

# Managing transboundary animal disease

Jonathan Rushton, Anni McLeod and Juan Lubroth

Despite strenuous efforts, the control of transboundary animal diseases continues to elude livestock services in certain parts of the world. Good scientific progress has been made in the development and application of technologies and tools for control, including diagnostic tests, vaccines and remote sensing methods, as well as context-adapted disease investigation methods such as participatory epidemiology. However, the management of disease control in many countries lags behind the science. Controlling transboundary animal diseases (TADs) poses severe management challenges to veterinary services, since disease emergence and spread is affected by a range of social and environmental factors that are outside of the control of the state.

The veterinary service ideally provides leadership and carries out actions that complement and reinforce private sector activities and are appropriate to the epidemiological conditions. Controlling TADs requires from the government a strategy and operational plans (a national prevention plan and an emergency contingency plan) backed up by sufficient resources and an appropriate organisational structure and culture within the animal health system. Indicators of good management include: disease status that is accurately known; outbreaks occurring seldom and quickly controlled; and minimal costs to producers and government. Co-operation between producers and between the private sector and the government, as well as management of biosecurity in individual units, all contribute to good disease management.

Even the best leadership within the livestock

sector is limited by the national economic and institutional environment. Economic development, institutional systems and social factors such as increasing urbanisation and human mobility all impact on the spread of disease and the functioning of veterinary services. Governance of the country, manifested by indicators (World Bank, 2005) such as the rule of law, regulatory quality and control of corruption, as well as general government effectiveness, can be expected to affect the extent to which the veterinary service is able to develop effective disease control policies and implement regulations.

This paper examines the management of four major transboundary diseases on three continents: Classical Swine fever (CSF) and Foot-and-Mouth Disease (FMD) in Latin America, Contagious Bovine Pleuropneumonia (CBPP) in Africa and Highly Pathogenic Avian Influenza (HPAI) in South East Asia. The diseases affect cattle (CBPP), pigs (CSF), poultry (HPAI), and multiple species (FMD). They are found in countries with large livestock economies that are aggressively seeking export markets as well as countries whose livestock sectors do not satisfy their own protein demands. By reviewing successful and less successful attempts at control of these diseases, the paper identifies the economic and institutional conditions that must be met within and outside the veterinary service before a sustainable TAD management programme can be established.

## Disease status

### HPAI in South East Asia

Of the four diseases reviewed in this paper, HPAI has had the most recent and dramatic impact on a global scale. Although strains of avian influenza circulate regularly in poultry and wild birds with relatively mild effects, the H5N1 strains that recently emerged in Asia created serious economic impacts on the poultry sector and in some cases the general economies of the countries affected.

As well as causing high rates of mortality in chickens, HPAI can cause mortality in humans. At the time of writing, 122 human cases and 62 deaths were known to the World Health Organisation (WHO). Most cases to date could be attributed to the direct transmission of the virus from poultry or raw poultry products to humans, but there was a great concern that reassortment with human influenza might result in a global pandemic, with disease spreading from human to human.

In 1997, 2001 and 2002, outbreaks were reported in Hong Kong, SAR China, but the country has been free of clinical disease since 2002. More recently, outbreaks of H5N1 were reported in 2004 and 2005 from Cambodia, China, Indonesia, Japan, Lao PDR, Malaysia, South Korea, Thailand and Viet Nam. Although progress has been made in containing HPAI, cases are still occurring, notably in Viet Nam, Thailand and Indonesia and occasionally in other countries in East and South East Asia. At the time of writing, the disease was spreading across central Asia and into Europe, probably introduced by migratory birds.

In Cambodia and Lao PDR, the poultry economies are dominated by backyard producers. Neither country was involved in formal poultry exports prior to the HPAI epidemic. HPAI had a very minor impact in Cambodia in terms of direct

poultry deaths and control measures of stamping out, but a negative impact on egg and poultry meat markets, including chickens and ducks. In Lao PDR, HPAI had a major impact in the small commercial chicken layer and quail systems in the province of Vientiane Prefecture.

In Indonesia it was reported that the most important impact was on the small-scale commercial producers. Indonesia has a heavily protected poultry industry (Fabiosa *et al*, 2004) with a high proportion of its production in large industrial systems and in smaller commercial systems. In addition there are a large number of backyard producers. Indonesia has not been an important exporter, but it has a growing domestic demand for poultry meat, which provides the cheapest form of animal protein. Currently, vaccination is compulsory. Commercial producers finance and organise it themselves, while only limited vaccine coverage is maintained in backyard systems.

