Criteria and indicators for foot and mouth disease control strategy decision-making in Asia–Oceania countries

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E. Kim*, T. Carpenter, S. Rowanowski & N. Cogger

EpiCentre, Massey University, Palmerston North 4474, New Zealand

*Corresponding author: e.kim@massey.ac.nz, tteum2@gmail.com

Summary

The objective of this study is to identify the relative importance of criteria that could be used to evaluate control strategies for foot and mouth disease (FMD). A questionnaire was distributed to 21 Chief Veterinary Officers (CVOs), or their representatives, at the 28th Conference of the Regional Commission for Asia, the Far East and Oceania of the World Organisation for Animal Health (OIE), held on 18–22 November 2013 in Cebu, the Philippines. The CVOs/CVO representatives were present on behalf of 21 of the 31 OIE Member Countries in the region, and the questionnaire evaluated the importance of epidemiologic, economic and social–environmental criteria in the FMD control strategy decision-making process. In the epidemiologic criterion, the size of an FMD outbreak area, with a median relative importance score of 90 (range 45–100), was viewed as the most important indicator. While the direct cost of FMD control measures was considered to be the most important economic criterion indicator with a median relative importance score of 80 (range 30–100). Finally, in the social–environmental criterion, the mental health of FMD-affected farmers was viewed as the most important indicator with a median relative importance score of 70 (range 5–100). With respect to the FMD status of a country, the economic criterion was considered more important in 'FMD-free' countries (countries where

an FMD outbreak had not been reported to the OIE in the ten years prior to the survey) than in 'FMD-experienced' countries (countries where an FMD outbreak had been reported to the OIE within the same period). The median relative importance scores of FMD-experienced countries and FMD-free countries were 80 (range 50–95) and 95 (range 40–100), respectively. Regarding the percentage contribution of the agriculture sector to a country's gross domestic product, a statistically significant difference was not found between countries and indicators. In the future, the current survey of the relative importance of criteria and indicators should facilitate a transparent discussion on the implications of FMD control strategies and rapid response during an FMD outbreak.

Keywords

Asia–Oceania – Chief Veterinary Officer – Livestock diseases control strategy decision-making – Foot and mouth disease – Multi-criteria decision analysis.

Introduction

Foot and mouth disease (FMD) outbreaks have economic, environmental and social impacts. The 2001 FMD outbreak in the United Kingdom (UK) resulted in losses to the UK's agriculture sector of approximately £3.1 billion (1). Most of these economic losses were as a result of compensation paid for slaughtered animals and costs associated with the disposal of carcasses. The method of carcass disposal, such as burning or burying, could also have a damaging effect on the environment (2). In addition, when considering control options for FMD, ethical issues, including animal welfare, must be considered because the mass culling of animals or burning of carcasses could be considered to be cruel (3). Therefore, it is potentially important for decision-makers to consider epidemiologic, economic, environmental and social issues when selecting an appropriate FMD control strategy. A decision support tool that considers multiple views when formulating optimal decisions is multi-criteria decision analysis (MCDA). This tool was used in the study to quantify the preferences of decision-makers regarding FMD control.

The MCDA includes formulating the problem, evaluating possible solutions and balancing decision-makers' preferences (4). Firstly, the problem is defined and the views of various groups identified, then a process to evaluate possible options for solving the problem is followed. Finally, the solution chosen is explained and its choice justified.

If communication between decision-makers and stakeholders on the control of FMD is ineffective, however, the implementation of the FMD control strategy might be hampered. For example, during the 2001 FMD outbreak in the Netherlands, many farmers opposed the pre-emptive culling of at-risk animals that were not infected, even though it had been shown that this strategy was more effective than vaccination (5). Thus, it is important for decision-makers and stakeholders to share their understanding of decision-making with regard to the FMD control strategy. Understanding the preferences of decision-makers and stakeholders for the control of FMD would facilitate communication between them. By gathering information from stakeholders on their preferences, decision-makers could incorporate stakeholder viewpoints in their policy-making. Generally, Chief Veterinary Officers (CVOs) play an important role in decision-making on veterinary policy for the control of FMD. The CVOs are the heads of the national animal health authorities and are responsible for the totality of veterinary professional input to animal health issues such as FMD, helping to shape policy for the control of diseases, and influencing the delivery of disease control policy. For example, in the Republic of Korea, the CVO provides policy advice on animal health issues by collaborating with the country's veterinary colleges, the animal health community and the veterinary profession (6). In Australia, the Animal Health Committee, which consists of the CVO of Australia, the Australian state and territory CVOs, Animal Health Australia, and the Commonwealth Scientific and Research Organisation, makes decisions on the national strategy for emergency animal diseases such as FMD (7). Thus, the perspectives of CVOs would affect the final decision on FMD control strategies. To date, only one research paper has used MCDA to describe the preferences of CVOs for the control of an animal disease; this was for classical

