been shown in southern Africa to be inadequate.

The conclusion is therefore that until all these issues are addressed adequately vaccination sufficient to influence the distribution and rate of circulation of FMD in the country will not be adequately achieved.

To correct this situation requires some specific activities in the near future:

- As a first priority, a system needs to be developed for testing vaccines(using internationally recognised approaches) that are either locally manufactured or purchased for use in Ethiopia. This could be quite easily done through testing of antibody responses to vaccines under investigation. However, acquisition of immunologically naive animals and their isolation while testing is in progress will require planning and investment in basic infrastructure and bio-security arrangements.
- A plan to produce and/or procure safe and potent FMD vaccines ($PD_{50} \geq 3$) that will cover all or at least most of the genotypes/viral variants in circulation. It is understood from discussions in this respect that the relevant Government authorities and international vaccine manufacturers are involved in negotiations along these lines. This will clearly be a major undertaking andimplementation will take time and investment to effect.

- An extension service that gets across to livestock owners who use FMD vaccines routinely (e.g. commercial dairy producers) the need to abide by administration schedules that are known to be effective. Furthermore, livestock owners need to be convinced that use of poor quality vaccine and/or suboptimal vaccination schedules is a waste of time and money.

Unless these improvements are forthcoming little will be achieved in the field of FMD managementin Ethiopia in the medium term.

3.3 Government aspiration & political support

Compliance with government objectives and political support is necessary for any undertaking in the public sector. However, it is also true that government objectives need to recognise realities on the ground. In this respect it would appear that the targets set for trade in livestock commodities by the Ethiopian Government's current Growth and Transformation Plan, 2010/11-2014/15 over ambitious (Ethiopian Ministry of Finance & Economic Development, 2010). It is also vital that commensurate investment in support of the plan is made available.

3.4 International norms and guidelines provided by the OIE's Terrestrial Animal Health Code and the Progressive Control Pathway for FMD (PCP-FMD)

The available guidelines (i.e. in the OIE's Terrestrial Animal Health Code – Chapter 8.6) constitute a problem for Ethiopia in that they focus predominantly on the creation of FMD-free zones, i.e. the processes recommended concentrates on the creation of zones or compartments free from FMD or, alternatively, ridding particular production systems of FMDVs (e.g. the dairy sector). However, in the latter context little practical guidance is provided. Important issues in this respect are:

- Attempts to identify areas of Ethiopia where FMD-free zones could be established have proven unsuccessful in the past (e.g.Forman, 2004). Furthermore, because there is no clear separation between highland and lowland production systems in Ethiopia, together with the problem created by more-or-less free movement of livestock, including across international boundaries, there are no obvious situations where establishment of FMD-free zones would be practical. During this consultation no coherent proposal for creation of a FMD-free zone was encountered.
- On the other hand, the PCP-FMD document contains explicit statements to the effect that where necessary alternative systems can and should be developed, i.e. that flexibility is essential. The example of southern Africa where wildlife presents a problem not covered adequately by existing recommendations is specifically mentioned (FAO/OIE/EUFMD, 2011). In the HoA/East Africa, pastoralism, quite apart from the wildlife problem, creates a situation that is similarly not amenable to solution using existing geographically based guidelines or standards.
- Extensive work by a consortium led by Texas A&M University developed a guideline for a two-phase SPS certification system for livestock products derived Ethiopia (Rich et al., 2008; Rich et al., 2009, Norman Borlaug Institute for International Agriculture, 2011). The system proposed implies large-scale infrastructure development and it is, furthermore, unclear whether the quarantine stations currently under construction (at Mile &Haroressa) are in effect 'phase 2 SPS certification facilities' as envisaged by the SPS-LMM Project. The risk analysis conducted on the SPS-LMM certification system showed that although it

would reduce the risk associated with meat products to negligible levels, it would not reduce risk associated with live animal trade to internationally acceptable levels (Duarte et al., 2008). For beef, a simpler and cheaper system (as proposed in this report) could be introduced for exports to achieve acceptable risk in respect of FMD. For shoat meat, on the other hand, it would be necessary to conduct both feasibility and cost/benefit studies to determine whether the implementation of the SPS-LMM system would bepractical and affordable.

For these reasons it is clear that the solution to Ethiopia's complex problems related to the interaction between trade in animals and animal products and FMD management will require innovative solutions. Fortunately, trends in sanitary trade standard evolution are favourable for developing more practical solutions (see below).

3.5 Trends in international trade standards for commodities & products derived from animals, including sanitary standards

While international sanitary standards for trade in commodities and products derived from animals are predominantly based on creation of countries, zones and compartments free from FMD and other transboundary animal diseases (TADs), there is increasing movement towards development of non-geographically based standards by the OIE and other international agencies. The available methodologies/mechanisms are summarised in Table 4.

Table 4: Available sanitary management systems/mechanisms

Name of the approach	Principle	Comment
Country or zonal freedom (with or without vaccination)	Geographic freedom from infection	Fundamental approach of OIE but in some situations difficult/impossible to apply. Applicable to live animal & meat trade
Compartmentalisation	Application of integrated bio-security to establishments comprising the compartment	Suitable for vertically integrated, intensive production systems but difficult to apply to extensive production. Applicable to live animal & meat trade
Articles 8.6.14 & 8.6.25 of the OIE's TAHC	Combination of principles; partly geographic	Clear opportunity for Ethiopia for beef exports
Commodity based trade (CBT)	Non-geographic risk management	Management of identified hazards by the most appropriate method(s). Actually, not a system but a concept

Name of the approach	Principle	Comment
Value chain approach	Non-geographic: Integrated HACCP & CBT risk management	Management of food safety and animal disease hazards by the most appropriate method(s). Most applicable to product production

Thus today there are international sanitary trade standards for live domestic ruminants and pigs derived from locations that are not free from FMD and the same applies to beef (Articles 8.6.14 & 8.6.25 of the OIE's Terrestrial Animal Health Code [TAHC] respectively). The FAO has also recently provided a guideline for managing animal disease risks along value chains which does not require that the locality of production is free from FMD and other TADs (FAO, 2011). Building on this, it has been shown that commodity-based trade (CBT) and hazard analysis critical control points (HACCP) approaches can be integrated to manage sanitary (i.e. animal disease & food safety) risks along value chains (Thomson et al., 2013).

