Rev. sci. tech. Off. int. Epiz., 2002, **21** (3), 645-661

The economic impact of foot and mouth disease control and eradication in the Philippines

T.F. Randolph [1], B.D. Perry [1], C.C. Benigno [2], I.J. Santos [2], A.L. Agbayani [3], P. Coleman [4], R. Webb [5] & L.J. Gleeson [6]

(1) International Livestock Research Institute (ILRI), P.O. Box 30709, Nairobi, Kenya
(2) National FMD Task Force, Bureau of Animal Industry, Visayas Avenue, Diliman, Quezon City, Philippines
(3) Phil-Canada LGSP, 2/F Diel Comm Building, Carmen, Cagayan de Oro City, Philippines
(4) London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, United Kingdom
(5) P.O. Box 2244, Orange, NSW 2800, Australia
(6) Commonwealth Scientific and Industrial Research Organisation (Australia) (CSIRO) Livestock Industries, Australian Animal Health Laboratory, Private Bag 24, Geelong, VIC 3220, Australia

Summary

The authors evaluate the impact of foot and mouth disease (FMD) and control of the disease in the Philippines using cost-benefit analysis. A scenario in which FMD control is maintained at recent levels with continued presence of the disease is compared to scenarios in which a publicly funded programme achieves eradication by 2005 (current policy objective), 2007 and 2010. Under varying assumptions regarding the development of exports of livestock products following eradication, estimated benefit-cost ratios for the investment in eradication range from 1.6 (2010, no exports) to 12.0 (2005, export of 5,000 tonnes each of low-value and high-value livestock products annually), indicating eradication to be an economically viable investment. The commercial swine sector is estimated to capture 84% of the benefits generated by the public investment in eradication, versus 4% by backyard swine producers. The implications of these results within the context of regional efforts to control FMD in South-East Asia are explored.

Keywords

Animal health – Cost-benefit analysis – Disease control – Economic impact assessment – Economics – Eradication – Foot and mouth disease – Policy analysis – South-East Asia – The Philippines.

Introduction

As incomes increase in South-East Asia, demand for livestock products is growing rapidly, creating part of the so-called global 'livestock revolution' (2). Per capita meat consumption in the region, which rose from 11 kg in 1983 to 18 kg in 1997, is predicted to continue rising, reaching 29 kg by 2020 (3). Although much of this increase in demand is being met by higher production levels within each country, there may be opportunities for countries to capitalise on their comparative and competitive advantages to develop export trade of certain livestock products. Additional incentives are being provided by the liberalisation of trade and reduction of tariff barriers started under the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) and on-going under the World Trade Organization (WTO) (7). These trends promise improved access, in particular to traditionally heavily protected high-value markets. However, to be acceptable to importing countries, livestock exports are increasingly required to meet a range of stringent animal health and sanitary standards as permitted under the 1994 Agreement on Sanitary and Phytosanitary Measures. Typically, a pre-condition to developing export trade in livestock products is establishing freedom from the Office International des Epizooties (OIE: World organisation for animal health) List A diseases, especially foot and mouth disease (FMD), in the exporting country.

© OIE - 2002

In this context, countries in South-East Asia have shown renewed interest in controlling and eradicating FMD. Responding to this, a Regional Coordination Unit (RCU) to promote improved control of FMD was established by the OIE in Bangkok, Thailand in late 1997. Among the activities of the RCU, and with funding from the Government of Switzerland, a pilot study of the economic impact of FMD in the region was initiated. The results of the study are intended to help guide future investments in FMD control and eradication within the region. The first case study evaluated FMD control policies in Thailand, as reported previously in this journal (11). This was followed by a second case study initiated by the Head of the National FMD Task Force in the Philippines, with support from a research team of the International Livestock Research Institute (ILRI) and the RCU. This paper presents the results of the Philippines case study.

Foot and mouth disease and control of the disease in the Philippines

Foot and mouth disease has been endemic in the Philippines at least since the beginning of the century when the disease was introduced with cattle imported from Hong Kong in 1902. During the years prior to the Second World War, the disease was recorded virtually every year, but only in ruminants. During the Second World War, the livestock population declined significantly, and FMD was reintroduced during the restocking process in 1952. The first outbreak in pigs was recorded in 1955. The disease possibly reached a peak during the 1970s, prompting the first economic impact assessment (1), and the introduction of more intensive vaccination programmes. Prior to 1975, less than 1% of the animals at risk were reportedly vaccinated.

The disease pattern of FMD has changed over the years, possibly influenced by the introduction and spread of different virus serotypes. The country recognises the presence of serotypes A, O and C. Serotype A was responsible for epidemics in the 1970s, but has not been identified since 1990. Serotype C was also introduced in the mid-1970s, reportedly in a vaccine importation from South America. This serotype has not been isolated from clinical cases in recent years, but there is some serological evidence of continued presence of serotype C in the country. Serotype O has been arguably the most prevalent, first identified in the country in 1952. A different subtype of O appears to have been introduced in late 1994, and this is highly specific to pigs, causing high piglet mortality, abortions and infertility. To illustrate this, there were approximately 98,000 pigs affected in 1995, compared to 200 carabao (*Bubalus bubalis*), whereas in 1975, there were reportedly 55,000 carabao and 9,000 pigs affected.

There is considerable variation in the geographical distribution of FMD in the Philippines. This has been one of the driving forces in developing disease-free zones in the country, based on the fact that the country is comprised of a series of islands, separated from other neighbouring countries by water. As a general rule, FMD has occurred with high incidence in the northern island of Luzon, in parts of which the disease remains endemic, and low incidence elsewhere, particularly in the southern island of Mindanao. The disease has never been reported in 38 of the 43 provinces across the southern island groupings of Mindanao, Visayas and Palawan. However, there is considerable movement of people between the islands, and this is increasing with economic growth and development. There is a tradition of the carriage of meat, particularly pork products offered as gifts when visiting friends and relatives, as well as the transport of meat products to tourist destinations (such as on the island of Cebu).

The control of FMD in the Philippines initiated in the 1970s was based on vaccination of all susceptible animals, supported to a lesser degree by movement control and other measures. For many years, a practice of mass vaccination appears to have been applied, although there is little documentary evidence available, and the programme seems to have varied considerably in intensity and effectiveness of application. In 1996, a new official Government strategy was launched, which broadened the range of control measures to be applied and modified the vaccination programme. The strategy has three phases (1996-1998, 1999-2002 and 2003-2004) of increasing control until complete freedom from FMD can be declared nationally, and comprises four components, namely: disease monitoring and surveillance (including laboratory support), information and education, animal movement management and vaccination. The key elements of the strategy were to increase the monitoring and surveillance of the disease and of the areas in which eradication had been achieved, enhance the control of animal movement through the introduction of checkpoints, modify the vaccination from 'blanket' vaccination to 'strategic' (in which 80% population immunity is achieved only within the high-risk population, designated as within 3 km on both sides of a national highway, a 5-km radius from the infected premises or zone, and a 3-km radius from affected slaughterhouses and markets). No vaccination is conducted in areas designated as FMD-free. Furthermore, within the areas in which vaccination occurs, the Government is now using monovalent serotype O vaccines instead of the trivalent A, O and C vaccines used previously.

As indicated in Figure 1, this strategy has been generally successful, although there was a setback in September 1999 when an outbreak occurred in Iloilo (Panay) within the designated FMD-free zone. Following the Iloilo outbreak, the FMD zonation was revised as shown in Figure 2 and was accepted officially by the OIE, which now recognises Mindanao as an FMD-free zone without vaccination (8) (Figs 1 and 2).

© OIE - 2002

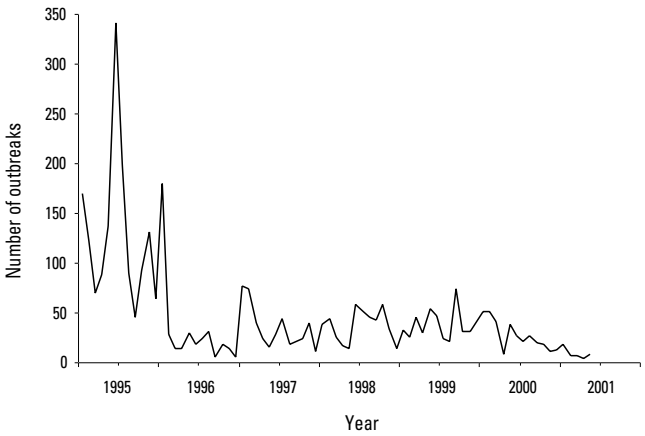

Fig. 1
Total number of foot and mouth disease outbreaks recorded monthly in the Philippines, 1995-2001
Source: National FMD Task Force