Thailand was the fifth largest poultry meat exporter in the world before 2003 (FAOSTAT data). It suffered a severe drop in export values in 2004 and has now switched to processed products. A large proportion of the Thai poultry population and production are in the industrial system, although the majority of its producers are small scale. While outbreaks are still being reported,

#### POULTRY SYSTEMS IN FIVE SOUTH EAST ASIAN COUNTRIES AFFECTED BY HPAI IN 2003-5

Country	Industrial	Large commercial	Small commercial	Backyard
Cambodia		<1% poultry	<1% poultry	99.9% farms, 90% poultry
Indonesia	3.5% poultry, export & national consumption	21.2% poultry	11.8% poultry	63.4% poultry
Lao PDR		Small	10% poultry	90% poultry
Thailand	70% production, export important	20% production	10% production, 98+% producers	
Viet Nam	Small	20-25% production, few producers	10-15% production, few producers	65% production, possibly 70% of poultry

Source: adapted from Rushton *et al*. (2005).

PHOTO: A. MCLEOD



Duck herding in Vietnam

they are few in number and generally quickly controlled. The herded duck systems associated with paddy rice production pose a particular danger since ducks can carry the virus without showing clinical signs. Thailand prohibits vaccination. The government and private sector are assessing the use of compartmentalisation as part of the national disease control strategy, the only country in the region where this approach is seriously being considered.

Viet Nam has experienced continuing outbreaks in 2004 and 2005, although, like Thailand, the speed of outbreak control has been increasing and the number of birds dead or culled was considerably reduced in 2005 compared to 2004. The poultry economy is dominated by backyard systems, in terms of production and the number of producers, but there are emerging large commercial systems. Herded duck systems are found in and close to the two main river deltas. There has been a steadily growing domestic demand for poultry meat and some official exports were reported prior to the outbreaks. The HPAI impact on the backyard systems in Viet Nam was very severe, with high mortality rates in affected flocks (Dolberg, 2004).

### CSF and FMD in Latin America

CSF is being pushed back in Latin America to geographically circumscribed areas. FMD has also been pushed back to a certain extent, but outbreaks in recent years in certain countries of Latin America show that progress is fragile.

Both diseases threaten the export of livestock and livestock products, and constitute a major concern for commercial producers in the Southern Cone<sup>1</sup> of Latin America, where a large proportion of cattle and pigs are found in extensive commercial systems. The majority of countries in the Southern Cone have managed to attain free status from both CSF and FMD, although FMD freedom was temporarily upset by outbreaks in 2000 and 2001 in Argentina, Brazil and Uruguay. Paraguay has maintained FMD free status with vaccination, but is one of the poorest countries in South America and has a weak disease control infrastructure. In Brazil problems continue to exist.

The Andean and Caribbean countries, by contrast, mostly have low numbers of livestock units

<sup>1</sup> The southernmost areas of Latin America, including Argentina, Chile, Uruguay, Paraguay and Southeastern Brazil.

(LSUs) per person, and rely on intensive monogastric systems to satisfy protein demand. They also have a significant proportion of LSUs from sheep and camelids. CSF is more problematic than FMD

in these countries for two reasons: the majority of the pig population is found in backyard smallholder systems that are difficult to reach with existing veterinary delivery services, and most countries, with the exception of Colombia, have not yet mounted serious campaigns for the eradication of the disease (Viscarra and Rushton, 2004).

Central America has relatively few LSUs per person, and it contains some of the smallest economies and poorest countries in Latin America. Central America has never had FMD. With assistance from the Organismo Internacional

**CSF STATUS IN LATIN AMERICA, 2004**



Source: Rushton and Viscarra, 2004

**LIVESTOCK UNITS IN SOUTH AMERICA**

Livestock Units per km<sup>2</sup>



Livestock Units per person



Source: Rushton and Viscarra, 2004

**FMD STATUS IN LATIN AMERICA, SEPTEMBER 2005**



Source: Rushton and Viscarra, 2004

Regional de Sanidad Agropecuario (OIRSA) and FAO, some success has been seen in the control and eradication of CSF.

Mexico is large in terms of geographic size, population and economy, but with few LSUs per head. It is also a country of tremendous diversity with numerous livestock producers in the northern States and the Yucatan Peninsula who maintain large ranches and large intensive pig production units. These large-scale commercial producers have been successful in controlling and eradicating CSF, but the country faces challenges with the eradication programmes for CSF, particularly in areas where there are commercial producers near to backyard systems. The country has been free of FMD since 1954.