The bottom line is that alternatives to geographic management of sanitary risks are already available and others will certainly be forthcoming in future. Awareness of this trend is consequently vital in developing and up-dating approaches to disease management and trade that best suit Ethiopia's situation.

3.6 Attitudes of decision makers in current & potential future markets

This issue is important in all types of international trade but more so when it comes to commodities and products derived from animals. The point is that different markets have different requirements and it is therefore important for marketers to appreciate this fact. A clear example is provided by India which is currently the largest exporter of beef in the world by volume. India is not free from FMD and has no FMD-free zones. The Indians simply export low grade beef(in reality domestic buffalo meat) to countries and regions with less demanding sanitary standards. This is essentially what Ethiopia has and is doing at the moment.

Competitive advantage comes down to innovatively matching products with available markets. In this respect entrepreneurial skills are vital.

It is suggested that this is an area where Ethiopia could significantly improve its performance. What is essential is a partnership leading to mutually agreed strategies between producer organisations, animal health authorities and marketers (i.e. public private partnerships). That is essentially what South American countries, epitomised by Brazil, have been doing successfully for the last 20 years.

4. A proposed FMD management strategy for Ethiopia

As indicated above, the approach recommended by most international bodies when it comes to improving management of FMD in endemic situations is to concentrate on reducing the distribution and prevalence of infection until elimination of endemicity becomes possible (e.g. the PCP-FMD).

However, to do that requires that the tools necessary for this purpose are available. Those tools, as indicated above, are currently inadequate in Ethiopia. This makes it essentially impossible to effectively reduce the distribution and prevalence of FMDVs until those tools become available. To do that will take time (probably in the range of 4-5 years) and political commitment. This effort needs to begin immediately and in a serious way, otherwise the time-frame for effective FMD management will be lengthened concomitantly.

The above does not imply that nothing can be done in the meantime about managing the negative impacts of FMD; quite the contrary, because as indicated above, there are increasing possibilities in the form of new trade standards and attitudes for managing the negative trade impact of FMD. This issue, furthermore, can be addressed within a short period of time if not immediately.

Thus it is proposed that a two-phase FMD management strategy be adopted in Ethiopia:

- Phase 1: A short-term strategy for increasing access to specific markets for live animals and meat. This will potentially enable trade in animals and animal products to be increased while the fundamentals required for Phase 2 are being implemented. Thus Phase 1 would be focused on ameliorating the immediate negative trade impacts of FMD.

- Phase 2: A medium term strategy to address the deficiencies in diagnostic/surveillance capacity (see above), a system for animal identification and movement control (in process of development) and, most importantly, improved access to adequate quantities of quality vaccine through new procurement and/or manufacturing arrangements.

The components of these two phases are expanded upon below.

4.1 Phase 1

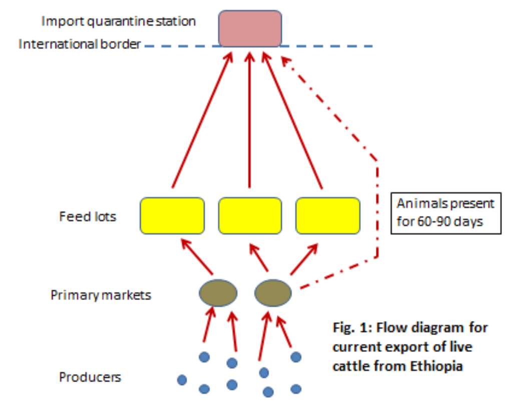
A widely recognised fact is that the FMD risk associated with meat imports into FMD free countries is significantly less than is the case for live animals. Nevertheless, even for live domestic ruminants and pigs there are OIE (i.e. international) standards for safe trade where the animals are not derived from locations recognised as free from FMD.

Apart from existing standards that can be applied more-or-less immediately to some commodities (e.g. beef), procedures can also be developed which, through the demonstration of 'equivalence' (i.e. an equivalent level of sanitary risk mitigation), an 'appropriate level of protection' (ALOP – terminology used in the World Trade Organisation's [WTO] Agreement on the Application of Sanitary and Phyto-sanitary Measures) can be achieved. ALOP is synonymous with acceptable risk (the WTO does not accept that risk-free [i.e. zero risk]trade in terms of sanitary issues is achievable – the issue is that the level of risk be acceptable).

Existing export systems for live animals and meat are depicted diagrammatically in Figures 1-4.

