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Foot and Mouth Disease: An Overview of its Global Status, Control Policies and the Thai Case

by

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Foot and Mouth Disease: An Overview of its Global Status, Control Policies and the Thai Case[1]

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Thomas D Murphy[2]

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The Commissioned Organization is the Queensland Department of Primary Industries. Collaborating institutions in Australia are CSIRO-ANHL, Geelong, Victoria and the University of Queensland (Department of Economics; Department of Geographical Sciences and Planning). In Thailand, the collaborating institutions are the Department of Livestock Development (National Institute of Animal Health; Disease Control Division), Chiang Mai University (Department of Agricultural Economics; Department of Animal Husbandry) and Thammasat University (Faculty of Economics). The collaborating institution in Laos is the Department of Livestock and Veterinary Services. Dr F.C. Baldock, Senior Principal Epidemiologist, Queensland Department of Primary Industries is the Project Leader in Australia and Dr P. Chamnanpood, Senior Epidemiologist, Thai Department of Livestock Development is the Project Leader in Thailand. Professor Clem Tisdell and Dr Steve Harrison, Department of Economics, University of Queensland are responsible mainly for the economic component of this project.

'The overall goal of this project is to develop and evaluate the .necessary tools to provide decision-makers with reliable animal health information which is placed in context and analysed appropriately in both Thailand and Australia. This goal will be achieved by improving laboratory diagnostic procedures; undertaking research to obtain cost-effective population referenced data; integrating data sets using modern information management technology, namely a Geographical Information System (GIS); and providing a framework for the economic evaluation of the impact of animal diseases and their control.

A number of important diseases will be targeted in the project to test the systems being developed. In Thailand, the focus will be on smallholder livestock systems. In Australia, research will be directed at the northern beef industry as animal health information for this sector of livestock production is presently scarce.'

For more information on *Research Papers and Reports Animal Health Economics* write to Professor Clem Tisdell (c.tisdell@economics.uq.edu.au) or Dr Steve Harrison,(s.harrison@uq.edu.au) Department of Economics, University of Queensland, Brisbane, Australia, 4072.

Foot-And-Mouth Disease: An Overview of Its Global Status, Control Policies and the Thai Case

ABSTRACT

FMD is one of the world's most researched and infectious diseases. FMD is endemic in most regions of South America, Asia and Africa. While the global incidence of FMD is falling, the prevalence of the disease worldwide is still significant with effective control programs constituting important national objectives. In recent times, there has been an increasing interest amongst endemic countries in the economic viability of disease control programs. This interest is expected to intensify as governments seek accountability in investments into disease control programs in the future. Disease control programs vary significantly in their application ranging from vaccination to "stamping out" to composite programs such as disease free zoning. The appropriate selection of these strategies can determine whether a country reaps the substantial national benefits of an optimal disease control strategy or incurs significant losses to producers, consumers and traders associated with an inappropriate program. This paper will provide a profile of FMD, its global prevalence and control policies applied, with particular reference to South East Asia.

Keywords: livestock disease control, South East Asia, Foot and Mouth disease.

JEL Codes: Q160

Foot-And-Mouth Disease: An Overview of Its Global Status, Control Policies and the Thai Case

1. Introduction

In recent times there has been increasing interest in the economic viability of disease control programs - an interest that will only intensify as governments seek accountability for investments into disease control programs in the future. The appropriate selection of a disease control strategy can determine whether a country reaps the substantial national benefits of an optimal disease control strategy or incur significant losses to producers, consumers and traders associated with an inappropriate program. Such characteristics of disease control are certainly applicable to Foot and Mouth Disease. FMD is both one of the world's most researched and infectious diseases. This paper will provide a profile of FMD, its global prevalence and control policies applied, with particular reference to South East Asia.

2. FMD: A profile of the disease

As Donaldson (1993) states, the reasons for needing to understand the epidemiology of the Foot and Mouth disease is to be able to design optimal strategies for control and eradication. The epidemiology of Foot and Mouth disease is complex and varied (particularly under different management regimes). This section will provide a brief overview of some of the major epidemiological features of the disease (pathogenesis, transmission, production and vaccination) outlined comprehensively by Thieme (1983) and Donaldson (1993).