### CBPP in Eastern and Southern Africa

Levels of CBPP control have fluctuated across Eastern and Southern Africa over the past 50 years, but this disease has become more problematic in these regions in the last 10 years. CBPP has been repeatedly mentioned as important to the success of African livestock production (Provost and Davies, 1996; Roeder and Rweyemamu, 1995; Windsor and Wood, 1998), although studies to confirm its importance are few (Twinamasiko, 2002) and analysis of the official data submitted to the World Organisation for Animal Health (OIE) indicate that in an eight year period between 1996 and 2003 only 48,748 cattle either died or were sacrificed in order to stop its spread.

The livestock economies in Eastern and Southern Africa are dominated by cattle, with over 90% found in pastoral, semi-arid, subhumid and highland mixed systems (Otte and Chilonda, 2002). In the pastoral areas livestock are critical to the livelihoods of producers, but in the mixed systems they are often a secondary activity that in many areas is well integrated into the general farming system. In terms of importance to the general society, there are relatively few LSUs per person in all countries of the region except Sudan, Botswana and Namibia. In addition, the consumption

of meat and milk is relatively low in all countries except Botswana and Namibia for meat and Sudan, Somalia and Kenya for milk. Tambi and Maina (2003) report that livestock productivity is low and that while beef production has increased it has come from cattle population increases. In the case of Southern Africa there has been a reduction in overall productivity. Botswana, Namibia (and formerly Zimbabwe) export to the EU while other countries engage in regional trade to varying degrees.

In East Africa, CBPP is important in southern Sudan, Tanzania and in drier areas of Uganda and Kenya inhabited by pastoralist livestock keepers. It was eradicated in Tanzania in 1964, reappeared in 1990 and subsequently spread across much of the country, causing the death of some 350,000 cattle in a ten year period (Kusiluka and Sudi, 2003). In the pastoral production systems of Western Uganda, Twinamasiko (2002) found that in high prevalence herds the majority of the disease occurrences (77%) were due to CBPP, but in the general population only 13% of the disease occurrences were due to CBPP. In pastoralist herds in Tanzania, AU/IBAR (2002) learned that the disease would enter a herd and cause high mortality in the first year and then sporadic mortality in subsequent years. CBPP is defined as either the first or second most important disease in pastoral systems of the Masai and Afar and ranked as second or third in importance by the agropastoralists in Ethiopia (Bonnet, personal communication). However, it is reported to be sporadic and of limited importance in the drier areas of northern Sudan and north-eastern Kenya (Mariner, personal communication), although in herds that experience the disease, losses can be very high.

In Southern Africa, southern Angola has been associated with harbouring the disease and being a source of infection for neighbouring countries. Cattle movement was particularly important in its spread during the heavy periods of the civil war which ended in 2004. Botswana experienced a serious CBPP outbreak in 1995 that halted

**OUTBREAKS OF CBPP REPORTED IN EASTERN AND SOUTHERN AFRICA BETWEEN 1996 AND 2003**

Year	Eastern Africa			Southern Africa		
	Outbreaks	Cases	Deaths	Outbreaks	Cases	Deaths
1996	105	1,567	717	97	3,951	2,657
1997	89	2,454	777	66	4,226	252
1998	133	6,642	3,726	12	560	127
1999	283	11,188	3,773	4	15	2
2000	188	3,029	1,429	18	514	167
2001	224	8,878	4,139	9	41	17
2002	236	11,064	2,197	171	934	424
2003	218	7,349	1,388	106	7,966	4,128
<b>Total</b>	<b>1,476</b>	<b>52,171</b>	<b>18,146</b>	<b>483</b>	<b>18,207</b>	<b>7,774</b>

Source: OIE, 2005

exports and ended with the destruction of 320,000 cattle. CBPP impact and control measures appear strongest in Kenya, Tanzania, and Namibia followed by Ethiopia, Uganda and Zambia. Botswana has been free since 1995, Zimbabwe last reported the disease in 1904, with Malawi and Mozambique have never reported it.

## Disease management

### HPAI in South East Asia

Prior to 2004, HPAI was controlled at the sub-national level in the USA (1983), Italy (2000) and Chile (2001). However, the large-scale occurrence of HPAI in Asia due to H5N1 and H5N2 viruses in 2003-2005 represents a challenge. Among Asian countries/regions that have recently experienced HPAI outbreaks, Hong Kong, SAR China and Malaysia stand out for successful management of the disease, with Thailand making good progress in spite of initially serious outbreaks. In all three of these countries, disease management has been carried out entirely or substantially without external financial support.