Figure 1: Flow diagram for current live cattle exports

Figure 2: Flow diagram of current beef exports



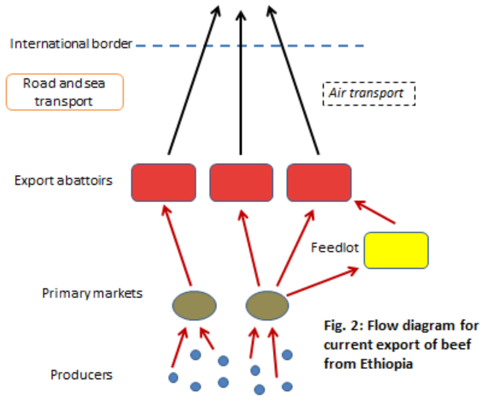
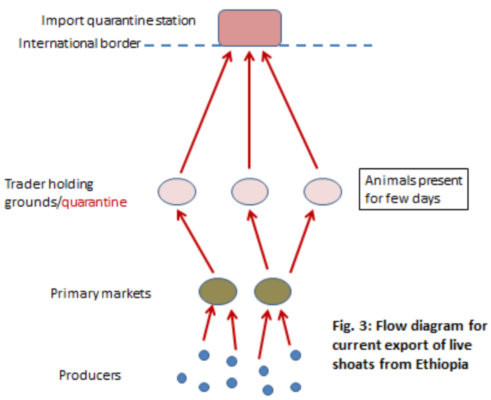
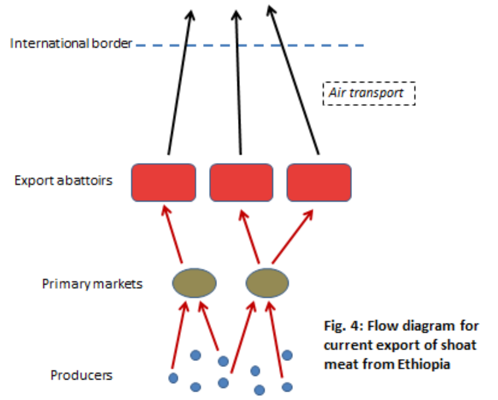


Figure 3: Flow diagram of current live shoats exports

Figure 4: Flow diagram of current Shoat meat exports





Sanitary measures proposed for managing FMD risk specific to individual value chains or livestock sectors are considered below:

4.1.1 Beef (i.e. deboned beef – what is known in the trade as 'boxed beef')

An appropriate international standard exists in the form of Article 8.6.25 of the OIE's TAHC which covers requirements to manage FMD risk when beef is derived from locations where FMD is endemic but where an official control system is in operation.

The clauses of this Article are the following, i.e. for fresh meat of cattle and buffalo (*Bubalusbubalis*) (excluding feet, head & viscera) that:

1. Comes from animals which:

a) have remained in the exporting country for at least 3 months prior to slaughter;

b) have remained, during this period, in a part of the country where cattle are regularly vaccinated against FMD and where official controls are in operation

c) have been vaccinated at least twice with the last vaccination not more than 12 months and not less than one month prior to slaughter

d) were kept for the last 30 days in an establishment and that FMD has not occurred within a 10 km radius of the establishment in that period

e) have been transported in a vehicle which was cleansed and disinfected before the cattle were loaded, directly from the establishment of origin to the approved abattoir without coming into contact with other animals which do not fulfil the required conditions for export

f) have been slaughtered in an approved abattoir

i) officially designated for export

ii) in which no FMD has been detected during the period between the last disinfection carried out before slaughter and the shipment for export has been dispatched

g) have been subjected to post-mortem inspections for FMD with favourable results within 24 hours before and after slaughter.

2. Comes from deboned carcasses:

a) from which the major lymph nodes have been removed

b) which prior to deboning, have been subjected to maturation at a temperature above + 2^0 C for a minimum of 24 hours following slaughter and in which the pH value was below 6.0 when tested in the middle of the *M. longissimusdorsi*.

This standard could potentially be applied immediately to Ethiopia's beef export value chain (although currently little or no beef is being exported) where 3-5 year-old bulls are procured in the pastoral areas of Borena and transported to feedlots in the centre of the country where they are fattened for 2-3 months beforeslaughter and processing for production of beef. The critical elements as far as FMD risk management is concerned are:

- Cattle are healthy when introduced into the feedlots & maintained in isolation in the feedlots for 3 months (this implies an all-in/all-out system);
- No FMD is detected within the feedlot or a 10 km radius around the feedlot during the month before slaughter;
- The animals are vaccinated twice against FMD: once at the time of introduction to the feedlot and a second vaccination one month later;
- *Ante-* and *post-mortem* inspection of all animals/carcasses for presence of lesions consistent with FMD;
- Maturation of carcasses for at least 24 hours after slaughter at the prescribed temperature with pH measurement of each half carcass as an assurance mechanism;
- Deboning of the beef into cuts from which all visible lymph nodes have been removed.

Beef produced in this way can be certified as complying with the requirements of Article 8.6.25 and is therefore safe with respect to FMD for international trade.

4.1.2 Export of live cattle, goats and sheep

As for deboned beef, the OIE's TAHC provides a standard (Article 8.6.14) for the safe importation of these animals from FMD infected countries or zones. The standard does not stipulate whether the animals need to be vaccinated or not which implies this is a matter of choice. However, practical logistical and financial difficulty is created by the requirement in this standard for laboratory testing – see below.

The specific recommendations of Article 8.6.14 are that Veterinary Authorities should require the presentation of an international veterinary certificate attesting that the animals:

1. showed no clinical signs of FMD on the day of shipment;
2. were kept in the establishment of origin since birth <u>or</u>
    a. for the past 30 days if a stamping out policy is in force in the exporting country <u>or</u>
    b. for the past 3 months if a stamping out policy is not in force in the exporting country;
3. were isolated in an establishment for 30 days prior to shipment, and all animals in isolation were subjected to diagnostic tests (probang& serology) for evidence of FMDV infection with negative results at the end of that period and that FMD did not occur within a 10 km radius of the establishment in that period <u>or</u>
4. were kept in a quarantine station for the 30 days prior to shipment and all animals in quarantine were subjected to diagnostic tests (probang& serology) for evidence of FMDV infection with negative results at the end of that period, and that FMD did not occur within a 10 km radius of the quarantine station during that period;
5. were not exposed to any source of FMD infection during their transportation from the quarantine station to the place of shipment.