2.1 Pathogenesis

FMD is a contagious livestock disease that afflicts all cloven hoofed animals. It is believed to be caused by seven major viruses, types A, C, 0, Asia 1, STA 1, SAT 2, SAT 3 (Thieme, 1983). It is generally accepted that FMD virus infects via the respiratory route especially in ruminant species where small doses can initiate infection (Donaldson 1993, p 11). In cattle and sheep, the primary region of viral growth is within and around the pharynx. While in pigs the respiratory route is suggested to be the more usual portal of entry, they are more susceptible to the infection by the oral route than ruminants (Donaldson 1993, p 11).

Infection can also occur through breakages in the skin.

While FMD is a highly contagious disease, in adult animals this infection does not usually result in a high rate of mortality (rarely above 5%). In younger livestock however, the mortality rate can reach as high as 90%, particularly within a high density environment (such as feeding lots). Young pigs used in intensive feeding units are particularly susceptible. The length of the incubation period is variable and can range from 2-14 days depending on the density of the stocking area.

2.2 Transmission

Donaldson (1993) noted that during the acute phase of the disease, lasting up to 3-4 days, all excretions, secretions and tissues contain virus. At this stage the animals need to be isolated or destroyed in order to halt the spread of the virus. After recovery up to 80% of ruminant species can become persistently infected (Donaldson 1993). These animals can initiate fresh outbreaks when in contact with fully susceptible animals - a real threat to non-vaccinating countries who fail to eliminate all carrier animals. Across all the mechanisms for transmission of FMD, movement of animals is the most important followed by movement of contaminated animal products such as milk and meat.

2.3 Production systems, epidemiology and vaccination

The pattern of the spread of FMD amongst livestock herds is affected by several factors. Important elements that influence the nature of this spread are the type of animal husbandry and the environment. As noted earlier, high stocking densities facilitate the spread of FMD due to the high contact rate between infective and susceptible animals. For these reasons, intensive production and stocking systems assist spread of the disease.

In order to minimise the potential of infection and extent of the spread, vaccination is employed to protect animals against production losses caused by FMD. Provided there is adequate coverage with a sound vaccine (antigenetically matched to the virus strain), a national vaccination program should protect stock and render animals immune (Donaldson 1993). Regional vaccination programs are often employed to create a barrier zone. These zones are established to reduce the risk of FMD spreading from infected to “free” zones. Regional free zoning is a strategy adopted in Zimbabwe, Botswana and the Republic of Southern Africa where cattle are isolated from wildlife via fencing and vaccination is applied in bands that extend outward from these fences. The outer zone is a non-vaccinated free area

from where stock can be sourced for export purposes.

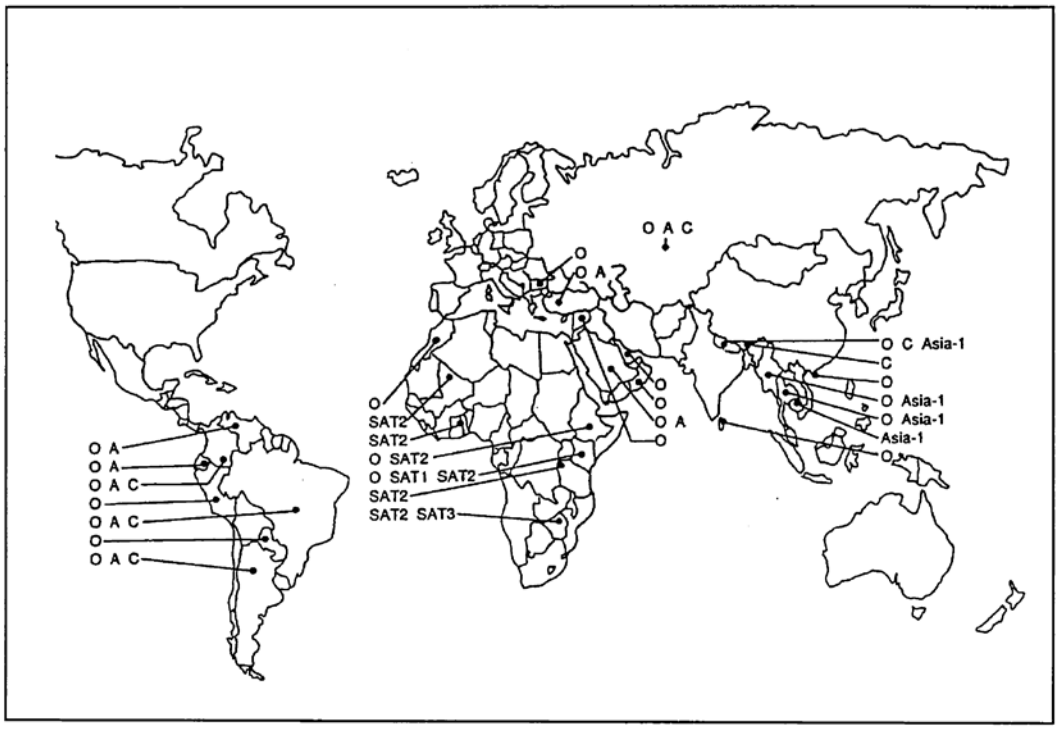
Different species of livestock vary in the role they play in the epidemiology of FMD. Livestock such as cattle play an important role due to their high susceptibility to the air-borne virus and the excretion of the virus in their milk (days before the virus is evident) while pigs are important due to their susceptibility to infection by the oral route and the vast levels of virus they excrete (Donaldson 1993). The spread of FMD is obviously facilitated by the mixing of infected with susceptible animals from different regions. As will be noted in the next section, the global prevalence of the disease is often determined by those countries that share land borders with others.