Hong Kong, SAR China, is an interesting case in that, while poultry are important to the local economy and domestic consumption, export is minimal, and most production takes place on

small commercial farms. The outbreak in 1997 was controlled by culling of all chickens in the country. When disease returned in 2001, mass culling was not repeated. There was a strong economic and social incentive for the government, poultry producers and market stallholders to find an alternative approach. A disease management plan was developed, based on farm and market biosecurity, surveillance and compulsory vaccination for all but very small flocks (Wong, 2005). It is jointly funded by the public and private sectors and very strictly enforced (for example, if a market stallholder fails to observe compulsory "rest days" their licence is permanently removed). Since 2002 the country has been free of disease. The national animal health institutions are stable, and quite well funded from an economy with a strong tax base, and the country scores highly on rule of law, regulatory quality and control of corruption (World Bank, 2005).

Malaysia had only a single outbreak, which it rapidly controlled by culling and disinfection of premises and strict movement controls in the infected area. There was a considerable incentive and pressure from commercial producers not to lose the export market, and a concern that presence of HPAI would damage tourism. The animal health service is stable, well organised and rela-

tively well funded, it has well established policies and disease control regulations, and funds were quickly made available to deal with the outbreak. Malaysia, like Hong Kong SAR China, scores highly on governance indicators.

In Thailand, poultry export is important to the economy, although the agricultural sector is not large, and the major producers and exporters work in partnership with the government. Zoonotic disease emerging from the livestock sector is a threat to tourism as well as to general human health. Over approximately 18 months, the country has considerably reduced the number of outbreaks. In an attempt to eradicate the disease without vaccination there has been an increased speed of response to new outbreaks and an active surveillance programme has been initiated based on clinical inspection of all poultry operation. The country's interest in compartmentalization is partly driven by the need to find a solution that accommodates the needs of both the exporters and the large number of smallholder farmers who keep poultry (FAO TCP and staff mission reports, 2004). Thailand's government is stable, its public service generally effective and the society is generally law abiding.

Viet Nam and Indonesia share the benefit of growing domestic demand for poultry (at least, prior to HPAI) and the challenge of decentralised government systems. In Indonesia, decentralisation is especially pronounced with decisions at district level having a major influence on the execution of national plans. Compulsory vaccination was introduced partly to reduce the need for compensation, and has been funded and organised in commercial flocks by the producers, leading to some success in controlling clinical disease. Commercial producers are many in number and fairly well organised, with producer associations. However, funds for vaccination of backyard flocks, surveillance or compensation are very limited. Issues relating to vaccine quality in Indonesia remain unresolved to date. Viet Nam also has a decentralised government with fund-

ing decisions made at both central and provincial level, but a large proportion of finance for HPAI control in 2004 came from the central government (Riviere-Cinamond, 2005). Funds for disease control, especially compensation of small producers, are limited, and the government has recently reviewed its compensation policy to try to address this problem. Although domestic demand and the commercial poultry sector are growing, there are still relatively few commercial poultry producers.

Most of the countries affected by HPAI have a large proportion of their poultry in backyard systems where there is private ownership of the birds, but these animals are using communally owned land. Therefore there are no clear boundaries in land use and frequent mixing of birds from different flocks.

There is a need for information on regional movements of birds and poultry products, in order to plan regional strategies of control (at the time of going to press, efforts to this end were accelerating, driven by the need to understand the consequences of wild bird migration). At present it would appear imperative to implement regionally supported campaigns to eradicate HPAI in countries that export poultry and/or poultry products (legally or informally) in order to eliminate the risk of continued movement of the disease to neighbouring countries. Such eradication efforts, combined with the need for the poor or middle income countries affected by HPAI to take on international responsibilities in order to reduce the risks of a human influenza pandemic (WHO, 2004a; 2004b), deserve consideration for regional or international finance, as proposed by FAO and OIE.