Ethiopia does not have a stamping out policy and therefore clauses that refer to that condition are not applicable.

It should be possible to integrate the quarantine system under development (quarantine stations under construction near Mile to serve the Djibouti export route and at Haroressa serving the Berbera/Bosasso export route) with this standard. However, brief perusal of the design plans and outline of the proposed operating procedures (detailed plans were not available to the consultant) for the quarantine stations under construction indicate that the level of bio-security likely to be achieved may be inadequate. This is a matter that requires urgent further attention – see recommendations below.

A serious problem is the requirement of Article 8.6.14 for testing of sera and probang samples obtained from all export animals at the end of the isolation/quarantine period but prior to shipment. These tests, especially probing testing where large numbers of animals are involved, usually require several weeks to perform in the laboratory and are also potentially costly. Furthermore, the rationale for probang testing is questionable because this type of testing is particularly insensitive (i.e. it tends to produce a high number of false negative results) and for that reason its usefulness is doubtful.

There are a number of potential approaches that could be adopted to overcome this problem. The most obvious is to reach an agreement with Gulf States or other importing countries that probang testing is unreliable and that NSP testingcombined with quarantine of export animals would be adequate.

4.1.3 Meat derived from sheep & goats

Unfortunately, there is no international standard for meat derived from these species where freedom from FMD is not recognised, i.e. a standard similar to 8.6.25 for beef. It is likely that some countries would accept such meat if it were deboned but deboning sheep or goat meat is impractical because that process is expensive and inefficient and would likely decrease the value of the commodity to a considerable extent. For these reasons deboning would probably not be acceptable to either exporters or importers.

On the other hand, the existence of a standard for live animal export implies that the same standard should be acceptable for meat derived from the same animals because the risk of transmission of FMDVs through meat are considerably lower than for live animals. This provides latitude for developing a system based on the requirements for live animal exports. A problem is the requirement for laboratory testing which introduces additional expense and logistical difficulty.

4.1.4 Improved management of FMD in the dairy sector

There is currently little prospect of freeing the dairy sector of FMDV infection because most producers operate at small scale and their farming systems are often 'mixed', i.e. involve having other types of susceptible animals in the establishment concerned (i.e. farm). Large-scale producers are few and of the approximately 10 million dairy cows in the country only about 0.5 million cross-bred ('improved') cows make up this sector. In addition, because of the numbers of farms and animals involved, intervention could not be implemented by the State, i.e. producers would need to be relied upon to implement control activities. This is complicated by the fact that it appeared in the course of this consultation that there are differences of opinion among dairy farmers and industry representatives on the importance of FMD to productive capacity.

For these reasons the only obvious option for Ethiopia's dairy sector is for the State to make good quality vaccine available in sufficient quantities for dairy producers to purchase. Such good quality vaccines are expensive (around € 1.5 per dose) which will mean that uptake may be limited if it is sold on a cost recovery basis. Cheaper vaccines are most unlikely to be effective and would create a false sense of security.

It is also clear that very few dairy farmers in Ethiopia understand how important it is to employ an effective vaccination programme/schedule. Thus the availability of vaccine will need to be accompanied by an effective extension service to get the message concerning vaccine application across.

A further difficulty is that because there are so many small-scale dairy farmers in highland areas, an effective vaccine distribution system will need to be developed because it could not be expected of farmers to apply vaccines effectively unless the vaccine is easily obtainable where and when it is needed. The distribution system would need to ensure that vaccines are stored and transported while being maintained at 4-8^0 C (i.e. maintenance of an effective cold chain).

4.2 Phase 2

The tools that are essential for reducing the distribution and prevalence of FMD in Ethiopia were identified above, i.e. (1) improved diagnostic/surveillance capacity; (2) an animal traceability and movement control system and (3) access to better quality and supply of vaccines covering the prevalent serotypes and genotypes prevalent in the country. As also already indicated, this will be an expensive, technically demanding and time consuming operation and therefore needs to be planned in detail together with accurate costing and time scale development that are beyond the scope of this consultancy. Therefore, what follows can only serve as a guideline of what will be necessary.

4.2.1 Diagnostic/surveillance capacity

A good basic understanding of the occurrence and behaviour of FMD in Ethiopia has been established through (1) geographically representative cross-sectional serological studies based on antibody prevalence using non-structural viral protein (NSP) ELISAs and (2) recovery of viruses and subsequent nucleotide sequencing/antigenic analysis using material collected during outbreak investigations. Advantageous collaboration with the FAO World Reference Laboratory for FMD at Pirbright (UK) has been established so that it would appear the serotypes and genotypes of the most prevalent viruses have been identified.

What is now needed is more detailed examination of the interaction between FMD viruses and individual economically and strategically important livestock value chains/sectors. This will enable value chain-specific interventions. For this to happen will require additional laboratory techniques to be established at NAHDIC as well as greater laboratory throughput. The new microbiology laboratory under construction at NAHDIC should prove invaluable in this respect. However, also necessary will be a larger cadre of trained scientists and technologists which takes time, organisation and money to get into place. It needs to be recognised that well trained and able technical staff are just as, if not more, important than physical infrastructure.

Better understanding of the interaction between FMDV interaction and specific value chains will also require new approaches designed for each of the major value chains. Some initial initiatives that could be planned are the following:

- Identification of FMDVs active in cattle and sheep/goat markets in different areas of the country

It has recently been shown that mouth swabs collected from clinically healthy animals at markets can identify viruses active in those markets (Jamal et al., 2012). So, once the capacity is adequate, consideration should be given to extending outbreak investigations currently undertaken to include routine collection of mouth swabs from healthy cattle and sheep/goats at major livestock markets in strategically selected parts of the country (i.e. in both highland & lowland areas). This may enable identification of viruses associated with particular livestock sectors in particular regions.