3. Global and regional prevalence of FMD

This section will outline the present situation of FMD from a global perspective. This will enable the South East Asian situation to be viewed within an appropriate context. In terms of frequency of outbreak, regions countries and zones within countries can be classified as endemic, sporadic, and free. Ozawa (1991) and Donaldson (1993) provided a comprehensive outline of the FMD global situation in the 1990s with the following classifications (in Donaldson 1993) indicating the global situation.

- *Endemic* - Most of South America, Africa and Asia.
- *Sporadic* - Italy, Bulgaria, Russia, Israel, Malaysia and Magreb countries of North Africa. In Southern Africa the livestock population of Botswana, Zimbabwe and Republic of South Africa are free but virus is spread and in game parks.
- *Free* - Central Middle and North America, Australia, New Zealand, Japan, Indonesia, North and South Korea, Chile Uruguay, Guyana, French Guyana and most of Europe.

While the global incidence of FMD is said to be gradually falling, the prevalence of FMD worldwide is still significant. Figure 1 shows the international distribution of FMD virus serotype (Ozawa, 1992). This illustrates that the disease is still endemic in most countries of the world that have mutual borders with neighbouring countries as is the case Thailand. Figures 2, 3 and 4 provide an outline of the FMD situation in three endemic regions, Asia, Africa and South America.



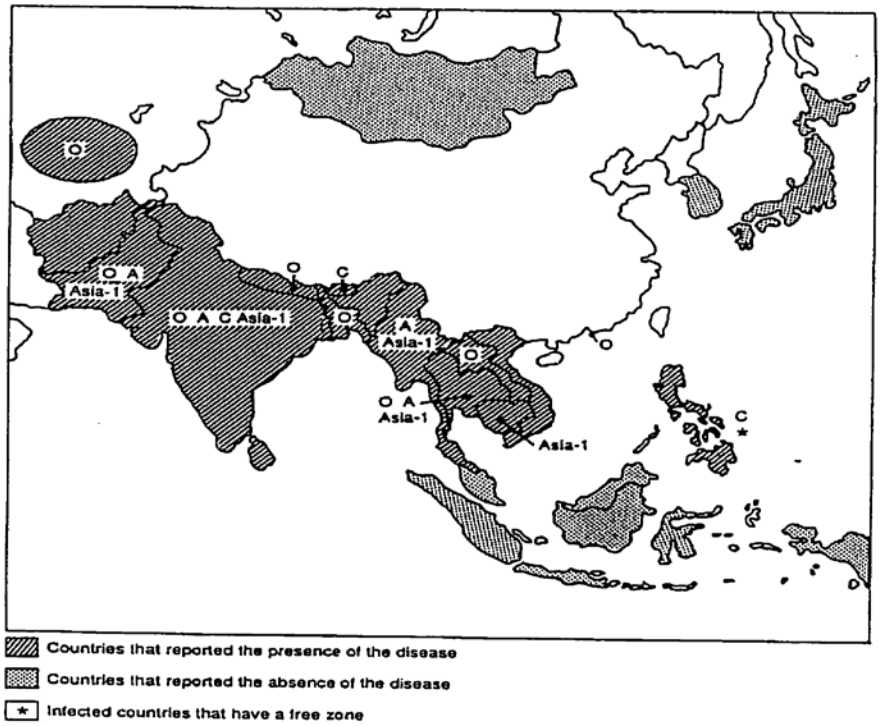
Source: Ozawa (1992)