swine fever (CSF) in Europe (8). No published papers were found in which MCDA had been used to evaluate FMD control options in the Asia–Oceania region, neither has the technique been applied to other animal health problems in countries in this region. In the Asia–Oceania region, FMD is absent in some countries but endemic in others. Moreover, there have been no reports published on what the representatives of veterinary offices in Asia and Oceania consider to be important when choosing an FMD control strategy. Therefore this study has two objectives:

– to collect the opinions of CVOs, or their representatives, in order to help in selecting an FMD control strategy

– to catalogue the differences in the relative importance assigned to criteria between countries.

An important advantage of collecting the preferences of CVOs or their representatives with regard to selecting an FMD control strategy is that the preferences can be used as weighting factors to reflect the values of CVOs in decision-making on an FMD control strategy. Another advantage of collecting this data is that the differences in preference between CVOs from 'FMD-free' countries (countries where an FMD outbreak had not been reported to the World Organisation for Animal Health [OIE] in the ten years prior to the survey) and 'FMD-experienced' countries (countries where an FMD outbreak had been reported to the OIE within the same period) can be compared and contrasted. In addition, insights can be provided to improve understanding of decision-making in the strategy of FMD control.

Chief Veterinary Officers and the questionnaire

The preferences of CVOs, or their representatives, recorded in this study were based on the results of the above-mentioned written questionnaire (see Table I). Through this questionnaire, participants expressed their opinions on epidemiologic, economic and social–environmental criteria in the FMD control strategy decision-making process using relative importance scores and rankings of indicators.

The study participants were the 21 CVOs/CVO representatives, who attended the 28th Conference of the OIE Regional Commission for Asia, the Far East and Oceania held on 18–22 November 2013 in Cebu, the Philippines. These participants represented 21 of the 31 OIE Member Countries in the region, and their completed questionnaires were collected on 19 November 2013.

The questionnaire comprised 21 items grouped under four questions as indicators to be ranked and scored, resulting in 42 statistical items in total (21 ranked and 21 scored). The ranking questions indicated the priority of indicator use when making a decision on an FMD control strategy. The rank ranged from 1 to 6, where 1 was the highest priority indicator and 6 the lowest. The scored questions quantified the relative importance of the indicators in the FMD control strategy. Possible scores ranged from 0 to 100 with higher scores indicating greater importance. The questions were related to the preference of CVOs/CVO representatives according to three criteria: epidemiologic, economic and social–environmental in which questions 1, 2 and 3 were related to epidemiologic, economic and social–environmental criteria, respectively, and question 4 incorporated all three criteria. The three criteria to quantify the preferences of CVOs/CVO representatives when selecting an FMD control strategy were based on previous MCDA studies (8, 9), which measured the preferences of CVOs in the European Union (EU) when selecting an optimal CSF control strategy. Questions on the epidemiologic criterion addressed the importance of the epidemiologic effectiveness of the FMD control strategies, including the duration of the outbreak, the size of the outbreak area, and the number of infected farms and animals. Questions on the economic results of the FMD control strategies addressed indicators like the direct cost of an FMD control measure, the loss from depopulated farms and animals, and the decrease in animal products exported. The social–environmental component contained questions on the effects of FMD outbreaks on human and environmental health; for example, questions related to the mental health of the public or of farmers with FMD-affected farms, the effects of carcass disposal on the environment or animal/human welfare. Participants were asked to answer the questions taking into

consideration the current FMD status of their countries. Prior to the study, the questionnaire was trialled on ten non-native English-speaking postgraduate students in the EpiCentre, Massey University, New Zealand, to check that the questions were being understood as the authors had intended. The questionnaire did not require any human ethics issues.