- Identification of FMDVs associated with dairy production in different areas of the country

Cows infected with FMD often excrete high concentrations of FMDV in their milk (Thomson &Bastos, 2004). This fact could be used to detect and quantify FMDV in bulk milk samples and thereby obtain a measure of FMD activity in dairy systems in different parts of the highlands, i.e. both temporally and spatially.

Results from such surveys could then be used to identify 'hot spots' for more detailed investigation.

4.2.2 *Management of animal movement/traceability system*

Particularly when it comes to international trade in foodstuffs, the importance of traceability is growing exponentially. Traceability potentially also enables more effective disease control especially where contagious disease such as FMD are concerned. Therefore, it is essential that the traceability system being developed be integrated into future FMD management policy. How precisely this should be done will require dedicated collaboration between the groups concerned with traceability and animal disease management.

Such activity would be complemented by results obtained from the two lines of investigation proposed above.

4.2.3 *Availability of more and better quality vaccines against FMD in Ethiopia*

There is little doubt that FMD vaccines manufactured locally as well as at least some imported FMD vaccines have been of inadequate quality (essentially lacking in potency and possibly safety) and have inadequately 'matched' the FMD viral genotypes that are prevalent within and on the borders of Ethiopia. In the latter respect (i.e. matching of field viruses and vaccine strains), some imported vaccines have almost certainly been deficient.

It is emphasised that use of poor quality vaccine is essentially a waste of time and money. The question is therefore how to overcome current deficiencies?

In the short term this can only be done by importing quality vaccine in adequate quantities. This inevitably implies considerable cost because quality vaccines are expensive; more so when the antigenic spectrum they need to cover is wide as is the case in Ethiopia. Such vaccines are potentially available but whether they are available in quantities needed in Ethiopia would need to be specifically investigated. Furthermore, persuading commercial producers to use such vaccines on an ongoing, routine basis requires closer investigation. People consulted during this consultancy expressed different opinions in this regard.

A further issue is that application of vaccines in the field in Ethiopia has not generally been applied according to schedules that are proven to generate effective immune responses. For example, it was found that there is poor appreciation that FMD vaccines, when first inoculated into naive animals, need to be administered as two inoculations about a month apart, i.e. to induce an effective primary immune response. In common with practices elsewhere in Africa, there seems to be a belief locally that FMD vaccines should ideally be administered to all animals every six months. Apart from anything else, this practice is contrary to most vaccine manufacturers' instructions to users; it has also proven a failure in southern Africa where this approach has been used for decades (G.R. Thomson, personal observation, 2014). In addition to establishing the primary immune response, young cattle in highly endemic situations need to receive booster doses every 4 months.

To vaccinate only the approximately 0.5 million cross-bred dairy cows in the country would therefore require a minimum of 1.25 million doses of FMD vaccine per year, i.e. more than double the number of doses distributed in Ethiopia during 2013.

In the long run, with a susceptible cloven-hoofed livestock population as large as Ethiopia's, it would be advisable to up-grade and expand the vaccine production facility in place at Debre Zeit. Ideally, to ensure rapid and efficient progress, such an operation should be undertaken in partnership with a multinational commercial company. It is understood that negotiations in this direction are in progress. However, the cost of constructing and maintaining bio-secure vaccine production facilities for FMD is high, not to mention the cost and time required to train the scientific staff required.

5. Recommendations

5.1 Market access for live cattle, sheep and goats

It is essential that the public and private sectors in Ethiopia aremade aware of the new non-geographic standards that already exist with respect to export of live domestic ruminants. Ethiopia needs to propagate this standard (Article 8.6.14) as the basis for expanding access to existing and other external markets. However, as explained below, some modification of 8.6.14 is required for it to become practical.

The new quarantine stations under construction to serve live animal exports via the Djibouti and Berbera/Bosasso routes need be integrated into the existing export system and risk analyses (separate for cattle and sheep & goats) conducted to show that the up-dated system will achieve ALOP (using Article 8.6.14 as the yard-stick). In this respect there is an opportunity to show that incorporation of 30-day quarantine into the system for cattle will enable the quarantine period to replace probing testing (an insensitive test required by Article 8.6.14) as a more effective risk mitigation measure. Requisite NSP testing can be retained and conducted while animals are in quarantine (that, however, will require logistical planning). It is emphasised that a formal risk analysis needs to be conducted to prove that the up-dated system achieves ALOP.

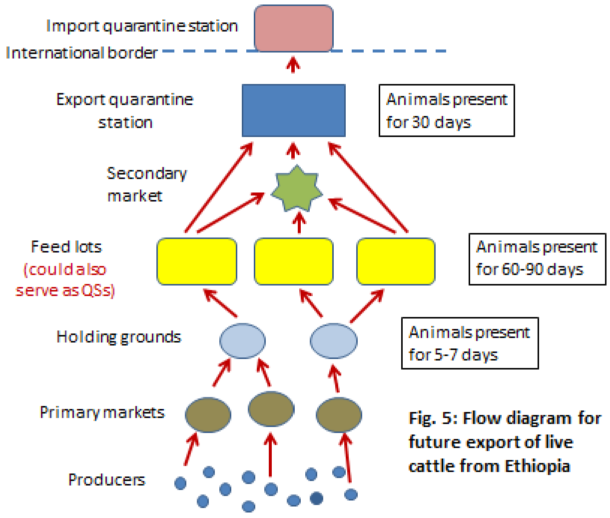
For sheep and goats it was emphasised to the consultant that 30-day quarantine is impractical and therefore a different approach for shoats will be necessary. This will best be achieved through bilateral negotiation between Ethiopia's competent authority and those of the importing countries.