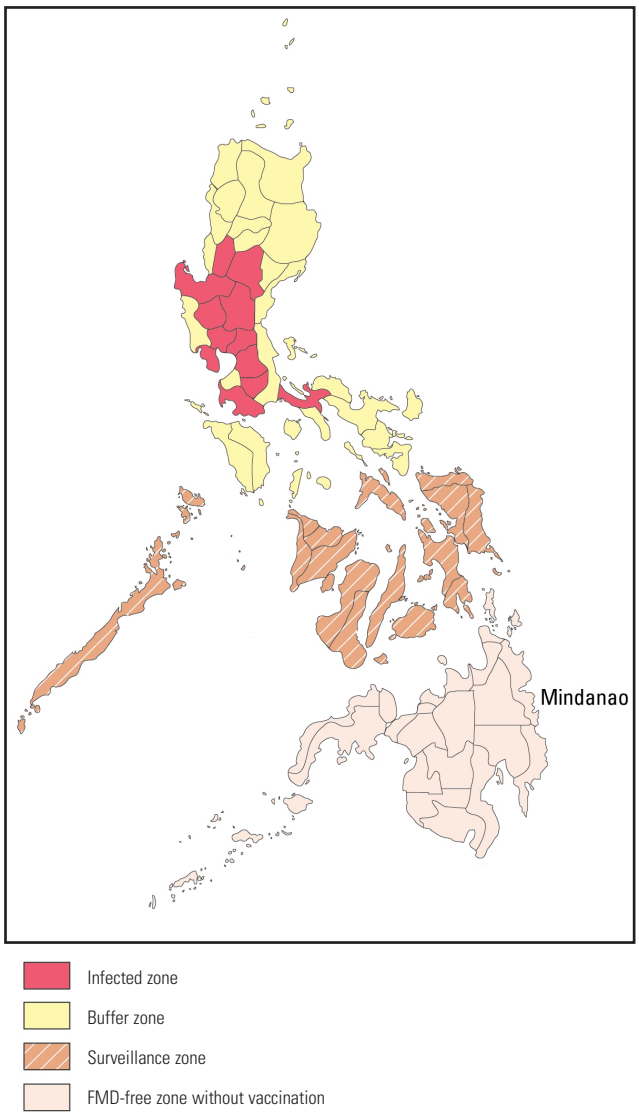

Fig. 2
Map of foot and mouth disease (FMD) control zones
Source: Office International des Epizooties (OIE) (2002)

Assessing the impact of foot and mouth disease and eradication of the disease

To ensure that support could be maintained for the eradication effort, the National FMD Task Force initiated an assessment of the economic impact of FMD and the proposed control programme and other options, adopting the general approach developed in the earlier study conducted in Thailand (11). This approach features two key elements. First, the evaluation requires a combination of epidemiological and economic modelling. The epidemiological modelling is needed to understand how different control strategies are likely to impact upon FMD risk and livestock productivity parameters. Using this information, together with additional inputs on prices and control costs, the economic modelling can then evaluate the relative benefits and costs and distributional impacts of different FMD eradication scenarios. The second feature is the need to begin at the sectoral level by disaggregating the analysis on the basis of production system (such as backyard versus commercial pig systems) rather than national aggregate populations represented by the single category 'pigs'.

Scenarios

This framework is used to evaluate potential national FMD control strategies in the form of different FMD eradication scenarios. Four scenarios are considered as described below.

Baseline scenario

Under the baseline scenario, which is used as a comparison point for the eradication scenarios, FMD is assumed to continue to occur in the Philippines based on historical trends. Specifically, Mindanao is assumed to generally remain free of FMD, as is currently the case, but with a 3% chance of an outbreak occurring, reflecting the last outbreak in Mindanao 20 years ago. The Visayas are assumed to remain free, but with a 20% chance of a periodic outbreak, again based on past frequency. In Luzon, the incidence of FMD is assumed to return to the endemic level experienced from 1996 to 1999 of approximately 400 outbreaks per year.

Under this baseline scenario, FMD control efforts continue at the level they were implemented in 1999-2000.

Eradication scenario 1: internationally recognised eradication of foot and mouth disease from the Philippines by the end of 2004

To meet this, the country would need to experience no more cases of FMD after December 2002 and no vaccination against FMD during 2003 and 2004. This is a challenging target given the 1999 extension of the disease into a previously free area but, given also the considerable progress in terms of overall reduction in FMD incidence, is one that merits serious

© OIE - 2002

consideration. As part of this scenario, the strategic measures that will be necessary to achieve eradication by this date will be considered, such as intensive monitoring in currently FMD-free areas, intensified bio-security operations, intensified animal movement controls, enhanced public awareness, slaughter and compensation measures and the costs of such inputs.

Eradication scenario 2: internationally recognised eradication of foot and mouth disease from the Philippines by the end of 2006

The 1999 outbreak in Iloilo demonstrated the potential vulnerability of non-endemic areas of the country to re-infection due to the extensive movement of people, pigs and pork products from island to island. As such, it might be argued that a longer period of time will be required to consolidate the FMD-free areas in terms of greater movement control and public awareness, and thus benefits from national eradication will be delayed and additional costs will be incurred.

Eradication scenario 3: internationally recognised eradication of foot and mouth disease from the Philippines delayed until 2010

A more pessimistic scenario would be that there will be recurring outbreaks at a lower level which, while not giving rise to large production losses, would incur continued and sustained eradication costs, and would delay the recognition of FMD-free status, thus continuing to deny the Philippines access to international markets.

For each scenario, the impact of eradication in terms of avoided production losses and potential savings in control costs can be estimated by comparison with the baseline scenario.

Export opportunities

In addition to improving national productivity of livestock, the other major expected benefit of eradicating FMD will be improved opportunities for exports of livestock and livestock products. The Philippines is a net importer of livestock and livestock products. According to Food and Agriculture Organization (FAO) trade statistics (Table I), imports of live animals and meat products averaged US$130 million annually during the 1990s, versus exports of less than US$1 million. Exports consist for the most part of small volumes of speciality pork products to a limited number of countries within the framework of bilateral agreements. The most consistent destination for meat products has been Hong Kong. Annual exports of pork to Hong Kong were strong in the late 1980s, peaking at US$854,000 in 1990, but have been much more modest since, recovering to around US$100,000 in 1998 and 1999 (National FMD Task Force data). Meat products have been exported to a number of other destinations, but typically in small amounts of one to two tonnes or less per year. Exports began to increase to several new destinations beginning in 1998, including Taipei China (US$69,000 in 1999), Singapore (US$17,000 in 1999), the United States of America (US$16,000 in 1999) and the United Arab Emirates (US$14,000 over 1998-1999) (Table I).

Table I
Average annual trade in livestock and livestock products in the Philippines between 1990 and 1999

Commodity	Imports	Exports
	Value (US$1,000)	
Live animals	**59,130**	**316**
Cattle	50,378	0
Pigs	2,502	0
Other	6,249	316
Meat products	**74,363**	**589**
Meat-fresh, chilled, frozen	66,693	242
– beef	53,940	0
– pig meat	5,537	217
Meat-dried, salted/smoked	646	23
Meat (other)	7,024	324
Dairy products and eggs	**325,139**	**596**

Source: FAOSTAT (http://apps.fao.org/page/collections?subset=agriculture)

Despite the apparent deficit trade position for trade in livestock and livestock products of the Philippines, improving export opportunities is considered a priority reason for the need for FMD eradication. This was highlighted, for example, during informal discussions with commercial pig farming organisations represented by the National Federation of Hog Farmers. Improving exports would likely involve two strategies, as follows: firstly, strengthening existing trade of speciality pork products based on past bilateral agreements, particularly to Hong Kong and to Singapore and, secondly, developing new commercial export capacity. One scenario would be the establishment of an export slaughterhouse for pork adjacent to a port on the island of Panay. This would target the higher priced Asian markets as well as other potential markets within the South-East Asia region, particularly during the months of July and August when demand in the domestic market is usually weak. Another scenario that has been suggested involves establishing a beef export operation in Mindanao where cattle would be imported, fattened and processed for re-export to regional markets (especially the Brunei Darussalam, Indonesia, Malaysia and the Philippines-East ASEAN Growth Area).

No data are currently available to permit projecting potential investments and returns, production levels and specific export markets that could be achieved if FMD were effectively eradicated nationally. Access to specific markets and the willingness of the livestock sector to pursue these markets will largely depend upon the trade agreements currently in effect, how these are expected to evolve under the WTO and specific regional and bilateral arrangements, and price incentives

© OIE - 2002

created by domestic and international supply and demand dynamics. For the purposes of the analysis therefore, improved export opportunities are represented by assuming that new exports gradually develop once FMD freedom is achieved, from 0 to 5,000 tonnes annually to lower-priced regional markets as well as from 0 to 5,000 tonnes annually to higher-priced markets elsewhere. The results of this analysis will indicate to what degree FMD eradication would generate sufficient economic benefits based on enhanced national livestock productivity alone, or would require added benefits from improved export opportunities to justify the investment.