A binary variable was created to code the FMD status of the 21 countries whose CVOs/CVO representatives had responded. As mentioned above, a country was considered to be 'FMD-free' if an FMD outbreak had not been reported to the OIE in the ten years prior to the survey and 'FMD-experienced' if there had been an FMD outbreak within the same period, as recorded in the OIE World Animal Health Information System (10). It is important to note that the classification system used in this paper is not the same as that used by the OIE when determining a country's official disease status. Specifically, in the current study, some countries classified as FMD-experienced may have eradicated FMD either with or without vaccination and would be considered to be officially FMD-free by the OIE; however, for the purposes of this paper, if a country had reported an FMD outbreak within the last ten years then it was considered to be FMD-experienced (Table II). In addition, the FMD-experienced countries were divided into two groups based on the time since their last FMD outbreak: less than a year or more than a year (Table II). The percentage contributions of the agriculture sector to the gross domestic product (GDP) for 2013 of each of the 21 OIE Member Countries were obtained from the World Bank (11) and are contained in Table III. There could be other factors which might influence the relative importance of criteria and indicators such as the regulation of an FMD control or compensation for culled animals. However, the authors did not collect information on those factors because the goal of the study was not to explain the reasons for differences between countries but to explore the range of the differences.

Data analysis

The data from the completed questionnaires were entered into Microsoft Excel and analysed using R, version 3.1.0 (www.r-project.org/). Statistical analyses took place in two parts: descriptive and inferential. The relative importance of each of the six indicators in each of the three criteria (questions 1 to 3) and each of the three weighting factors (question 4) were expressed using the minimum, median and maximum scores. Using the Mann-Whitney-Wilcoxon test, differences in the relative importance of criteria and indicators were explored between: *i*) FMD-experienced countries and FMD-free countries; *ii*) countries in which the percentage contribution of the agriculture sector to the GDP was more than 10% and those in which it was less than 10%; and *iii*) countries in which the time since the last FMD outbreak was less than a year and those in which it was more than a year. Significance was indicated by a value of $p < 0.05$. The rank of criteria and indicators was only used to confirm that the score had been assigned appropriately (i.e. higher ranked criteria or indicators should have higher scores). The correlation of the relative importance between criteria was explored using the Spearman rank correlation test and significance was indicated by a value of $p < 0.05$.

Results

All 21 CVOs/CVO representatives at the meeting completed the questionnaire and there were no missing values. Among the 21 respondents, 12 were from FMD-experienced countries and nine were from FMD-free countries. No statistically significant difference was detected between both groups in the scores given for epidemiologic, economic and social–environmental criteria (p-value = 0.42). When determining an FMD control strategy, the epidemiologic criterion was the highest scored criterion, with a median relative importance score of 90 (range 50–100; Table IV). Median relative importance scores for the economic and social–environmental criteria were 85 (range 40–100) and 80 (range 25–98), respectively.

With respect to FMD status, only the economic criterion showed a statistically significant difference in relative importance between

FMD-experienced and FMD-free countries; these were 80 (range 50–95) and 95 (range 40–100), respectively. In addition, the score ranges were larger in the FMD-free countries than the FMD-experienced countries. The median epidemiologic scores were 90 (range 80–100) in FMD-experienced countries and 95 (range 50–100) in FMD-free countries. The social–environmental scores were 61 (range 25–80) for FMD-experienced countries and 80 (range 30–98) for FMD-free countries.

The relative importance scores of each indicator in the three criteria: epidemiologic, economic and social–environmental, are shown in Tables V, VI and VII. No statistically significant difference was found in the relative importance scores between indicators in each criterion. In the epidemiologic criterion, the size of the FMD outbreak area was regarded as the most important indicator, with a median relative importance score of 90 (range 45–100; Table V). The other indicators in the epidemiologic criterion, in decreasing order of importance, were: duration of FMD outbreaks, number of infected farms, number of infected animals, number of depopulated farms and number of depopulated animals. There were no statistically significant differences between FMD-experienced and FMD-free countries in the relative importance scores for each indicator. The order of importance for indicators in the epidemiologic criterion was similar for FMD-experienced and FMD-free countries. Both types of country considered the size of an FMD outbreak area to be the most important of the six indicators. The median relative importance scores for the FMD outbreak area indicator were 90 (range 50–100), in FMD-experienced countries, and 88 (range 45–98), in FMD-free countries. In the economic criterion, the cost of control measures was considered the overall most important indicator, with a median relative importance score of 80 (range 30–100; Table VI). The other indicators, in decreasing order of importance, were: farm loss from depopulation, farm loss from movement restriction, industry loss from movement restriction, export loss and tourism loss. As with the epidemiologic criterion, there was no statistically significant difference in indicator scores between FMD-experienced and FMD-free countries.