5.1.1 Cattle

Apart from the new quarantine facilities under construction, there is an opportunity for the feedlots, where most traded cattle spend 60-90 days, to serve a double purpose, i.e. as quarantine facilities as well as fattening feedlots. In that case feedlots, through a collective programme (e.g. a feedlot association), could be considered as components of a FMD-free 'compartment' located in the central part of the country (around Mojo/Adama). The requirements for FMD compartments are covered in Article 8.6.6 of the TAHC. If that could be done it would mean that cattle could be exported directly from the feedlots, i.e. without going through the official quarantine stations at Mile or Haroressa.

The problem with this is that current provisions of Article 8.6.6. preclude the use of FMV vaccine in compartments or even the entry into a compartment of animals vaccinated against FMD in the last 12 months. However, the provisions concerning FMD vaccination in compartments is contentious and has been argued about for a number of years now at the OIE. These provisions could therefore change in future.

Figure 5: Flow diagram for future live cattle exports



The proposed future system (Fig. 5) has the problem that cattle would need to spend 2-3 months in a feedlot/quarantine facility plus a further month in an official quarantine station. This makes the system logistically complicated, lengthy and expensive.

An issue that will require specific re-planning is the proposal to establish secondary markets for cattle following the feedlot period (Fig. 5), because that would present an unacceptably high bio-security risk. The reason is that mixing of animals from different feedlots at secondary markets, where maintenance of strict bio-security would be very problematic, would greatly increase the risk of FMD-infected animals being dispersed by live animals that have been through secondary markets. It is appreciated that secondary markets provide an opportunity for the GoE to generate VAT but, on the other hand, it is unlikely that the income thereby generated would be worth the added bio-security risk.

5.1.2 Sheep & goats

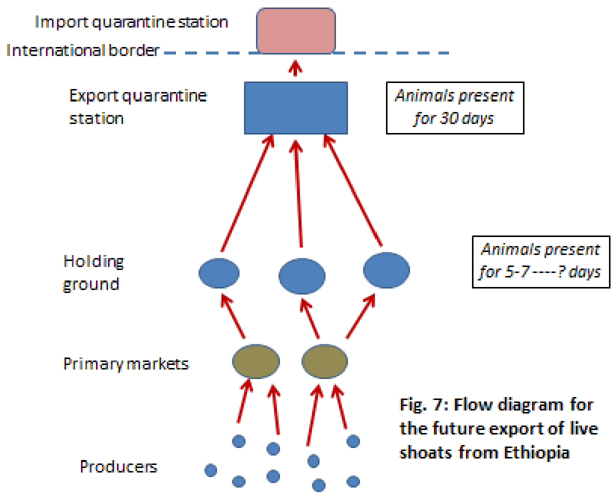
Export of live shoats is complicated from a sanitary perspective by the widely held opinion that quarantining/holding of these animals for 3-4 weeks prior to export is impractical. As it is, the mortality rate among exported shoats isconsidered to be too high.

The current system (Fig. 3) does not include quarantine/holding for longer than a few days although importers generally require a certificate stating that the animals have been through a quarantine system which implies a longer period.This creates an obvious dilemma.

For the above reason the future export of shoats (Fig. 6) is, from a bio-security perspective, problematic and the only obvious way forward is for further negotiation between Ethiopia's official veterinary service and those of importing countries.

It is emphasised that operating procedures for the new quarantine stations under construction need to be reviewed because from the brief descriptions made available it may be that the level of bio-security attained will be unacceptable to some export markets.

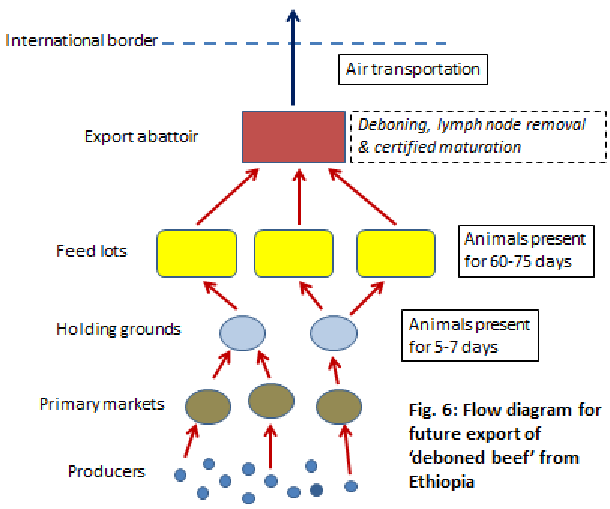
Figure 6: Flow Diagram of future live shoat Exports



5.2 Market access for de-boned beef

The exiting standard for de-boned beef – Article 8.6.25 – could be implemented in Ethiopia without difficulty. Such beef (Fig. 7) could therefore be certified as meeting the required international standard for export to any destination in the world.

Figure 7: Flow diagram for future deboned beef exports



5.3 Market access for sheep and goat meat

As already explained there is no exiting international standard for trade in sheep and goat meat that is not derived from countries and zones free from FMD. However, in this respect Ethiopia's exporters currently supply countries that are not free from FMD themselves (i.e. have the same FMD status as Ethiopia). For that reason such importers should not require measures that are not applied in their own countries (convention of the WTO Agreement on Application of Sanitary and Phyto-sanitary Measures – http://www.wto.org/english/tratop_e/sps_e/spsagre_e/htm). These countries also do not have significant numbers of pigs which reduces still further the exposure risk (European

Commission, 2006). It has been explained above that pigs are a vital link in the FMD transmission chain involving meat and meat products (see 1.3).The low numbers of pigs in countries of the Arabian Peninsula essentially almost abrogates the FMD risk posed by meat exports (this applies to beef as well).