Epidemiological model

Modelling foot and mouth disease incidence

A key component of the impact assessments involves substantiating the relationship between intervention activities (level of vaccination coverage, intensity of movement control, etc.) and FMD incidence. In a previous study conducted in Thailand (11), an epidemiological model was developed for this purpose that generated FMD incidence data for different levels of vaccination intensity, based on local data. However, there are several differences in the Philippines. Firstly, there is a marked difference in the predominant production system. Currently, pigs are the predominant species affected, mostly kept in so-called backyard systems, which are defined in official Philippines statistics as farms with twenty or less pigs (farms having more than twenty pigs are considered commercial). The epidemiological model for Thailand was developed on the basis of the 'village' system, comprising village cattle and buffalo, in which it was assumed that the disease was maintained, with spill-over into small-scale and commercial pig systems. This is clearly not the case in the Philippines. Secondly, the current Philippines vaccination programme (known as strategic) is reactive (ring vaccination following reported occurrence) rather than preventive such as the strategy evaluated in Thailand. This means that rather than trying to achieve high and sustained levels of population immunity at the national level, or even within the endemic areas, the current strategy is to respond rapidly to reports of FMD occurrence by ring vaccination, movement control and enhanced bio-security. Much greater emphasis is placed on movement control (and at a more local level) and public awareness.

Reviewing the outbreaks that occurred from 1995 to 1999 suggests that an appropriate epidemiological model for FMD in the Philippines would need to capture both the temporal and spatial dynamics of the disease, according to the production system. Data available for monthly outbreaks from 1995 to 1999 in municipalities of three selected provinces where the majority of outbreaks occurred in the infected zone were examined (Fig. 2). The three provinces include Pangasinan in the northern part of the infected zone, Bulacan in the centre, and Laguna in the south. The data indicate that certain municipalities in Bulacan are particular 'hotspots' for FMD that may play a role in the persistence of the disease. A more detailed analysis to investigate trends in the spatial and temporal distribution of FMD outbreaks and the importance of these 'hotspot' municipalities could not be pursued due to data limitations.

Pending such an analysis and given the emphasis on control and eradication through animal movement restrictions and public awareness, a much simpler model was adopted for the purposes of the present study. The model is needed for two reasons. First, the future incidence of FMD outbreaks must be predicted for the baseline scenario. In this scenario, FMD control is presumed to continue at current levels, but without successfully achieving eradication. The disease is therefore assumed to continue to occur consistent with historical trends for the period 1996 to 1999. In other words, FMD outbreaks continue to occur regularly in the infected and buffer zones, more sporadically in the surveillance zone, and rarely in the FMD-free zone. An implicit assumption is made that only the current strain of swine FMD remains present in the country and that no new strains are introduced. Total outbreak incidence is predicted for each FMD control zone, with the infected and buffer zones in Figure 2 treated as a single zone. Since outbreaks tend to be clustered both in time and space, the prediction is modelled as the probability that an outbreak occurs in a given year times the number of expected outbreaks if at least one outbreak does occur. Each probability is represented as a Poisson distribution, which is appropriate for modelling infrequent events such as disease outbreaks. The distribution parameters are specified in Table II by species and control zone.

The second need for epidemiological modelling relates to the impact of additional intervention activities on FMD incidence. As noted above, eradication is anticipated to depend primarily on strengthened movement controls and public awareness – which are difficult to link to a change in incidence in a modelling framework – rather than on vaccination. Again, a simple model is assumed whereby effective implementation of the eradication efforts reduces incidence projected under the baseline scenario by 75% in the year immediately preceding that in which the disease is assumed eradicated.

Control measures

The proposed FMD eradication strategy for the Philippines involves three different phases of control, namely: pre-eradication, eradication, and maintenance of FMD freedom post-eradication. The pre-eradication phase covers the period from the beginning of the programme in 1996 through to 2001, during which some measures were gradually strengthened. Control measures undertaken during this period are listed in Table III. Certain measures are to be further intensified or added during the eradication phase beginning in

© OIE - 2002

Table II
Parameters for epidemiological modelling

Species by production system and control zone [a]	Probability of outbreak [b]	Average number of outbreaks in an outbreak year [b]	Number of animals affected per outbreak	Average case fatality (%)
Backyard cattle				
Zone 1	1	0.75	1	0
Zones 2 and 3	0	–	–	
Backyard carabao				
Zone 1	1	4.25	1	0
Zone 2	0.2	4.0	1	0
Zone 3	0	4.0	1	0
Backyard swine				
Zone 1	1	388.5	10	15.5
Zone 2	0.2	45.0	9	18.6
Zone 3	0.03	45.0	9	18.6
Commercial swine				
Zone 1	1	15.75	90	35.6
Zone 2	0.2	2.0	877	26.1
Zone 3	0.03	2.0	877	26.1

(a) Foot and mouth disease control zones:
Zone 1: infected and buffer zones in Figure 2
Zone 2: surveillance zone
Zone 3: foot and mouth disease-free zone without vaccination
(b) Serves as the lambda (λ) value in the corresponding Poisson distribution

Table III
Summary of foot and mouth disease control measures, by phase of eradication programme

Measure	Pre-eradication	Eradication and post-eradication
Disease monitoring and surveillance		
Slaughterhouse monitoring	10 monitors in Region III *; otherwise performed by provincial staff	Same, plus 23 police personnel to assist
Diagnostic laboratory	Laboratory staffed; antigen and antibody testing	2 additional staff
National FMD control programme	Unit with 7 personnel	7 additional staff
Regional budget allocations for control	US$37,000 per region for 15 regions	Budget increased to US$60,000 per region
Training	None	20 personnel trained annually
Public awareness		
National campaign	3 personnel, with US$20,000 budget	Budget increased to US$100,000
Animal movement control		
Checkpoints	19 checkpoints maintained (6 in Luzon, and 13 elsewhere)	2 additional internal checkpoints Staff increased Checkpoints at 14 international ports established
Bio-security measures	4 personnel, disinfectants and equipment	Quantity of disinfectants increased
Vaccination (blanket vaccination discontinued in 1998)	Emergency fund for containment vaccination maintained (345,000 doses)	Same
Containment (outbreak response)		
Surveillance and monitoring	Strategic testing	Continued during eradication phase, but no longer relevant after eradication is achieved
Public awareness	Temporary campaigns	
Animal movement controls	Temporary checkpoints established	
	Additional bio-security measures	
Curative services	Treatment of infected animals in backyard systems	
Vaccination	Strategic or ring vaccination performed	

Source: National FMD Task Force
* Region III: Official administrative unit of the Philippines that comprises the provinces of Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac and Zambales on the island of Luzon

© OIE - 2002

2002, and these measures, also summarised in Table III, are assumed to continue after eradication is achieved to protect the country from re-introduction of the disease. The only difference between the eradication and post-eradication phases is the discontinuation of outbreak response measures (Table III).

Economic model

Cost-benefit analysis (CBA) is used to assess the economic implications of the different FMD eradication scenarios defined above. The basic approach is to identify the various incremental costs associated with each eradication scenario, and to compare these with the expected incremental benefits derived from eradicating FMD (13). The economic impact of the various scenarios can then be evaluated in terms of their net returns over time.

The baseline scenario serves as the basis for measuring the incremental costs and benefits of eradication and assumes that no concerted effort is mounted to eradicate FMD, but rather that the objective of control is to contain the impact of continued outbreaks in endemic areas and the occasional introduction of the disease into FMD-free zones. As described above, the epidemiological model provides estimates of the expected frequency of outbreaks and numbers of animals infected.

The CBA could be approached from two different perspectives. The first, which could be termed 'project evaluation', would consider the complete life of the current national FMD control project since control activities were initiated in 1996, and would involve a mix of retrospective (ex-post) and prospective (ex-ante) evaluation. Such an approach would require modelling the counterfactual baseline or 'without project' scenario that assumed no national FMD control had been undertaken following the extensive outbreaks in 1995, and is not relevant to the present study. The second perspective, which can be referred to as an 'investment analysis', evaluates future eradication efforts only and so assumes that all earlier project costs and benefits (from 1996 to date) are sunk, and focuses instead on those from 2001 onwards. This second perspective is likely to be more useful to policy makers required to make decisions about the value of continued allocation of resources to the eradication effort.

The analysis is conducted over a 25-year time horizon to ensure a minimum 15-year benefit period following eradication. As is standard in such analyses, both past and future cost and benefit streams are appropriately discounted to account for the time value of money. A discount rate of 7% is assumed. To value costs and benefits, historical prices are used for previous years and otherwise projected future prices are assumed constant at current 2001 levels.

To conduct the analysis, a spreadsheet-based model was constructed in Microsoft® Excel 2000, using the add-in @Risk© software (10). This software permits probability distributions, rather than single point estimates, to be assigned to key parameters in the model and then the analysis to be conducted repeatedly using Monte Carlo sampling techniques. Such an approach helps to compensate for the lack of reliable data for certain impacts and addresses the uncertainty inherent in projecting costs and benefits into the future.