In the social–environmental criterion, the mental health of farmers on farms affected by FMD was considered to be the most important indicator, with a median score of 70 (range 5–100; Table VII). The other indicators, in decreasing order of importance, were: the mental health of the public, the welfare of FMD-infected animals, the welfare of non-infected animals, air pollution, and ground pollution due to carcass disposal. No significant difference between FMD-experienced and FMD-free countries was found for the social–environmental indicators.

With respect to the time since the last FMD outbreak and the percentage contribution of the agriculture sector to a country's GDP, no statistically significant difference was found between countries and criteria (p-value > 0.05; Tables VIII, IX).

With respect to the correlation between criteria, statistical significance was found between epidemiologic and economic criteria ($\rho = 0.34$, p-value = 0.02; Fig. 1) and between economic and social–environmental criteria ($\rho = 0.53$, p-value = 0.01; Fig. 1). However, no statistically significant correlation was found between epidemiologic and social–environmental criteria ($\rho = 0.20$, p-value > 0.05; Fig. 1).

Discussion

This survey of 21 CVOs/CVO representatives from the Asia–Oceania region is the first published study to evaluate the preferences of CVOs for indicators used in decision-making regarding FMD control strategies. The study found no statistically significant differences between the scores given for epidemiologic, economic and social–environmental criteria. However, the CVOs or their representatives ranked the epidemiologic criteria as the most important in FMD control strategy decision-making. In other words, when CVOs/CVO representatives chose an FMD control strategy, epidemiologic indicators such as the duration of FMD outbreaks, the size of an FMD outbreak area, or the number of FMD-impacted farms were more important than the indicators used to determine the financial or social–environmental criteria. For CSF, Mourits *et al.* reported the same criteria ranking as the authors found in this study (8). The participants

in the study of Mourits *et al*., as in the current study, were CVOs or their representatives, in the former instance, in the EU as opposed to the Asia–Oceania region. The present study found that while the median relative importance scores of the epidemiologic and social–environmental criteria was not found to be statistically significant between respondents from FMD-free and FMD-experienced countries, the median relative importance of the economic criterion was. The economic losses resulting from an FMD outbreak and the economic effectiveness of the FMD control strategy were considered more important for the FMD control strategy decision-making process in FMD-free countries than in FMD-experienced countries. For example, the Republic of Korea has been applying a vaccination strategy since its 2010/2011 FMD outbreak after which all cattle and swine in the country were vaccinated. The Korean decision-makers involved in creating the FMD control strategy were forced to make value trade-offs between the epidemiologic and economic criteria in light of the country's experience of an FMD outbreak. No statistically significant difference was found between FMD-experienced and FMD-free countries in the median relative importance scores of the indicators. In the study, the CVOs/CVO representatives in the Asia–Oceania region scored their preferences for six indicators in each criterion. In the epidemiologic criterion, the size of an FMD outbreak area was scored as the most important indicator followed by the duration of the FMD outbreak. In contrast, CVOs/CVO representatives in the EU in Mourits *et al*.'s study considered the duration of outbreaks to be more important than the size of outbreak areas when considering CSF control strategies (8). The current study also considered the FMD status of respondents' countries, viewing this as the most significant factor in FMD control strategy decision-making. For example, if FMD is endemic in a country, the FMD control strategy will be applied to minimise the disease impact, however if an FMD outbreak occurs in a previous FMD-free country, the FMD control strategy will be performed to eradicate the disease.

The authors designed the current study to capture and quantify the difference in the relative importance of decision-making factors with regard to a country's FMD status. The small study sample size – 21

representatives of 31 OIE Member Countries in the Asia–Oceania region (representatives of the remaining ten Member Countries did not attend the meeting where the questionnaire was distributed) – means it has a low statistical power and may not truly represent the preference of CVOs/CVO representatives in the study region. For example, the statistical power of the study was calculated, using G*Power, version 3.1.9.2 (www.gpower.hhu.de/en.html), to be approximately 0.1 with an effect size of 0.29, the mean economic indicator for FMD-experienced countries was 81 (standard deviation = 18) and for FMD-free countries was 86 (standard deviation = 17). In other words, the lack of a statistically significant difference could have been due to the lack of statistical power. The source population was the Asia–Oceania region; however, the following ten countries from the region were not included in the study because they were not represented at the meeting: Bangladesh, Bhutan, India, Laos, Maldives, Nepal, Pakistan, Republic of Korea, Timor Leste and Vanuatu. Among these ten non-participant countries, only Vanuatu is an FMD-free country with the others being FMD-experienced countries. The inclusion of these countries, however, would have been insufficient for the study to gain a statistical power above 80%. Nevertheless, despite requiring an expansion in its scope, the study has achieved its main goal of – collecting various opinions to aid in FMD control strategy decision-making from CVOs or their representatives.