It is clear that a future export system (Fig. 8) will require careful consideration by both the competent authority and producers on how to address the requirement of importers in the Arabian Peninsula for animals to undergo effective quarantine.

Figure 8: Flow diagram for future shoat meat exports.

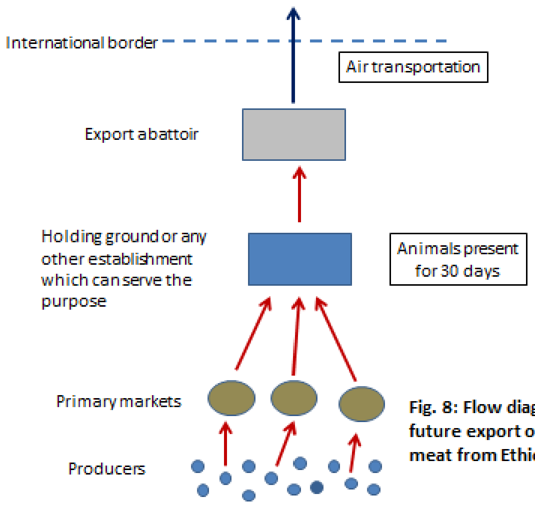


Fig. 8: Flow diagram for future export of shoat meat from Ethiopia

5.4 Requirements for a good negotiating team

It is axiomatic that the GoE requires a team knowledgeable and experienced in negotiating with existing and proposed future export markets on issues discussed above. This requires people with a good understanding of the epidemiology of FMD (and other transboundary animal diseases), risk analysis and international trade rules and practices, particularly in respect of SPS issues. For that reason a small group of people should be assigned that responsibility and be provided with the necessary training.

5.5 FMD surveillance

The surveillance approach to FMD hitherto adopted in Ethiopia (essentially outbreak investigation & prevalence studies based on NSP serology) has provided essential information. This now needs to be expanded to measure the interaction of FMDVs with the various value chains. Some suggestions for initial activities in this respect are provided insection 4.1.

A better understanding of the African buffalo populations and their FMD status in south-west Ethiopia is advisable. That will require sampling of the populations once their numbers and structure is clearer. That will need to be approached with circumspection because these populations are small and vulnerable. Their cross-border movements also complicate the situation. For these reasons wildlife specialists with a sound understanding of FMD in relation to buffalo will need to be consulted.

5.6 Animal identification, movement control and traceability

This issue in an extensive country with an exceptionally large livestock population and where movement control is not an established practice as far as livestock producers are concerned is complex. It is furthermore currently being addressed by other consultants. Obviously, disease control is only one of the issues associated with this activity but it is vital that ability to control animal movement for disease control purposes is incorporated into the system. This will require further investigation.

5.7 FMD vaccine provision, distribution and application

This is undoubtedlythe most urgent requirement in respect of FMD management in Ethiopia. However, the issue, as explained above, goes beyond mere provision of good quality and 'matched' vaccines. Development and also financing of an effective vaccine distribution system, together with an accompanying extension service,is essential for the dairy sector in particular. In the latter respect there is poor understanding of optimal vaccine administration schedules which requires urgent correction.

These issues are covered in detail in section 4.2.3.

6. Conclusion

Ethiopia is confronted by a complex FMD management problem that will take considerable planning and investment to address adequately. It is proposed that a two-phased approach be adopted whereby the first, short-term, phase (Phase 1) would be aimed at progressively ameliorating the trade constraints consequent upon the endemic nature of FMD in Ethiopia. The second phase (Phase 2) would involve up-grading and then applying the tools necessary to manage FMD effectively in Ethiopia by reducing the distribution and the rate of spread of FMD viruses. This will require the following: (1) improvement in diagnostic/surveillance capacity and performance, (2) integration of FMD management into the overall animal movement control/traceability system under development and (3) improvement in the supply, distribution and applicationof quality FMD vaccines.

It is argued in this document that the different components of the livestock sector in Ethiopia (producer organisations, business people and the MoA, i.e. both the private sector and government agencies) will need to work closely together to overcome constraints to marketaccess by developing novel but integrated strategies that are increasingly becoming possible. New non-geographic international sanitary standards, which are more appropriate for Ethiopia's conditions, are becoming available and there is also the possibility of using the principle of equivalence (together with risk analysis) to show that sanitary risk mitigation strategies appropriate for Ethiopia's circumstances are just as able to deliver the equivalent risk mitigation as existing standards (i.e. employment of the principle of equivalence). This will require an able and well trained multidisciplinary team.

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Appendix A – Terms of reference

International Consultant

Development of a Progressive Control Strategy for FMD

Under the general supervision of the FAO Sub-regional Coordinator for Eastern Africa and FAO Representative in Ethiopia, to AU & ECA, the direct supervision of the Assistant FAO Representative, the technical supervisionof the Head of the Animal and Plant Health Regulatory Directorate and the Team Leader of the Livestock Team from the FAO Sub-regional Office for Eastern Africa (SFE), and in direct collaboration with Head of the Animal and Plant Health Regulatory Directorate, MoA, the consultant will develop and recommend a FMD disease control strategy. In particular, the consultant will:

While developing such a strategy the consultants should have in mind the vision of the National Authorities of Ethiopia for:

1. Developing export of livestock and livestock products to markets presently represented by countries of the Arabian Peninsula and North Africa, but possibly in future to higher priced markets in West Africa, South East Asia and Eastern Europe etc.;
2. Preventing the negative impact of FMD on trade through the progressive control of FMD, contributing to and ultimately leading to the eradication of FMD in line with the global strategy, the progressive Control Pathway for FMD (FMD_PCP);
3. Initiating a progressive control strategy that in the initial stages targets the export value chain, the dairy sector and pastoral areas in the south and south-eastern parts of the country;
4. Progressively establishing "FMD free zones with or without vaccination" according to the criteria of the Terrestrial Animal Health Code of the OIE including surveillance and quarantine requirements to prevent reintroduction of the disease.