Figure 1: International prevalence of FMD serotypes

a) Prevalence of FMD in Asia

Figure 2 outlines the prevalence of FMD in Asia. As Ozawa (1992) indicates FMD is endemic in most of the countries of southern Asia. The major types in these areas are Asia 1 and 0. Asia 1 has been isolated from samples received from Nepal, Cambodia and Thailand. Type C is the only serotype present in the Philippines and is prevalent in Nepal, Bhutan, and India.

FMD Type O, has been prevalent in Sri Lanka and endemic in Hong Kong. While Indonesia and Malaysia have remained free of FMD, in June 1992 Type O1 appeared in Malaysia near the Thai border. Within the Asian region, 12 outbreaks have been reported up until the middle of 1992 (Ozawa 1992). These outbreaks have been confined to bovines (cattle and buffalo) in this region.



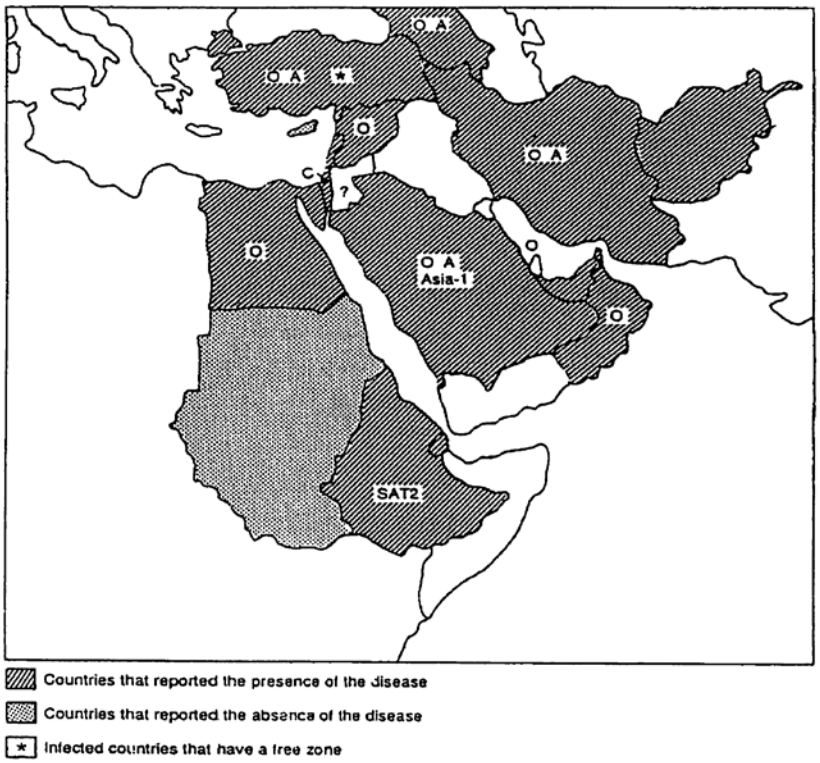
Source: Ozawa (1992)

Figure 2: Prevalence of FMD in Asia

In Thailand, FMD has been endemic for more than 40 years. Type A15 was first reported in 1953 and type Asia 1 and O were identified in 1954 and 1957. These three types of virus are endemic throughout the country except for the South which has been announced provisionally free of the disease (although sporadic outbreaks do occur) (Hanyanum, 1993).

b) Prevalence of FMD in the Middle East

Figure 3 indicates the prevalence of FMD in the Middle East. Type 0 has been isolated in samples collected in Bahrain, Israel, Oman, Saudi Arabia, Syria and Anatolia in Turkey. Type A reoccurred in Anatolia in 1991 and after 5 years of absence was again recorded in Iran and Saudi Arabia in the same year (Ozawa 1992).