Conclusions

The results indicate that CVOs, and their representatives, in FMD-experienced and FMD-free countries have a similar understanding of the epidemiological and social consequences of the disease. A difference was observed for the economic consequence only, which could not, however, be specified and could not be linked to either the contribution of the agriculture sector to GDP, or to the fact that the last FMD outbreak occurred less or more than one year prior to the study taking place.

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Table I

The questionnaire used to measure the relative importance scores of criteria and indicators related with foot and mouth disease control strategies

Which country are you from?

Put the rank adjacent to each indicator (1–6) with rank 1 being the most important and rank 6 being the least and put the scores adjacent to each indicator (0–100) with high scores being more important to you.

1. How important are the following epidemiologic criteria for FMD eradication/control in your country?

Indicator	Rank	Score
Duration of outbreak		/100
Size of outbreak area		/100
Number of infected farms		/100
Number of infected animals		/100
Number of farms where animals are destroyed		/100
Number of destroyed animals		/100

2. How important are the following economic criteria for FMD eradication/control in your country?

Indicator	Rank	Score
Direct cost of FMD control measures (e.g. vaccination)		/100
Farm loss from the amount of depopulated animals		/100
Farm loss from movement restrictions (e.g. holding milk)		/100
Industry loss from movement restrictions (e.g. slaughterhouse)		/100
Loss from an export ban		/100
Loss from tourism decrease		/100

3. How important are the following social/environmental criteria for FMD eradication/control in your country?

Indicator	Rank	Score
Mental health in FMD affected farmers		/100
Mental health in the public		/100
Welfare of the infected animals		/100
Welfare of the non-affected animals		/100
Air pollution from carcass disposal		/100
Ground pollution from carcass disposal		/100

4. How important are the following criteria for FMD eradication/control in your country?

Indicator	Rank	Score
Effectiveness of the FMD control strategy to eradicate/control the outbreak		/100

Impact of the FMD control strategy on the country's economy		/100
Impact of the FMD control strategy on the social and environmental issues		/100

FMD: foot and mouth disease

Table II

Foot and mouth disease status of 21 participant countries in the study

Country	FMD-free? *	Time since the last outbreak ≤1 year?
Australia	Yes	No
Brunei	Yes	N/A
Cambodia	No	Yes
China (People's Republic of)	No	Yes
Chinese Taipei	No	Yes
Fiji	Yes	N/A
Indonesia	Yes	No
Iraq	No	Yes
Japan	No	No
Korea (Republic of)	No	No
Malaysia	No	Yes
Mongolia	No	No
New Caledonia	Yes	N/A
New Zealand	Yes	No
Papua New Guinea	Yes	N/A
Philippines	Yes	No
Russia	No	Yes
Singapore	Yes	N/A
Sri Lanka	No	Yes
Thailand	No	Yes
Vietnam	No	Yes

Source: World Organisation for Animal Health (10)

* A country was considered free of foot and mouth disease if there had been no reported outbreaks of the disease within the ten years prior to the study

N/A: not applicable

Table III

The percentage contribution of the agriculture sector to the gross domestic product of the 21 participant countries in 2013 study

Country	Percentage of GDP (%)	Percentage of GDP ≥ 10% *?
Australia	2	No
Brunei	1	No
Cambodia	34	Yes
China (People's Republic of)	9	No
Chinese Taipei	N/A	N/A
Fiji	12	Yes
Indonesia	14	Yes
Iraq	N/A	N/A
Japan	1	No
Korea (Republic of)	2	No
Malaysia	9	No
Mongolia	15	Yes
New Caledonia	N/A	N/A
New Zealand	7	No
Papua New Guinea	N/A	N/A
Philippines	12	Yes
Russia	4	No
Singapore	N/A	N/A
Sri Lanka	11	Yes
Thailand	12	Yes
Vietnam	18	Yes

Source: World Bank (11)

* The median value of the percentage of the livestock industry of the 21 participant countries