### **FMD and CSF in Latin America.**

Effective management of FMD and CSF can be found in the southern cone of Latin America and Brazil. Here, cattle and pig production has a high importance for GDP and export earnings. Meat consumption is high at 77 kg/caput/year in Brazil and 89 kg in the Southern Cone, and the region contains major world meat exporters. The

livestock sector is dominated by commercial systems with very strong producer associations and aggressive systems of marketing, supported by government state veterinary services, especially when lobbied by organised producer groups. The exception is Paraguay. Although the economies of the biggest countries have experienced problems, they are growing, with a relatively large tax base, and government institutions are predominantly stable, although only Chile and Uruguay score very highly on governance indicators. Disease control policies and guidelines are well established and regularly reviewed. Success in managing FMD and CSF has been built on a strong collaboration between the private sector and the governments. Dubois and Moura (2004) estimated that in Brazil between 1992 and 2003 for every dollar spent by the state on the control of FMD US\$2.66 were invested by the private sector. The private investments are primarily in vaccines, but significant contributions are also made to salaries and to an eradication fund. FMD was very difficult to control during the periods of high inflation as cattle were used as a hedge. This did not encourage medium to long term cattle health management and also meant that movements were difficult to predict. The big challenge for this region in the future is the maintenance of FMD and CSF disease freedom (Rushton, 2004).

The Andean and Caribbean countries, by contrast, are some of the poorest countries in South America with low GDP per caput and a small tax base bolstered by aid receipts and tax revenues from the export of non-renewable resources. The livestock sector is not of great importance to the overall national economies of these countries and investment in livestock services and disease control has been limited. This region includes some of the weakest governments with pressures on representation from indigenous populations, problems of controlling drug production, and, in the case of Colombia an ongoing civil war. Despite these difficulties there have been significant advances in the control of FMD, which over

the last five years appears to have largely been controlled and potentially eradicated in some zones. It would also appear that the commercial sectors in these countries are free of CSF. Some of this success has been helped by regional collaborations. In the case of Colombia there has been strong private/public sector partnership with the national FMD campaign being largely financed and implemented by FEDEGAN, the private sector livestock association. Money is raised through levies placed on sales of cattle and animal products and national plans are formulated with the official veterinary service within the Instituto Colombiano Agropecuario (ICA). It is ICA's responsibility to oversee that the actions taken correspond to the general national plan. The success of the partnership can be demonstrated by the high vaccine coverage in Colombia surpassing 95% in most areas and only two limited outbreaks since 2002.

Central America contains some of the smallest economies and poorest countries in Latin America. However with the help of the United States and the formation of a regional animal health network (OIRSA) these countries have created a system where money can be raised through levies to support animal and plant health control programmes. Central America is free of FMD. OIRSA and FAO have worked closely and with some success in the control and eradication of CSF. Veterinary services of the region have undergone profound changes in the aftermath of imposed government restructuring programmes from international loaning bodies, leaving them weakened and limited in operational capability. Creative mechanisms to finance campaigns have emerged in attempts to fill resource gaps independent of typical donor or international organisation contributions. Belize has an interesting example of having created an organisation to run its animal and plant health activities (BAHA<sup>2</sup>) that is funded in part by the government and by

<sup>2</sup> Belize Agricultural Health Authority



user fees, and is controlled by a board of directors from the public and private sectors (Rushton, 2003). The institution was expected to be run at a profit, and its financing arrangement had fostered a strong link between BAHA and the commercial poultry and cattle farmers. However, the recent problems of the Belize government to meet its fiscal debt could jeopardise this system.

In Mexico, large scale commercial producers in the northern States and the Yucatan Peninsula have been successful in controlling and eradicating CSF and as a consequence have gained benefits in terms of export markets to the USA and to Japan. However, the country as a whole faces challenges with the eradication programmes for CSF, particularly in areas with a large proportion of producers and production in backyard systems. The recent decentralisation process has increased these challenges by giving the budgets for field actions to the states, but leaving the federal government with animal health control responsibilities (Ayala *et al.* 2004). What is interesting is that many of the successes in animal disease control in Mexico have been led by either the private sector and/or an external country working with the country (i.e., New World screwworm). In general, the country has good regulatory policies and a reasonably effective public service.

The control and eradication of FMD and CSF are most difficult in areas where the cattle are in extensive systems and pigs are in backyard systems. In both cases the animals are privately owned, but the land is either communally managed or boundaries between herds and land are not clear, allowing the mixing of herds and flocks. These problems have been overcome in the majority of Latin America in the control of FMD through strong coordination between the private and public sector. However, the 2001 FMD epidemic in Argentina, Uruguay and Paraguay demonstrated the fragility of its control. With CSF a number of countries have run successful eradication campaigns again through strong coordination between public and private sectors.

This disease remains a problem in countries with weak governments and private sectors and where a high proportion of pigs are in backyard systems.