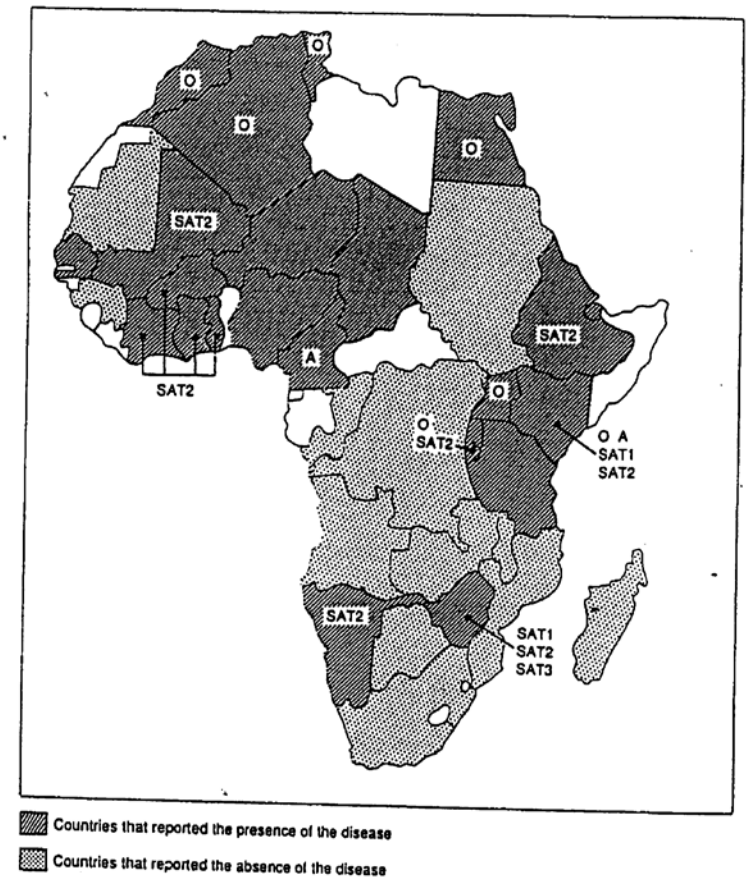


Source: Ozawa (1992)

Figure 3: Prevalence of FMD in the Middle East

c) Prevalence of FMD in Africa.

Figure 4 indicates the prevalence of FMD in Africa as outlined by Ozawa (1992). FMD type O has been reported in all North African supplying information to the OIE. While preventative measures such as "buffer" zones (see Table 1) have been implemented on the border of Morocco and Algeria, an outbreak has spread to the remainder of Moroccan territory (Ozawa 1992). In addition to the slaughter of infected or "contact" animals, ring vaccination operations were organised around the outbreak followed by a decision to vaccinate the entire national cattle population in November 1991. FMD virus type O was reported in Burundi, Kenya and Uganda. Virus type SAT 1, type A and C have also been observed in Kenya with the former being reported in a herd of cattle in Zimbabwe within the Hurungwe wildlife zone. While FMD virus SAT 2 is predominant in Western, Eastern and Southern Africa, SAT 3 was identified in cattle close to the southern border of Zimbabwe in 1992. The Republic of South Africa is in an area of direct cattle-buffalo contact with that of Zimbabwe.



Source: Ozawa (1992)