Incremental costs associated with foot and mouth disease eradication

The cost side of the CBA comprises incremental control costs required to achieve FMD eradication, as well as any revenues foregone in the process. Incremental control costs are those associated with the various activities listed in the right-hand column of Table III that would not be undertaken if the objective of FMD control were limited only to containment (rather than eradication) as represented by the activities in the second column of that Table. Eradication activities are undertaken by the public sector only; livestock producers are not expected to make any additional private investment in FMD control as part of the eradication effort. No relevant foregone revenues were identified.

Incremental benefits associated with foot and mouth disease eradication

The various benefits incorporated into the CBA are listed in Table IV, together with a brief description of how they were valued. Four types of benefits are expected to be gained by eradicating FMD.

The first is a reduction in some of the control costs currently incurred to protect commercial herds or due to outbreaks. With eradication, commercial swine producers in the current infected and buffer zones will no longer be allowed (or need) to vaccinate their herds as a preventive measure, thereby reducing their production costs. Similarly, private producers will no longer incur costs to treat infected animals, and public sector costs associated with actions to contain such outbreaks (last set of measures in Table III) will also decline accordingly, generating cost savings. A distinction is made between containment costs associated with smaller, more frequent, localised outbreaks in the endemic areas and those associated with the more urgent response to the occasional introduction of FMD in FMD-free zones. For outbreaks in endemic areas, representative costs per outbreak have been estimated based on FMD Task Force records, in operation since 1996. For outbreaks in FMD-free zones, a full cost assessment of the recent outbreak in Iloilo provides a representative estimate.

Improved productivity at farm level is the second benefit of FMD eradication. Production losses avoided by improved FMD control were estimated based on the projected changes in numbers of outbreaks from the epidemiological model. Using

© OIE - 2002

Table IV
Benefits and valuation of benefits

Benefit category	Description	Estimation
Control cost savings		
Treatment of infected animals	Infected animals are treated for foot and mouth disease (FMD), with the cost supported by producers	Numbers of avoided cases of FMD × average treatment cost/animal (cattle/carabao, swine distinguished by sow, fattener, other). Treatment cost includes antibiotic, Gentian Violet, and veterinarian service fee
Preventive vaccination	Commercial swine producers regularly vaccinate their animals in the infected and buffer zones, at their cost, with an estimated 80% coverage in recent years. All vaccination ceases once eradication is achieved	Numbers of swine in commercial herd in infected and buffer zones × 80% × 2 doses per head × average cost/dose
Outbreak containment	Actions taken by National FMD Task Force to contain outbreaks when they occur: additional surveillance, public awareness, enforcement of movement controls, diagnosis and treatment (in backyard systems), and strategic or ring vaccination	Average costs per outbreak in endemic areas estimated from historical data on National FMD Task Force expenditures for relevant activities (1996-2000). Cost per outbreak for reincursion in FMD-free zone estimated based on full costing of the 1999 Iloilo outbreak response
Avoided production losses		
Mortality	Only affects piglets	Numbers of avoided deaths × average piglet price, by production system
Weight loss	Animals lose weight or grow slower when infected with FMD	Estimated weight loss/animal (10 kg for cattle/carabao; 5 kg for swine) × meat price. Weight losses estimates are taken from Harrison and Tisdell (5) for Thailand
Milk losses	Milk production is reduced in infected dairy cows and carabao	Since 1995, no dairy cattle and few carabao have been affected, so these are considered negligible
Abortions	Relevant to sows in backyard systems. Half of infected pregnant sows reportedly suffer abortions, though no data exist to confirm	Number of sows infected in backyard systems × % of sows pregnant at any given time × 50% suffering abortions × net margin earned per litter raised to sale age
Poor reproductive performance	Treatment delays reproduction, resulting in fewer litters per year	Average reduction in number of litters per year × net margin per litter raised to sale age
Boars out-of-service	Boars in backyard sector cannot be used for servicing while sick	Representative service price × number of services per day (3) × number of days sick (7)
Draught power losses	Carabao may be incapacitated while sick, though FMD lesions in carabao are usually confined to the mouth	Number of carabao infected × % of time used for draught × number of days sick × representative daily rental price for draught carabao
Manure losses	Infected cattle and carabao eat less and so produce less manure used as fertiliser	The number of carabao and cattle infected since 1995 have been few, and given the lack of data on the value of manure, this is considered negligible
Market effects		
Movement controls requiring producers to keep fatteners past optimal sale date	Local movement controls when outbreaks occur constrain producers from taking fatteners to market, incurring extra maintenance costs and delaying the subsequent production cycle	A rapid appraisal of the impacts of such delays in a representative commercial operation suggests that producers have found a strategy of using cheap alternative feeds to maintain overdue fatteners that avoid any such losses. Such losses are therefore assumed to be negligible
Local price fluctuations	Movement controls and mortalities may cause temporary, localised shortages or surpluses, leading to temporary revenue windfalls or losses for producers and traders	No data were available to confirm or quantify these impacts
Consumer scares	Consumer concerns about zoonotic effects causing a significant drop in pork consumption and prices	No evidence was available to confirm that such consumer scares are likely to be repeated in the future, so avoiding such scares was not included
Enhanced export opportunities		
Increased export sales to lower value regional markets	FMD freedom will facilitate access to export markets	Export sales allowed to vary from zero to 5,000 tonnes annually. Production cost and export sale price each year sampled from triangular distribution with mean value of US$1.80/kg and US$2.00/kg, respectively
Increased export sales to higher value markets	FMD freedom will facilitate access to export markets	Export sales allowed to vary from zero to 5,000 tonnes annually. Production cost and export sale price each year sampled from triangular distribution with mean value of US$2.50/kg and US$5.00/kg, respectively

© OIE - 2002

an average number of animals affected per outbreak and case fatality rates computed from historical outbreak data for 1996-2000 (Table II), aggregate changes in mortality and morbidity by species were estimated. Reduced mortality, which affects only piglets, is valued based on their sale price. Reduced morbidity translates into several different types of savings, mostly affecting pigs, including avoided weight loss among fatteners (also affecting cattle and carabao), avoided abortions in sows, avoided reproductive losses (litters lost when infected sows are treated) and avoided idled boar services. Other potential impacts on draught power in carabao, milk production in carabao and dairy cattle, and manure production are considered negligible given the very few, if any, animals affected in these categories.

Third, FMD eradication will eliminate direct impacts of outbreaks on markets for livestock and meat products. These are often related to movement controls in and around outbreak areas where animals or products ready to be marketed may be blocked and forced to remain on farm, or temporary shortages or surpluses causing price fluctuations in local markets. Outbreaks can also provoke consumer scares. In 1995, public concerns over FMD infection of humans led to a sharp drop in pork consumption and prices, and substantial revenue losses for producers and traders across the principal Luzon markets. Appropriate data for measuring these types of impacts, however, were not available.

Foot and mouth disease freedom is also expected to provide producers and processors in the Philippines access to new export markets. Predicting their capacity and willingness to respond to these opportunities and identifying which markets, products, volumes and prices are likely to be involved, are beyond the scope of this study. Instead, meat exports to both lower and higher value markets are allowed to vary from zero to 5,000 tonnes. The domestic cost of production of meat (both beef and pork) is assumed to follow a triangular probability distribution, with mode at US$1.80 kg^{-1} for lower value markets and at US$2.50 kg^{-1} for higher value markets. Similarly, the export sale price for each market is also modelled as a triangular distribution, earning a modal price of US$2.00 kg^{-1} in lower value markets and US$5.00 kg^{-1} in higher value markets, noting that a preliminary assessment cited premium markets in east Asia as offering up to US$5.80 kg^{-1} for pork imports (11).

Indirect impacts

Foot and mouth disease eradication is expected to have a number of additional, indirect impacts, much more difficult to measure and value, which have not been incorporated into the analysis, but which are described below.

Macro-economic impacts

Expansion of exports will generate additional foreign currency and improve the balance of payment. This is likely to translate into increased investment and economic growth.

Sectoral impacts

Improved productivity and expansion of exports will generate employment and demand for inputs from other sectors, generally referred to as the 'multiplier effects' of an injection of income into the livestock sector (4).

Market impacts

Improved productivity and links to export markets will also affect the supply and demand dynamics of domestic markets for livestock and meat products. Improved productivity will shift the supply curve out, putting downward pressure on prices. (The CBA can be extended to include an economic surplus model that effectively captures the supply curve shift and impact on prices [6]. The incidence of FMD on supply in the Philippines context is very modest and so such impacts are considered negligible.) Links to higher-value export markets and demand for supplies for exports may have a counteracting effect, elevating prices, although this effect will depend on the strength of the links. Meat producers also noted that another anticipated benefit of FMD freedom would be the likely imposition of restrictions on low-priced livestock and meat imports from non-FMD-free countries, particularly carabao from India. This will provide protection for domestic markets from low-value imports.