### **CBPP in Eastern and Southern Africa**

The livestock sectors of Botswana and Namibia stand out as exporters that also have moderately high domestic meat consumption (26 kg/caput/year in Botswana and 56 in Namibia) and strong commercial players. These two countries are also the richest in terms of GDP per caput in the region. Relative to other countries in the region they have a reasonable tax base, generated mostly from non-renewable natural resources, although none of the economies in the region is growing rapidly. They also have stable animal health institutions and well established disease control policies, and, with South Africa, they score highly on governance indicators. To counter the threat of diseases including CBPP from neighbours, Namibia maintains a surveillance and vaccination zone with a fence in the northern part of the country. Botswana has a free zone bounded by fences. When CBPP was detected in 1995, Botswana took drastic action by slaughtering 320,000 cattle in order to eradicate the disease and retain its access to the lucrative, export market. However, the impacts of these control measures have been widespread due to links between the livestock sector and other sectors of the economy (Townsend *et al.*, 1998) and these impacts continue with some producers still unable to find an alternative to cattle raising (Mullins, 2000).

Economies with weak and in some cases negative growth, governments with weak tax bases and limited government investment in veterinary education have all contributed to a low capacity for control of TADs including CBPP. Crises in government financing in the 1980s led to the sudden and often poorly implemented and understood privatisation of veterinary services in many African countries after years of state subsidised services. Financing of animal health has been

### LIVESTOCK UNITS PER VETERINARIAN, VETERINARY SCHOOL AND VETERINARY GRADUATE IN THE DIFFERENT CONTINENTS OF THE WORLD

Continent	LSUs per veterinarian in the:			LSUs per	
	Public sector	Private sector	Total	Veterinary School	Graduates in 2002
Africa	12,758	11,058	5,924	3,957,069	64,343
America	12,852	2,984	2,421	1,850,810	35,365
Asia	4,869	3,635	2,081	2,288,854	48,032
Europe	3,170	1,888	1,183	1,893,605	21,040

Source: data from Moura *et al.* (2004), analysis by the authors

dominated by international aid. Some countries in the region have suffered some of the bloodiest conflicts of the last 20 years. Therefore, it is hardly surprising that CBPP control has not been consistently applied and there have been reappearances of this disease in countries that had been free for many years.

This same premise would hold true for other epidemic diseases that affect the success and sustainability of livestock production. The cascade effect on the poor and in some cases falling livestock productivity in these regions (Otte and Chilonda, 2002; Tambi and Maina, 2003) is worrisome. Rather than investing in animal health to support disease control and encourage the adoption of improved management practices, the figures on the number of veterinary schools and graduates per livestock unit in the continent underline the inadequate investment in key livestock professionals, which continues to be below the worldwide trend. CBPP appears to be a particular problem in areas where cattle are in extensive systems, where there is private ownership of animals, but communal management of land. Herds are allowed to mix and there is much movement relating to seasonal availability of pasture. These movements have been disturbed in a number of areas due to social strife.

Since the early 1990s, livestock owners have used antibiotics to cure and prevent clinical CBPP, even when they were not licensed for this use. There has been controversy over antibiotic

use because of concerns that animals treated with antibiotics might develop a carrier status, creating a situation where mortality was reduced but the disease could continue to spread. Nevertheless, livestock owners have continued to use antibiotics (AU/IBAR, 2002; Twinamasiko, 200), most commonly tetracyclines as they are widely available.

There have been limited concerted interventions against CBPP. Although control of the disease has been noted as important to the success of African livestock production (Provost and Davies, 1996; Roeder and Rweyemamu, 1995; Windsor and Wood, 1998), only in exporting countries is there a sufficiently strong economic incentive to establish well-funded TAD prevention measures. Twinamasiko (2002) proposed that different parts of Uganda, with different epidemiological conditions, might be treated differently for CBPP control, which could be regarded as a public good in areas with epidemic disease and as a private good in areas where the disease is endemic. Moreover, the possibility of using antibiotic as a control measure offers livestock owners in endemic areas an alternative to participating in mass vaccination campaigns. Between 1996 and 2003 only 33.8 million cattle are reported to have been vaccinated, representing 3.38% of animal years. It is recognised that control programmes will need to include vaccination, with vaccine made widely available, and antibiotic treatment (FAO-OIE-AU/IBAR-IAEA, 2003).

### Economic and institutional requirements for effective disease management

Only countries with a healthy GDP and tax base have the financial foundation from which to carry out TAD control on a sustainable basis. The political will to control disease usually flows from commercial pressure. When the livestock sector makes an important contribution to GDP and export earnings, and the commercial operators are strong and well organised and have an effective working relationship with the government, the private sector encourages government ministries to plan and support effective disease management, and then contributes to their financing. Additional pressure is applied when the health of the livestock sector has a demonstrable effect on the economic health of other sectors such as tourism.