Figure 4: Prevalence of FMD in Africa

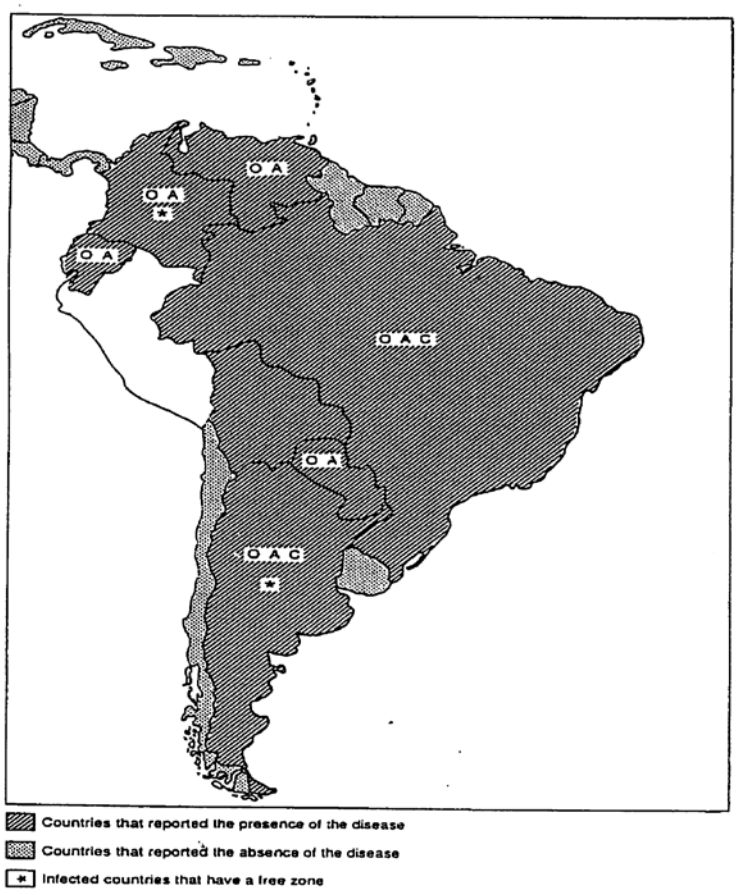
d) Prevalence of FMD in Europe

The adoption of unilateral FMD control measures in the European Community saw FMD eliminated in Spain in late 1990 and in the Netherlands, Germany, Belgium, France, Portugal, Italy in 1991. In the same year other European countries such as Austria, Czechoslovakia and Romania stopped all vaccination. At the end of 1991, there were no longer any countries in Europe where vaccination was systematically practised with the exception of certain former republics of the Soviet Union. Only in the Eastern European countries of Armenia (type A) Bulgaria and Georgia (Type O) was FMD reported.

e) Prevalence of FMD in the Americas

North America, Central America, West Indies, Guyana and Chile are free of FMD without vaccination. Figure 5 indicates the prevalence of FMD in South America. Uruguay has

remained free of outbreaks due to a national vaccination program undertaken since 18 June 1990. Despite the concerted action of countries like Argentina Brazil and Uruguay and the Pan American FMD Control Centre, occurrence of the disease viruses O and A was reported in Argentina, Brazil, Columbia, Ecuador, Paraguay and Venezuela. Type C was found in Argentina and Brazil, though with the former reporting a dramatically reduced number of outbreaks.



Source: Ozawa (1992)

Figure 5: FMD Prevalence in South America

4. Disease Control Programs

The global incidence of the disease is evidence of the significant issue that control of disease poses for many countries throughout the world. While control programs vary among countries there are generally considered to be a few standard ways of attempting control:

1. Vaccination

2. Stamping Out

3. Disease Free Zoning.

4.1 Vaccination.

Vaccination programs involve vaccination of cattle more than four months of age generally three times annually to maintain immunity. Should an outbreak of FMD still occur it is brought under control by the slaughter and destruction of animals on affected farms, extra vaccination in areas around the affected farm and transport bans.

Vaccines have been successfully used in some European and some South East Asian countries to eradicate FMD. Either strategic (ring) vaccination can be used which limits the vaccination to around the outbreak to contain disease to a specific geographical area, or blanket vaccination could be used which applies broad based vaccination across regional or national areas to slow the spread of disease and reduce effects on production. Barrier vaccination refers to vaccination of susceptible animals in a buffer zone to prevent the spread of FMD to adjacent areas - this can be applied on a regional (zonal) or national basis.

The costs of vaccination control programs (including movement of stock, handling, and treatment), when combined with overall control campaign costs, result in substantial cost to the individual cattle producers and the economy. Therefore the question of whether to continue with preventative vaccination is a regular topic for discussion in many countries which still vaccinate. Advocates of discontinuation put forward the favourable results obtained in other non-vaccinated countries, the recurring annual vaccination costs and the possible new export potential (whereby ceasing vaccination would indicate free of FMD-status). Those in opposition to this argue that there will be much swifter spread of FMD in an unvaccinated population if a primary outbreak occurs, with the related consequences of export bans. The discussions within the EC concerning this subject led to the decision to stop yearly vaccinations in all member countries on the 1 January 1992 (Berentsen, Dijkhuizen, Oskam, 1992, p 229).