Improved control of other livestock diseases

The eradication effort and subsequent need to protect the export sector will require strengthening and maintaining effective monitoring and surveillance systems for FMD, movement controls and emergency preparedness for potential re-incursions. An additional, intangible benefit will be the demonstration to the private sector of the benefits of public-private collaboration in disease control and the precedent this may set for improved collaboration for disease control. Both will serve to improve the control of other livestock diseases, further improving productivity in the sector. Participation in international trade will also increasingly require developing infrastructure and policies to meet international food safety and sanitary standards. These should also provide benefits to domestic markets in terms of improved food quality, food safety and control of zoonotic and food-borne diseases.

Each of these indirect impacts requires additional macro-economic modelling and economic analysis that are beyond the scope of the present study. Thus, within the CBA, benefits are likely to be underestimated and limited to measurable direct impacts.

Results

Economic impact of foot and mouth disease

The differences between the baseline and eradication scenarios in terms of the evolution of the various costs associated with

© OIE - 2002

FMD are illustrated in Figure 3. (Expected values for all stochastic parameters are used to estimate the projected values in Figure 3, so future trends display no year-to-year variation. In the simulation modelling, however, the stochastic parameters are indeed stochastic, introducing year-to-year fluctuations.) Costs are distinguished between those borne by producers ('private') versus those undertaken by the public sector ('public') and by category. For producers, costs are separated into control costs – referring to treatment and preventive vaccination – and value of production losses. Public sector costs are subdivided into containment, prevention and eradication interventions. Estimates are included both for the earlier phase of the national FMD control programme (1996-2000) based on historical data, and for the time horizon covered by the analysis (2001-2025) (Fig. 3).

The annual economic impact of FMD was highest at the beginning of national FMD control programme, peaking at over PHP420 million (US$14 million) in 1997, due primarily to extensive privately- and publicly-funded vaccination making up a large share of costs. (The average exchange rate for Philippine pesos (PHP) in 1997 was PHP 30/US$ 1; exchange rates [in PHP/US$] for other years were: 1996, 25.9; 1998, 40.7; 1999, 38.7; 2000, 44.3; 2001 and after, 50.7.) Publicly-funded blanket vaccination campaigns targeting animals in backyard production systems were discontinued in 1998 and at the same time, commercial producers – especially those outside the endemic areas – also began to vaccinate more strategically, thus explaining the subsequent decline in total costs.

Under the baseline scenario, the economic impact of FMD is projected to rise gradually from year 2000 levels. Approximately a third of the total each year, or an average PHP54 million (US$1.1 million) (33% of the total impact in 2002), represents public control costs for prevention, mostly related to surveillance and monitoring activities. An additional PHP14 million (US$0.3 million) (9%) is spent to contain the persistent FMD outbreaks. Commercial swine producers support the largest share of the economic impact, paying PHP88 million (US$1.7 million) (54%) in 2002 for preventive vaccination of their herds. This amount is projected to grow slowly, reflecting the continuing expansion of swine production. The value of production losses suffered by producers in both commercial and backyard systems due to FMD is limited to an estimated PHP5 million (US$0.1 million) annually (3%). These trends continue over the study horizon.

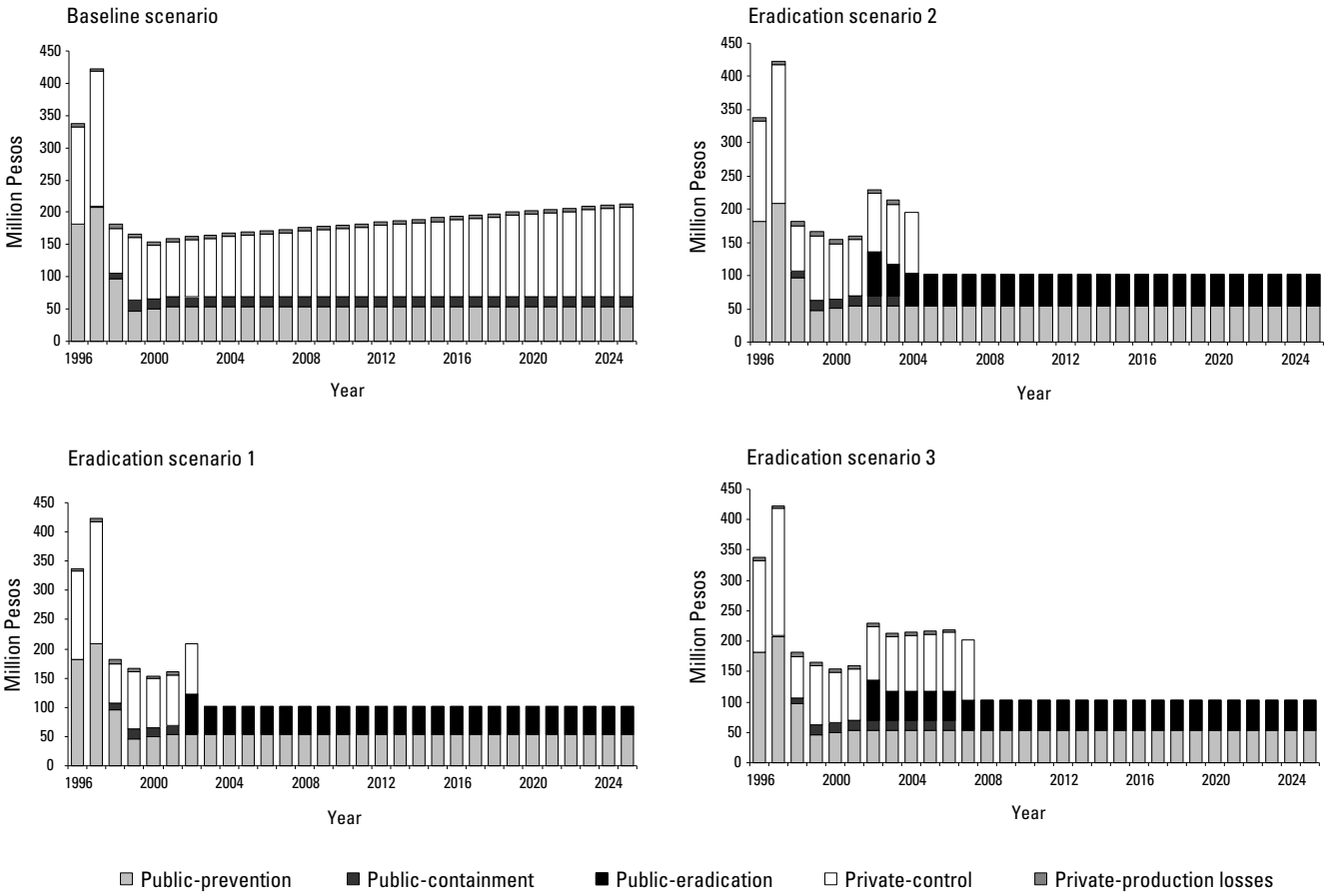

Fig. 3
Evolution of undiscounted costs associated with foot and mouth disease under different scenarios, 1996-2025
('private' refers to costs borne by producers; 'public' to costs funded by the public sector)

© OIE - 2002

Under the eradication scenarios, the cost of FMD increases during the eradication period as the national FMD programme activities expand and commercial producers continue to vaccinate. Once the disease is eradicated (as of the beginning of 2003 in eradication scenario 1 in Figure 3, for example), the private sector no longer incurs any control costs or production losses, and the public cost of containing outbreaks is also eliminated. Total costs fall to a constant PHP124 million (US$2.4 million) per year, all of which are supported by the public sector for emergency preparedness and to protect from re-introduction of the disease. Eradicating the disease does not also eradicate the cost of the disease.

A cursory comparison of the eradication and baseline scenarios in Figure 3 anticipates the likely result of the analysis. Only in the first year (2002) are total costs under eradication scenario 1 greater than those in the baseline. In all years that follow, the added PHP48 million (US$0.9 million) investment in eradication yields at least PHP110 million (US$2.2 million) in savings. Even after discounting future amounts, the benefits appear to be sufficiently greater than the investment cost to ensure a benefit-cost ratio (BCR) greater than one. If FMD freedom does indeed lead to expanding exports, then additional benefits could be added commencing two years after eradication is achieved (beginning in 2005 for eradication scenario 1 in Fig. 3).

Returns to eradication

The results generated by the combined epidemiological-economic model are summarised in Table V. Two standard investment indicators are considered: net present value (NPV) and the BCR. (A third indicator often used is the internal rate of return [IRR]. The IRR can only be computed if there is a distinct investment period at the beginning of the time horizon under consideration. In the present case, investment continues throughout the study period, so an IRR cannot be estimated.) The NPV is an absolute measure computed as the sum of discounted net benefits from each year of the study period. The BCR is a relative measure, computed as the sum of discounted annual benefits divided by the sum of discounted annual costs. A worthwhile investment project should generate sufficient benefits to at least cover the investment costs, which means the NPV should be positive and the BCR greater than one. The higher the values of NPV and BCR, the more attractive is the project in economic terms.