Equally important are the indicators of governance within the economy, such as rule of law and strong deterrents against corruption. It is impossible to enforce movement control or import regulations if public servants can be bribed. Governance is also about the ability to formulate acceptable policies. Farmers will be reluctant to report disease where an adequate compensation scheme does not exist, or where they receive conflicting messages from central and local government. Both of these conditions hampered reporting of HPAI in 2003 and 2004. Government level commitment to international norms is equally important. The majority of the major TADs outbreaks in the past few years have been characterised by late and incomplete reporting to the OIE. Commitment to international norms at government level sends a message about the principles of accountability and transparency of actions to the people which is strengthened when funds for livestock disease control are also managed transparently and accountably. Effective fiscal management is essential when disease control may require rapid access to emergency funds and when the private sector directly contributes to funds such as animal health trusts.

Countries with widely dispersed livestock systems and/or livestock kept on publicly owned land face particular challenges. Costs of control are much higher when animals are widely dispersed, live in remote areas, follow transhumant grazing patterns or roam freely within villages. When they are kept on publicly owned land, the private returns to transboundary disease control are lower and less easily captured and the incentive of livestock keepers to participate in government vaccination campaigns or observe movement control regulations are fewer. This problem is particularly acute in rural Africa, where vaccination programmes against CBPP achieve very low coverage in pastoralist areas. The scavenging pigs and poultry of Latin America and Asia are also difficult to fit into programmes for preventing CSF and HPAI, or other public health problems.

While veterinary services cannot control the conditions of the wider economy, they have at least some power over their own management, and can choose to be innovative.

- Dialogue and co-operation with stakeholders is essential for the design of enforceable regulations. Concern about loss of livelihood leads people to sell sick animals rather than report them (observed during HPAI and CSF outbreaks when compensation was uncertain) or to refuse to vaccinate (e.g. the 28 day withholding period for certain HPAI vaccines makes farmers reluctant to vaccinate broilers which will be sold before the withholding period has expired). Concern for the health or appearance of animals leads owners to refuse to vaccinate (e.g. against CBPP, when it was feared that the tail would be damaged). Enforcing “rest days” in markets can reduce the livelihood of stallholders unless provision is made for them to earn additional income at other times. Restricting the use of vaccine to mass campaigns can, for many reasons, reduce coverage. However, innovative approaches can be effective. In some provinces of Viet Nam, making CSF vaccine available at all times through local animal health systems

has increased its use. Colombia, in the face of a civil war, has managed to achieve high FMD vaccination coverage by means of a private/public sector partnership. The continued use of antibiotics against CBPP by livestock keepers in the face of government disapproval suggest a need to consider situation-specific solutions, applying different approaches in endemic and epidemic situations.

- Many opportunities exist for government services to work with NGOs and civil society. For example, it is well documented that veterinary services, either state or private, have difficulties reaching poorer producers (Ahuja *et al*, 2003). This can be a problem where these systems provide a continuous pocket of naïve animals to TADs. Education and outreach are often designed as mass campaigns, yet experience in the livestock and human health sectors and in other sectors shows that a long term process of stakeholder engagement is necessary to change human behaviour. Examples of innovative approaches to outreach include the use of participatory epidemiology (Mariner, 2001; Rushton & Viscarra, 2003) for disease surveillance in Africa, Pakistan and Bolivia, and improving biosecurity in wet markets in Hong Kong, SAR China, The Philippines and Malaysia.
- Veterinary services have the opportunity to encourage collaboration between large scale commercial operators and small scale farmers. In Mexico it has been reported that commercial poultry systems finance veterinary services in order to provide Newcastle disease vaccination for the backyard producers in their vicinity (G. Ayala personal communication). In Chile the control and eradication of CSF was due in part to the coordination of the commercial and the small scale pig owners. In the cattle sector, the control of FMD in many South American countries has only been achieved with investment and implementation by the livestock owners.
- Decentralisation of veterinary services, while it offers the possibility of services oriented to local needs, also poses a considerable challenge for financing and management of TAD control. The problems are not insurmountable (the USA, for example, has a decentralised veterinary service) but they do require a “federal” or central level of control and funding, in emergencies, that overrides the usual decentralised operation. Most countries have this in principle, many find it hard to operate in practice. They also, and this has received less attention, need a mechanism for negotiating agreed norms for longer term activities such as surveillance, emergency warning and preventive vaccination.
- Novel financing mechanisms may assist compensation/insurance schemes to be implemented for lower income countries, but trust in payment and accountability processes will be a major challenge. The most successful financing processes usually involve a partnership between the public and private sectors (Dubois and Moura, 2004). This recognises that disease control actions generate both private and public goods (Leonard, 2000). The review of financing of disease control measures in Europe by van Asseldonk *et al* (in press) clearly demonstrates that no one model is appropriate in all situations. Some control programmes are beyond the means of national governments, and if the disease being controlled is of international concern for zoonotic or poverty alleviation reasons, there are strong arguments for concerted international support.
- Increasing the capacity for rapid response is essential, particularly when a control programme relies on disease reporting without vaccination, rather than widespread vaccination. A number of approaches have been piloted to improve emergency reporting (participatory epidemiology among pastoralists in Africa, community animal worker networks in Asia). They will only be successful in the long