The FMD progressive control strategy should have the following elements:

1- Review existing information on direct and indirect losses associated with FMD to justify the feasibility of a control program.
2- Review the movement pattern of the major livestock species cattle small ruminants and swine) within and into the country and its possible role in the maintenance and transmission dynamics of the disease.
3- Using the available information at NAHDIC, identify the circulating serotypes and subtypes, identify the hot spots using well thought-out risk pathways.
4- Using the available information and in close consultation with NAHDIC and the regional states, generate qualitative and quantitative information regarding the incidence rate of FMD for each region and production system of the country, and map the incidence using color mapping techniques so as to indicate areas with highest level of occurrence/endemicity.
5- Generate an hypothesis on how the FMDVs circulate in the population and also indicate the possible role of wildlife in the transmission of the disease.
6- Set out the roadmap for an Ethiopian progressive FMD control strategy, initially targeting a part of the country, a sector or subsector; This would involve developing a comprehensive FMD control strategy safeguarding the export market and the dairy sector based on grade animals, and progressively move towards freedom through progressive FMD control pathway in line with the global FMD control program. This includes proposing a timeline and phases for the implementation of the FMD control pathway.
7- Identify the amount of FMD vaccine required in the initial stages and subsequent steps in the progressive control pathway.
8- Design FMD surveillance strategy, which includes both active and passive disease surveillance components.
9- Look into and recommend requirements for FMD surveillance in small ruminants and other wildlife.
10- Identify risk factors in FMD transmission and propose risk mitigation measures and certification procedures for both live animal and meat export value chains.

11- Design the management of the vaccination programmes, i.e. the role of the Federal veterinary services versus that of the regional states, the zonal and woreda veterinary services as well as participation of the industry, producers, livestock owners (small scale subsistence and large scale commercial), community animal health workers and the role of private veterinary professionals.
12- Assist in outlining a broader framework for the development of guidelines and Standard Operation Procedures (SOPs) for [progressive control of FMD.
13- Identify the needs for and the requirements for the veterinary services to develop and maintain an effective communication strategy to build public-private partnerships and gain the support of the livestock owners, traders, feedlot operators, live animal exporters and other stakeholders in the progressive control of FMD.
14- Propose approaches on how best to harmonize FMD control activities with neighboring countries, which have developed similar strategies.
15- Indicate the capacity building needs of the veterinary service to implement the strategy;
16- Undertake other related activities as may be required.

Qualification and experience

Duration of the mission: 60 days (two months).

Duty station: Addis Ababa with some field travel.

Appendix B – Consultant's schedule in Ethiopia

Schedule of consultant's travel activities

First visit (8-23 January 2014)

- 8 Jan – Travel to Addis Ababa from Johannesburg
- 9 Jan – Addis Ababa/visit to National Veterinary Institute, Debre Zeit
- 10 Jan – Addis Ababa/visit to National Animal Health Diagnostic & Investigation Center, Sebeta
- 11 Jan – Visit to feedlots around Mojo/Adama
- 12 Jan – Visit to farms in the Debre Zeit area
- 13-14 Jan – Consultations, Addis Ababa
- 15 Jan – Travel to Yabello
- 16-17 – Visits to livestock markets in the Borena region
- 18 Jan – Return to Addis Ababa
- 19 Jan – Sunday
- 20 Jan – Preparation for workshop, Addis Ababa
- 21-22 Jan – Consultative workshop 1, Addis Ababa
- 23 Jan – return to Johannesburg

Second visit (17-28 February 2014)

- 17 Feb – Travel to Addis Ababa
- 18-20 Feb – Consultation/preparation for workshop
- 21 Feb – Sunday
- 22 Feb – Consultative workshop 2
- 23-27 Feb – Consultation/report preparation
- 28 Feb – Return to Johannesburg

Appendix C –People consulted

Directorate of Animal Health, Addis Ababa

Dr BewketSiraw, Director veterinary Services

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Consultants associated with Directorate of Animal Health

Dr Wondwosen Asfaw (Local counterpart for this study)

Mr Yakob Aklilu (livestock economist)

Dr Peter Moorhouse (epidemiologist)

Dr John Woodford (animal health specialist)

Dr Michael Bradfield (animal identification/traceability specialist)

Dr David Paton (international FMD expert – Pirbright institute (UK)

Mr FufaDawo (post-graduate student specialising in FMD at Pirbright Institute (UK)

National Artificial Insemination Center

Dr BesufekudJufar

Dairy Industry experts

Dr Tegegne Azage (ILRI)

Mr Jean Franco EliveraNardeli

Mr Lencho Alemu (dairy farm manager)

Feedlot animal health expert

Dr Kima Mohammed (Makassar)

Pastoral market experts (Yabello - Borena)

Mr Solomon Tekle

Dr Kara Dadi

Quarantine station construction co-ordinator

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A Consultative Workshop on FMD

Participant's Attendance Sheet

Venue: Ministry of Agriculture **22 January 2014, Addis ababa**

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Consultative Meeting on Draft FMD National Control Strategy

Ministry of Agriculture in Collaboration with FAO sub regional office

February 24-26 2014 Addis Ababa

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