Under the assumptions of the model, eradication is shown to be a worthwhile investment. The current official plan for eradication is represented by scenario 1. If successful, and even without benefits generated by expanded exports, this scenario achieves an NPV of PHP740 billion (US$14.6 billion) over the 25-year time horizon considered and a respectable BCR of 2.4, thereby providing returns of PHP2.4 for every PHP1 invested. Assuming that FMD-free status does indeed lead to exports, then the indicators improve substantially. Even if exports from the Philippines gain access to low-value markets only and reach a volume of 5,000 tonnes of meat products, the BCR increases from 2.4 to 3.4. Entering high-value markets raises the indicators much higher again. Figure 4 shows how the BCR

Table V
Benefit-cost indicators for the foot and mouth disease eradication scenarios, under varying export assumptions
(million Pesos)

Scenarios	No exports	Low-value exports only [a]	High-value exports only [b]	Both low- and high-value exports [c]
Scenario 1				
Sum of discounted benefits	1,286	1,837	5,818	6,369
Sum of discounted costs	533	533	533	533
Net present value	**753**	**1,304**	**5,285**	**5,836**
Benefit-cost ratio	**2.41**	**3.45**	**10.89**	**11.95**
Scenario 2				
Sum of discounted benefits	1,107	1,563	4,857	5,312
Sum of discounted costs	533	533	533	533
Net present value	**574**	**1,030**	**4,324**	**4,779**
Benefit-cost ratio	**2.08**	**2.93**	**9.11**	**9.97**
Scenario 3				
Sum of discounted benefits	869	1,204	3,628	3,663
Sum of discounted costs	533	533	533	533
Net present value	**336**	**672**	**3,095**	**3,430**
Benefit-cost ratio	**1.63**	**2.26**	**6.81**	**7.41**

a) Assumes that low-value exports begin once foot and mouth disease (FMD) freedom without vaccination is officially recognised nationally (two years after eradication is achieved), with 1,250 tonnes of meat products exported the first year, 2,500 tonnes the second year, 3,750 tonnes the third year, and 5,000 tonnes every year thereafter
b) Assumes that high-value exports begin once FMD freedom without vaccination is officially recognised nationally (two years after eradication is achieved), with 1,250 tonnes of meat products exported the first year, 2,500 tonnes the second year, 3,750 tonnes the third year, and 5,000 tonnes every year thereafter
c) Assumes both of the export scenarios described above, with a total of 10,000 tonnes of meat products being exported four years after official FMD freedom is achieved nationally

© OIE - 2002

would vary under eradication scenario 1 for different mixes of exports to lower- and higher-value markets.

Scenarios 2 and 3 measure the sensitivity of the results for the official scenario if eradication takes longer than expected. In scenario 2, eradication takes an additional two years and in scenario 3, an additional six years. Delays in achieving eradication serve both to increase cost (since FMD outbreaks continue to occur during this period, so public costs for containment and private costs for vaccination and production losses are extended at the same time as the added eradication investments are being made) and reduce benefits (which are pushed later into the future, thus reducing the benefit period and concentrating them in the portion of the study period with highest discount rates). As expected, the investment indicators decline accordingly; a six-year delay cuts the NPV by more than half, and reduces the BCR to 1.6. However, the fact that the indicator values remain so clearly favourable under such a pessimistic scenario provides evidence of the robustness of the overall conclusions to be drawn from the analysis.

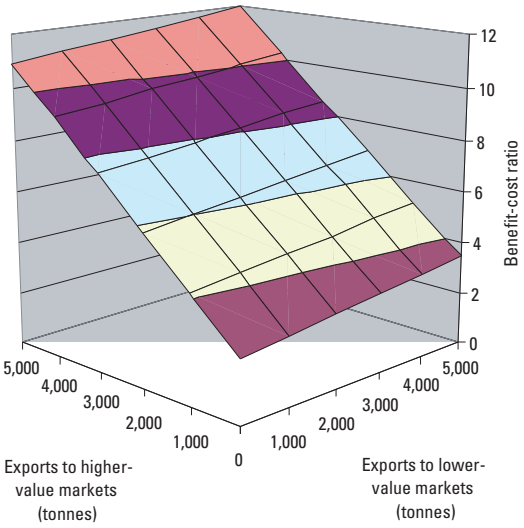

Fig. 4
Surface of benefit-cost ratio values as exports to lower- and higher-value markets vary (eradication scenario 1)

In addition to the sensitivity analyses regarding the time to eradication and export volumes built into the formulation of the scenarios, other sensitivity analyses were conducted by allowing key parameters in the model to be stochastically determined. Two sets of parameters in particular were allowed to vary: the number of predicted FMD outbreaks and the net margin earned from exports. The number of FMD outbreaks were allowed to vary from year to year and were modelled based on Poisson distributions (Table II). Net margins for exports were estimated based on separate triangular distributions for costs of production and export sale prices for both lower- and higher-value markets, with a single value used to value exports to each market in all years in a given simulation. The simulation was repeated 1,000 times, generating the estimates reported in Table VI. The distributions of the estimated BCRs are displayed in Figure 5.

Table VI
Benefit-cost ratio estimates based on sensitivity analysis

Scenarios	No exports	Low-value exports only [a]	High-value exports only [b]	Both low- and high-value exports [c]
Scenario 1				
Mean	**2.41**	**3.45**	**10.91**	**11.95**
Standard deviation	0.01	0.46	2.10	2.16
Minimum	2.39	2.02	5.22	6.37
Maximum	2.45	4.55	15.29	16.54
Scenario 2				
Mean	**2.08**	**2.92**	**9.05**	**9.89**
Standard deviation	0.01	0.38	1.77	1.83
Minimum	2.06	1.76	3.98	4.47
Maximum	2.11	3.84	12.91	13.88
Scenario 3				
Mean	**1.63**	**2.27**	**6.79**	**7.43**
Standard deviation	0.01	0.27	1.33	1.36
Minimum	1.61	1.48	3.57	3.73
Maximum	1.66	3.02	9.66	10.49

a) Assumes that low-value exports begin once foot and mouth disease (FMD) freedom without vaccination is officially recognised nationally (two years after eradication is achieved), with 1,250 tonnes of meat products exported the first year, 2,500 tonnes the second year, 3,750 tonnes the third year, and 5,000 tonnes every year thereafter
b) Assumes that high-value exports begin once FMD freedom without vaccination is officially recognised nationally (two years after eradication is achieved), with 1,250 tonnes of meat products exported the first year, 2,500 tonnes the second year, 3,750 tonnes the third year, and 5,000 tonnes every year thereafter
c) Assumes both of the export scenarios described above, with a total of 10,000 tonnes of meat products being exported four years after official FMD freedom is achieved nationally

© OIE - 2002

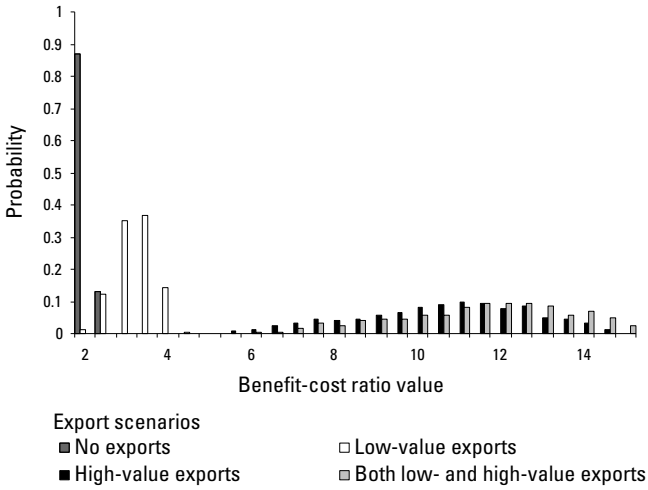

Fig. 5
Distribution of benefit-cost ratios for eradication scenario 1 (under different export assumptions), based on 1,000 simulations

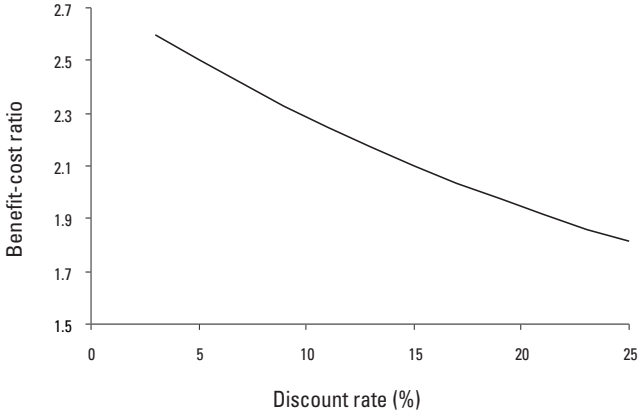

Fig. 6
Sensitivity analysis of benefits-cost ratio to varying discount rate (eradication scenario 1, no exports)

As demonstrated by the extremely narrow distribution of BCR estimates for the 'no exports' case, the results are insensitive to the epidemiological assumptions about numbers of FMD outbreaks. This is consistent with the small portion of costs affected directly by outbreaks, namely containment control costs and production losses (as evident in Fig. 3). The distributions of BCR estimates for the other export scenarios are much wider, highlighting the key and obvious role that export prices and net margins will play in determining the additional benefits to be derived from exports.