4.2 Stamping Out

The “stamping out” approach is a disease control program where no annual vaccination and no ring vaccination are applied after an outbreak. The program involves the slaughter and destruction of animals on contact farms. It is considered that this is sufficient to bring the

disease under control as destruction of infected herds removes the greatest source of the virus (via excretion from respiratory aerosols and ruptured vesicles) and avoids the possibility of carriers[1]. Contact animals in direct or indirect contact with FMD, regardless of their infected state, are also destroyed as a precaution. The 'slaughter policy', while increasing costs of control and compensation in the short term, is suggested an efficient way of avoiding future outbreaks and terminating the duration of the epidemic. Obvious problems exist in implementing this policy when combatting a rapidly spreading outbreak given the logistical problems associated with an extensive slaughter policy.

4.3 Disease-Free Zoning

Disease-free zoning is often applied in combination with vaccination and slaughter policies. If FMD is endemic in only part of the country, it is possible to establish infected and disease free zones in order to retain partial access to livestock markets. Zoning is becoming increasingly accepted internationally as a valid way of reducing impediments to trade. As noted below, it has been successfully adopted by Zimbabwe, Botswana, and South American countries to gain access to European markets.

From an economic point of view, the often asked question is which of the alternative regimes or combination of control regimes mentioned above, on a regional or national basis, provide the optimal strategy for control of disease. Vaccination and stamping out programs as independent regimes have characterised the traditional approaches to national control programs throughout the world. However, given the recent changes in international trading conditions, control programs of developing countries need to be reassessed given new opportunities for securing export earnings through disease-free zoning.

The OIE are currently developing criteria for the establishment of zoning. Table 1 illustrates the basic requirements of a disease-free zone to gain recognition by the European Union. Basically disease-free zone is separated from an infected zone by a surveillance zone (where an advanced degree of disease monitoring and control is practised) and possibly a buffer zone (in which animals are vaccinated). Tight controls over movements must apply between these zones (Bell, Cottam and Kennedy 1993).

Significant economic benefits have been derived by the establishment of such zones in FMD endemic African countries. In Southern Africa a series of livestock zones have been created across the country to provide an area from which unvaccinated cattle known to be free from

Foot and Mouth disease can be sourced for export to the European Union. In the case of Botswana and Zimbabwe, the European Union has recognised the following zones outlined in Table 1. Botswana currently export 19 000 tonnes of frozen beef to the European Union to earn an estimated total income of $US 37 million through its export approved abattoirs (Griffiths 1992, p 17). The essential importance of livestock export to the national economy of Botswana has been analysed in studies by Hubbard (cited in Harrison and Tisdell 1995).

Table 1 European Union Recognised Zones

- **Wildlife Zone**: To the north of the country there is a wildlife zone which is maintained as a cattle free zone. The movement of cattle in the area is unrestricted and animals can migrate from Namibia, Angola, Zambia, and Zimbabwe. This area is bounded by a double cordon game proof fence to the south.
- **FMD Vaccination Zone**: This zone is adjacent to the wildlife zone All cattle in this zone must be vaccinated and cattle cannot move out of the area. A double cordon fence is also maintained in the area.
- **Buffer zone**: This zone is a minimum of 10 km wide and is located adjacent to the FMD vaccination zone. Cattle that have not been vaccinated for 12 months may move by a series of quantitative steps into the buffer zone. Fencing is maintained around the buffer zone.
- **FMD free zone**: There is an FMD free zone adjacent to the buffer zone .Movement from one FMD free zone to another is restricted .Export abattoirs are located in Quarantine zone which is adjacent to the FMD free zone. All cattle in the FMD free zone go directly to slaughter and export via the quarantine zone are located around the abattoirs. Between each zone there are holding facilities and quarantine camps. There are hundreds of kilometres of steel fencing in Botswana. All fences are routinely checked and European Union inspectors visit annually. As part of their visit a fence inspection is made.

Source: Griffith (1992, pp 16-17).

In Thailand, controls on movement of livestock are comparative far more difficult than in Africa. The movement of animals is high between regions. Therefore the ability to provide control is poor and national immunisation programs are costly. Disease-fee zoning in the southern zone is a necessary first step given its natural boundaries and access to Malaysia. Regional cooperation though is essential between the South East Asian countries as recent OIE polices have tried to emphasise.