term if reporting results in rapid (and helpful) response. Capacity of veterinary services to respond is based on well-designed policies and operational plans for emergency response, as well as sufficient trained staff within the animal health system. Increasingly, contracting of private sector animal health practitioners will be the most effective and cost-efficient way to conduct public sector activities and at the same time to encourage the development of the private service. Most of the veterinarians involved in controlling the last FMD outbreak in the UK were from the private sector, from several countries. Para-professionals have taken part in vaccination campaigns in Indonesia and recently in Viet Nam.

- The approaches proposed above will be most effective when the core of the system, the government veterinary service, is institutionally stable and supported by a strong professional drive and up to date training. A number of management “drivers” are important, such as competitive salaries and meritocracy. A monitoring system based on appropriate indicators is also needed to measure progress, and a review of the appropriate indicators would be timely. For example, the focus for preventive vaccination invariably is on numbers of animals vaccinated (coverage) rather than whether the animals vaccinated are in key endemic areas or during the appropriate season. One indicator for a good surveillance system might be a large number of false positives, and this would also indicate the development of an open reporting culture.
- Regional co-ordination of various kinds (harmonising regulations, co-operative disease control activities, sharing information, joint funding) has considerable potential to enhance the above initiatives. Although in most cases regional co-ordination is not well established for disease control, the few successful examples that exist suggest that this is an approach

needing to be exploited. Mexico and the USA have a long history of plant and animal health collaboration which has achieved the eradication of FMD and screwworm and has made important advances in the control of CSF, tuberculosis, brucellosis, and Mediterranean fruit fly. Regional co-ordinations are also being carried out in the control of FMD with Argentina and Brazil working alongside Paraguay and Bolivia. It is hoped that these types of collaborations will be implemented in the control of HPAI in Asia, where embryonic initiatives exist within ASEAN and in the Mekong Delta and networks have been supported by FAO that may in time lead to formal co-ordinated action. East Africa is exploring harmonisation of disease control regulations through its regional trading groups, with a view to improving regional trade and eventually developing more stable export markets.

### Conclusion

Effective TAD management is possible, and has been achieved by several of the countries reviewed here, across all of the regions and diseases included in the review. It is, however, highly dependant on national governance and political support.

Political will flows from commercial pressure. A country with a strong commercial sector, operating within a livestock sector that is important to GDP and export, is more likely to have political commitment to TAD control than one with a weak economy, poor tax base and poorly organised producers.

The institutional conditions supporting disease control activities stem from national governance, including the rule of law, prevention of corruption and the ability to formulate effective policies.

With or without favourable national economic and institutional conditions, veterinary services have the choice to improve their own leadership and management. It is within the control of a vet-

erinary service to develop a TAD control strategy and operational plans (a national prevention plan and an emergency contingency plan). It is also within the veterinary service mandate to lobby for financial and human resources, and to deploy those available as effectively as possible. The veterinary services reviewed in this paper do not all operate under ideal conditions, yet some of them have managed to introduce innovative ideas and achieve good results.

An effective management system includes a good performance monitoring system with appropriate performance indicators. Outcome indicators suggested in this paper are: disease status that is accurately known; outbreaks occurring seldom and quickly controlled; and minimal costs to producers and government. To these might be added capacity indicators such as: a strong relationship with commercial operators, NGOs and civil society; mechanisms for overcoming the constraints to TAD control posed by decentralisation; innovative financing mechanisms backed up by accountability and transparency; continued development of professionals in public and private service; and strong regional networks. Many veterinary services around the world work to such indicators; it is time for a review of those used in developing countries.

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