In the analysis, a real discount rate (which assumes there is no inflation) of 7% is used to value future income streams. The discount rate reflects the marginal value of capital. In such analyses, the rule of thumb is to use a low rate (3%-5%) for developed countries with more capital available yielding lower average rates of return, and a higher rate (10%) for developing countries where capital is scarce and yields higher returns. The 7% rate therefore reflects the middle-income status of the Philippines. A final sensitivity analysis was conducted to evaluate the impact of the discount rate on the BCR. As seen in Figure 6, the BCR for eradication scenario 1 (no exports) remains clearly positive over the full range of discount rates considered, confirming that the discount rate assumption does not significantly affect the conclusions.

Distribution of benefits

The distribution of the various costs and benefits are summarised in Table VII. The public sector bears all the costs for eradication (PHP533 million [US$10.5 million]), but also captures some of the benefits (PHP152 million [US$3 million]), for a net transfer to producers valued at PHP381 million (US$7.5 million). Commercial producers (primarily in the swine industry) capture most of the benefits – valued at over PHP 1 billion (US$19.7 million) – due to savings from no longer having to vaccinate their animals against FMD. The commercial sub-sector is also expected to be the primary direct beneficiary of any expansion of meat exports; backyard production systems are not well positioned to supply export markets, both in terms of quality and other sanitary considerations. Additional economic analysis would be required to determine to what degree increased commercial activity for exports would generate multiplier benefits in other sectors of the economy. Otherwise, only a small portion (4%) of the direct non-export benefits accrue to smallholder producers in backyard production systems, mostly related to avoided production losses (Table VII).

Table VII
Total present value of costs and benefits over 25-year time horizon, by sector (eradication scenario 1, no exports)

Sector and type of cost-benefit	Total present value (million Pesos)	Share(%)
Costs		
Public	532.8	100.0
– eradication effort	532.8	100.0
Total costs	**532.8**	**100.0**
Benefits		
Public	151.5	11.9
– avoided containment costs	151.5	
Commercial	1,072.3	84.2
– avoided production losses	12.5	
– avoided prevention costs	1,056.0	
– avoided treatment costs	3.8	
Backyard	49.4	3.9
– avoided production losses	39.6	
– avoided treatment costs	9.8	
Total benefits	**1,273.2**	**100.0**

© OIE - 2002

Conclusion

Based on the results of the CBA, the proposed FMD eradication programme clearly promises a worthwhile investment of public funds, yielding PHP2.4 for every PHP1 invested, not including the additional gains from expanded exports should they be successfully developed. Even if the current goal of achieving full eradication by the end of 2002 proves to be unrealistic and is delayed further, the investment remains attractive.

The commercial sector stands to capture nearly all of the benefits from FMD eradication. This has two implications. Firstly, this result suggests that policy-makers may be justified in expecting the commercial sector to contribute to the eradication effort, whether directly or through taxation. Eradication will not be a one-off investment but will require continued investment to protect the FMD-free status of the country once achieved. Sustained public funding of the necessary FMD surveillance and control may not be feasible, particularly given the commercial orientation of the expected benefits. Participation of the direct beneficiaries in the commercial sector would provide a more sustainable alternative. Secondly, the commercial orientation makes it difficult to reconcile the investment in FMD eradication with poverty reduction objectives. For this reason, mobilising resources may be difficult if access to funding is dependent on political or donor support.

The strength of these conclusions obviously depends upon the quality of the data and comprehensiveness of the analysis. An indicator of the robustness of the results is provided by the various sensitivity analyses conducted, whether through the comparison of different scenarios or through the use of the stochastic model. In each case, despite liberal variation in the underlying assumptions and parameters, returns to eradication remain clearly positive. Moreover, since a number of the indirect or intangible benefits have not been included in the analysis, the benefits may have been significantly underestimated. On the other hand, the assumed level of effort required to achieve eradication may also be underestimated and this merits critical review.

Two other important components of the analysis may also deserve further attention. The first concerns the analysis of potential exports. Providing access to export markets promises to increase dramatically the benefits from FMD eradication and provides yet stronger justification for the investment. In this study, simple assumptions have been made concerning the ability to develop exports. A full evaluation is needed of candidate export markets for livestock and livestock products from the Philippines, other non-disease restrictions that might affect trade, the likelihood of adequate price incentives and the potential for developing the required domestic supply capacity. Developing export capacity will entail other investments besides those for FMD eradication that would also need to be factored into the analysis but have not been incorporated into the present study. The recent recognition of Mindanao as an FMD-free zone without vaccination will provide an opportunity to learn how the private sector is able to respond to improved access to export markets, and the additional investments required or obstacles faced. A key question yet to be resolved is whether there will be sufficient incentive to export as long as the Philippines maintains an overwhelming deficit in domestic markets.

The second component requiring further study is the epidemiological modelling. Again, the present study has adopted a rather simple model that assumes FMD outbreaks continue to occur based on historical patterns. No attempt has been made, for example, to link control actions to impacts on disease incidence. This probably is not very important for the economic analysis; assumptions on the disease incidence only marginally affect the analytical results, since related costs for containment and benefits in terms of avoided production losses account for only a modest portion of total costs and benefits. Improving the epidemiological modelling, particularly in terms of spatial and temporal dynamics, would nonetheless be useful for better targeting of control interventions and improving the cost effectiveness of these actions.

The economic analysis provides evidence that FMD eradication in the Philippines will yield sufficient returns to expected costs, and therefore offers a worthwhile investment of public funds. This is a key criterion that policy-makers will need to consider, together with other policy objectives and trade-offs with alternative candidates for investment, when deciding whether to pursue the planned programme of FMD eradication.

The regional context

Based on the results of the study in the Philippines and earlier studies in Thailand and Laos, patterns begin to emerge regarding the economics of FMD and control of the disease across South-East Asia (11, 12).

First, the feasibility of effectively controlling and eradicating FMD varies considerably depending on the region. Foot and mouth disease is endemic in most countries where waves of outbreaks are experienced, with the exception of Indonesia and the islands of Mindanao in the Philippines, both of which are recognised as satisfying OIE requirements for freedom from FMD (8). The nature and economic impact of FMD in the different countries of the region vary considerably with the production systems in which the disease occurs, and the degree of risk of re-introduction from outside sources. In Thailand, for example, FMD is probably maintained primarily in village cattle, buffalo and village pigs and can be continuously re-introduced into these populations by the high frequency of animal movement from neighbouring countries drawn by attractive markets. Similarly, in Laos, animals in village systems

© OIE - 2002

along the various informal trade corridors that cross the country, face continuous exposure to infection. In the Philippines, FMD is currently concentrated in the more market-oriented backyard pig systems of Luzon. However, as the county is comprised of islands, the risk of FMD re-introduction into the Philippines is lower and potentially controllable.

These factors influence the capacity of each country to achieve control and eradication. The presence of a significant commercial livestock sector becomes key, and this is particularly important with regard to the pig sector in the Philippines. The constant threat of FMD to the commercial sector requires commercial producers to incur high costs for preventive measures and likewise influences governments to invest in publicly funded FMD control in the small-scale and village sectors. A strong commercial sector also contributes pressure to capitalise on opportunities to develop export trade, which becomes an important driving force for eradication. Within the region, some of the countries with well-developed large-scale commercial sectors, such as the Philippines and Malaysia, also benefit from national borders that can serve as natural barriers to re-infection, thus making sustained disease freedom more feasible. In these countries, improved control and eradication are more likely to become economically viable and politically attractive. Other countries in the region, however, possess less-developed commercial sectors and less-protected borders, so potential benefits from FMD control still remain limited and the challenge of controlling FMD is much greater given the extent of cross-border animal movements and constrained public resources.

A second theme concerns the distribution of costs and benefits from FMD control. FMD often occurs in smallholder production systems in which the control costs to producers are often greater than the direct benefits gained, so incentives to participate in control efforts are low. Foot and mouth disease control is therefore typically considered a public good, and so is undertaken by governments at public expense. However, the benefits from effective control, and especially successful eradication, of FMD accrue primarily to large-scale commercial producers who can subsequently reduce their control measures and gain access to new export markets. This would suggest that considerable scope exists for governments to involve the private sector more actively in financing national FMD control efforts.