5. FMD Policies in Thailand and South East Asia

The control of FMD is of considerable concern to most countries in South East Asia. The OIE proposed in November 1990, at the International Symposium in Thailand[2] , that a group be formed for the control of FMD in the sub-region. In response to this, the OIE Regional Commission met in 1991 to discuss the symposium's recommendation and thereafter approved the formation of a co-ordinating group of countries in that subregion to coordinate campaigns against FMD. All countries in the region sharing land borders with their neighbours- Thailand, Vietnam, Cambodia, Myanmar, Laos and Malaysia were included in this group and agreed on the principle of regional co-operation. In the past, coordinated international campaigns have not succeeded. Civil strife and war in Indo-China have impacted on attempts to coordinate disease control programs in the past. As most of these countries share land borders, they suffer due to movement of infected animals.

While the political and economic climate has improved, Thailand has seen the increase of both legal and illegal movement of animals across borders with the FMD situation in some of the countries of South East Asia taking a tum for the worst. Ozawa (1992) suggests however that with the present favourable political climate in the region it offers a unique opportunity for increasing regional cooperation between countries in South East Asia for coordinated campaigns against FMD.

The first meeting of the coordinating group for FMD control in South East Asia was held in Bangkok from 17 to 20 February 1992 with participants of the Food and Agricultural Organisation (FAO) and observers from Australia, Japan, Malaysia the Philippines and the United States present. In February 1993 the second meeting of the same group consisting of Myanmar, Thailand, Malaysia, Laos, Cambodia, Vietnam and the Philippines group agreed that common overall strategies should be applied by these countries within national development programs.

5.1 OIE Plan for the Campaign against FMD in South East Asia

According to Ozawa (1993) the OIE plan for a campaign against FMD in the region .consists of basically three components,

- Improve the standards of veterinary services

- Improve productivity of animals by keeping FMD under control and to increase income of livestock producers in Myanmar, Laos, Cambodia, Thailand, Malaysia, Vietnam and the Phillippines

- The long term objective is facilitate and promote international trade of animals and animal products by creating FMD free regions in South East Asia.

With the assistance of developed countries such as Australia, the objectives of the South East Asian group of countries is to establish mechanisms for regional cooperation, research and active field programs to rid the region of FMD, similar to the processes used in Western Europe (Ozawa,1993).

5.2 Thailand's Control Strategy

In line with regional objectives coordinated by the OIE, Thailand's Department of Livestock and Development (DLD) has planned a new five year strategy project: The Foot and Mouth Prevention and Eradication Program which commenced in 1991. The five major components of the control strategy currently in operation are outlined in Ozawa (1992) as follows,

- A mass vaccination program

- FMD information systems

- Control of animal movements

- Stamping out; and

- Public relations with the goal of eradicating FMD from Thailand by the year 2000

The aims of this project are to firstly decrease incidence of disease, secondly maintain FMD free status in particular zones (for instance the 8th region), and thirdly to promote livestock production and export. The epidemiology of the disease, particularly in Thailand has meant constant difficulties in applying these control measures.

6. Economic Considerations of Control

Given the highly infectious nature of FMD and its endemic status within Thailand, these control measures warrant significant funding. As noted by Ozawa (1993) funding of control

programs in the past has run into the millions of dollars annually with limited success due to the fact there have been few lasting coordinated strategies in the region and no common overall strategy. With the recent changes in the political and economic climate of the region, there is growing commercial incentive to develop optimal control programs that would encourage commercial sectors to pursue international market-orientated trade in livestock (Ozawa,1992). Due to such factors optimal decisions on the most efficient regimes or combination of control regimes (for instance vaccination, stamping-out, zoning) are being increasingly determined through economic evaluation.

The major economic techniques applied in analysis of disease have traditionally been benefit cost analysis and simulation of epidemiological factors that help determine elements of cost. These techniques have been relatively well represented across many fields of agricultural economics.

How well economic techniques such as benefit-cost analysis can adequately represent the integrating features of epidemiology and attain an optimal solution or policy in its truest economic sense are important considerations in determining all facets of optimal decision making on control. An analysis of economic evaluation techniques is outlined in Murphy (1996b).

7. Notes

1. This eradication program is associated with other policies that prevent the introduction of the disease into the country by controlling the imports of meat products or other sources which might transmit the virus.

2. Sponsored by the OIE and the Federation of Asian Veterinary Associations (FAVA)

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