These findings have clear implications for regional FMD control efforts. Given the diversity in the economic impacts of FMD and in national capacities for control of the disease, regional freedom in South-East Asia remains highly unlikely in the short to medium term. Investments to support regional control efforts will need to continue to be carefully evaluated based on individual country realities. In the meantime, demonstrating the benefits from improving access to export markets could enhance incentives for control efforts within the region. This can be achieved through establishing zone freedom in certain areas, or by developing animal product processing procedures acceptable to importing nations. To be successful, applications to the OIE for recognition of zone freedom within a country require the demonstration of ability to maintain that freedom through the use of buffer and surveillance zones, among other measures. There has been considerable discussion of the possible creation of FMD-free zones and recently, a new initiative has been established between the countries of Myanmar, Thailand and Malaysia (MTM) to embark on a campaign for control and eradication of FMD in the peninsular area of South-East Asia that they share (9).

Furthermore, importantly, the principle of understanding better the distribution of costs and benefits from FMD control needs to be applied at the regional level. Clearly identifying the beneficiaries of improved FMD control within and across the countries of the region can provide the basis for formulating innovative strategies so that those who stand to gain (i.e., countries better positioned to export, or the large-scale commercial sector) 'invest' in those who otherwise lack the resources or incentives to support the needed control efforts. Co-ordination at the regional level of these differential incentives to invest in control may be as critical as co-ordinating the implementation of the control efforts themselves. The OIE Sub-Commission for Foot and Mouth Disease in South-East Asia has recently commissioned a working group to examine ways of enhancing the communications between the public and private sectors within the countries of the region to promote such initiatives (9).

The Philippines analysis presented in this paper, along with the earlier studies in Thailand and Laos, demonstrate the complexity of the issues involved in FMD and control of the disease in South-East Asia, and the valuable role that economic impact assessment can play in supporting responsible decision-making in the areas of policy and strategy. The challenge remains to improve further the quality of the data for such evaluations, and the scope and ability of the models upon which such analyses are based.

Acknowledgements

The authors would like to acknowledge the helpful comments of John McDermott, David Hall and Tony Forman.

This paper is referenced by the ILRI as ILRI Publication No. 200224.

© OIE - 2002

Impact économique de la prophylaxie et de l'éradication de la fièvre aphteuse aux Philippines

T.F. Randolph, B.D. Perry, C.C. Benigno, I.J. Santos, A.L. Agbayani, P. Coleman, R. Webb & L.J. Gleeson

Résumé
Les auteurs ont recours à l'analyse coût-bénéfice pour évaluer l'impact de la fièvre aphteuse et de la lutte contre cette maladie aux Philippines. Ils comparent à d'autres scénarios une situation caractérisée par le maintien des mesures de prophylaxie à leur niveau récent et la présence constante de la fièvre aphteuse. Ces scénarios prévoient, à l'horizon 2005 (objectif de la politique actuelle), 2007 et 2010, l'éradication de la maladie par un programme à financement public. En fonction des hypothèses d'accroissement des exportations des produits d'origine animale résultant de l'éradication, les investissements réalisés dans l'éradication présentaient un rapport bénéfice-coût variant de 1,6 (2010, aucune exportation) à 12,0 (2005, exportations de produits d'origine animale à faible et à forte valeur, pour 5 000 tonnes annuelles de chaque catégorie), attestant ainsi de leur rentabilité économique. Selon les estimations, la filière porcine industrielle devrait recueillir 84 % des avantages générés par le financement public de l'éradication, contre 4 % pour les élevages de porcs de type familial. Les implications de ces résultats sont passées en revue à la lumière des efforts de la région pour maîtriser la fièvre aphteuse en Asie du Sud-Est.

Mots-clés
Analyse coût-bénéfice – Analyse politique – Asie du Sud-Est – Économie – Éradication – Évaluation de l'impact économique – Fièvre aphteuse – Philippines – Prophylaxie – Santé animale.

■

Repercusiones económicas del control y erradicación de la fiebre aftosa en Filipinas

T.F. Randolph, B.D. Perry, C.C. Benigno, I.J. Santos, A.L. Agbayani, P. Coleman, R. Webb & L.J. Gleeson

Resumen
Analizando la relación costos-beneficios, los autores estudian las consecuencias de la fiebre aftosa y el control de la enfermedad en Filipinas. Tomando como punto de partida los niveles actuales de control y presencia de la enfermedad, comparan esta situación con la hipotética aplicación de un programa financiado con fondos públicos que culminara con la erradicación de la fiebre aftosa en 2005 (objetivo actual), 2007 o 2010. Una vez erradicada la enfermedad es de prever un cierto grado de desarrollo de las exportaciones de productos pecuarios. En función del nivel de desarrollo que se calcule, la estimación del cociente entre beneficios y costos (de las inversiones necesarias para la erradicación) oscila entre 1,6 (2010, sin exportaciones) y 12,0 (2005, exportación de productos

© OIE - 2002

pecuarios de escaso y de gran valor, 5.000 toneladas anuales de cada tipo). De ahí se deduce que la erradicación es una inversión económicamente viable. Se estima que el sector de la producción porcina industrial obtiene un 84% de los beneficios generados por las inversiones públicas en medidas de erradicación, frente al 4% que recae a los productores artesanales. Los autores, por último, examinan las consecuencias de estos resultados en el contexto de las iniciativas regionales de control de la fiebre aftosa en el Sudeste asiático.

Palabras clave
Análisis de programas – Análisis de la relación costos-beneficios – Control de enfermedades – Economía – Erradicación – Evaluación de las repercusiones económicas – Fiebre aftosa – Filipinas – Sanidad animal – Sudeste asiático.

References

1. Arámbulo P. (1977). – Estimation of the economic losses from foot and mouth disease and cost-benefit analysis of alternative policies for eradication in a developing country. PhD thesis, University of Texas, 240 pp.

2. Delgado C.L., Rosegrant M., Steinfeld H., Ehui S. & Courbois C. (1999). – Livestock to 2020: the next food revolution. Food, Agriculture, and the Environment Discussion Paper No. 228. International Food Policy Research Institute (IFPRI), Food and Agriculture Organization of the United Nations (FAO), and International Livestock Research Institute (ILRI). IFPRI, Washington DC, 72 pp.

3. Delgado C.L., Rosegrant M.W. & Meijer S. (2001). – Livestock to 2020: the revolution continues. *In* Report of the annual meeting of the International Agricultural Trade Research Consortium, 18-19 January, Auckland. International Food Policy Research Institute, Washington, DC, 38 pp.

4. Garner M.G. & Lack M.B. (1995). – An evaluation of alternative control strategies for foot and mouth disease in Australia: a regional approach. *Prev. vet. Med.*, **23**, 9-32.

5. Harrison S.R. & Tisdell C.A. (1999). – Economic impact of foot and mouth disease in Thailand. Draft report to the Department of Livestock Development. Department of Livestock Development, Bangkok, 95 pp.

6. Kristjanson P.M., Swallow B.M., Rowlands G.J., Kruska R.L. & De Leeuw P.N. (1999). – Measuring the costs of African animal trypanosomiasis, the potential benefits of control and returns to research. *Agric. Syst.*, **59**, 79-98.

7. Leslie J. & Upton M. (1999). – The economic implications of greater global trade in livestock and livestock products. *In* The economics of animal disease control (B.D. Perry, ed.). *Rev. sci. tech. Off. int. Epiz.*, **18** (2), 440-457.

8. Office International des Epizooties (OIE) (2001). – Resolution XVII: Recognition of the foot and mouth disease status of Member Countries, adopted by the OIE International Committee, 31 May (adopted by the International Committee of the OIE on 28 May 2002) (http://www.oie.int/eng/info/en_fmd.htm accessed on 29 July 2002).

9. Office International des Epizooties (OIE) (2002). – Recommendations from the 8th Meeting of the OIE Sub-Commission for FMD in South-East Asia, 4-8 March, Penang, Malaysia. OIE, Paris, 7 pp.

10. Palisade Corporation (1997). – Guide to using @Risk: risk analysis and simulation add-in for Microsoft Excel or Lotus 1-2-3. Palisade Corporation, Newfield, New York, 318 pp.

11. Perry B.D., Kalpravidh W., Coleman P.G., Horst H.S., McDermott J.J., Randolph T.F. & Gleeson L.J. (1999). – The economic impact of food and mouth disease and its control in South-East Asia: a preliminary assessment with special reference to Thailand. *In* The economics of animal disease control (B.D. Perry, ed.). *Rev. sci. tech. Off. int. Epiz.*, **18** (2), 478-497.

12. Perry B.D., Gleeson L.J, Khounsey S., Bounma P. & Blacksell S.D. (2002). – The dynamics and impact of foot and mouth disease in smallholder farming systems in South-East Asia: a case study in Laos. *In* Foot and mouth disease: facing the new dilemmas (G.R. Thomson, ed.). *Rev. sci. tech. Off. int. Epiz.*, **21** (3), 663-673.

13. Rushton J., Thornton P.K. & Otte M.J. (1999). – Methods of economic impact assessment. *In* The economics of animal disease control (B.D. Perry, ed.). *Rev. sci. tech. Off. int. Epiz.*, **18** (2), 315-342.

© OIE - 2002