GDP: gross domestic product

N/A: not applicable

Table IV

The relative importance scores of criteria for a foot and mouth disease control strategy according to the preferences of 21 Chief Veterinary Officers, or their representatives, from the Asia–Oceania region, taking into consideration foot and mouth disease status

Criterion	FMD-free*	Rank	Minimum	Median	Maximum	*p*-value
Epidemiologic	No	1	80	90	100	0.26
	Yes	1	50	95	100	
	Overall	1	50	90	100	
Economic	No	2	50	80	95	0.04
	Yes	2	40	95	100	
	Overall	2	40	85	100	
Social–environmental	No	3	25	61	80	0.13
	Yes	3	30	80	98	
	Overall	3	25	80	98	

* Data were grouped by FMD country status. A country was classified as 'FMD free' if there had been no FMD outbreak in the last ten years (n = 9) and as 'FMD-experienced', or not free of FMD, if there had been an FMD outbreak within last ten years (n = 12). No statistically significant difference was evident in the scores given for epidemiologic, economic and social–environmental criteria (p-value = 0.42)

FMD: foot and mouth disease

Table V

The epidemiologic indicator scores for a foot and mouth disease control strategy according to the preferences of 21 Chief Veterinary Officers, or their representatives, from the Asia–Oceania region

Indicator	FMD-free*	Minimum	Median	Maximum	*p*-value
Duration of FMD	No	10	70	95	0.53
	Yes	10	84	100	
	Overall	10	80	100	
Size of FMD outbreak area	No	50	90	100	0.78
	Yes	45	88	98	
	Overall	45	90	100	
No. of infected farms	No	30	80	98	0.78
	Yes	35	73	95	
	Overall	30	78	98	
No. of infected animals	No	30	60	90	0.52
	Yes	20	60	98	
	Overall	20	60	98	
No. of depopulated farms	No	5	30	80	0.15
	Yes	10	60	80	
	Overall	5	40	80	
No. of depopulated animals	No	5	20	95	0.24
	Yes	5	43	85	
	Overall	5	30	95	

* Data were grouped by FMD country status. A country was classified as 'FMD-free' if there had been no FMD outbreak in the last ten years (n = 9) and as 'FMD-experienced', or not free from FMD, if there had been an FMD outbreak within last ten years (n = 12). No statistically significant difference was evident in the scores given for the epidemiologic indicators (p-value = 0.44)

FMD: foot and mouth disease

Table VI

The economic indicator scores for a foot and mouth disease control strategy according to the preferences of 21 Chief Veterinary Officers, or their representatives, from the Asia–Oceania region

Indicator	FMD-free*	Minimum	Median	Maximum	*p*-value
Cost of control measures	No	30	83	100	0.47
	Yes	50	75	90	
	Overall	30	80	100	
Farm loss from depopulation	No	5	70	100	0.80
	Yes	30	70	100	
	Overall	5	75	100	
Farm loss from movement restriction	No	50	80	90	0.07
	Yes	5	64	85	
	Overall	5	70	90	
Industry loss from movement restriction	No	30	60	90	0.75
	Yes	30	75	93	
	Overall	30	70	93	
Export loss	No	5	50	95	0.83
	Yes	10	45	100	
	Overall	5	50	100	
Tourism loss	No	5	25	65	0.99
	Yes	5	13	90	
	Overall	5	20	90	

* Data were grouped by FMD country status. A country was classified as 'FMD-free' if there had been no FMD outbreak in the last ten years (n = 9) and as 'FMD-experienced' or not free from FMD if there had been an FMD outbreak within last ten years (n = 12). No statistically significant difference was evident in the scores given for the economic indicators (p-value = 0.21)

FMD: foot and mouth disease

Table VII

The social–environmental indicator scores for a foot and mouth disease control strategy according to the preferences of 21 Chief Veterinary, or their representatives, from the Asia–Oceania region

Indicator	FMD-free*	Minimum	Median	Maximum	p-value
Mental health of affected farmers	No	40	80	100	0.46
	Yes	5	62	100	
	Overall	5	70	100	
Mental health of the public	No	25	70	80	0.55
	Yes	10	53	100	
	Overall	10	60	100	
Welfare of infected animals	No	5	62	100	0.43
	Yes	30	53	80	
	Overall	5	60	100	
Welfare of non-infected animals	No	5	60	85	0.83
	Yes	20	50	90	
	Overall	5	50	90	
Air pollution	No	5	10	90	0.29
	Yes	5	67	90	
	Overall	5	50	90	
Ground pollution	No	5	30	100	0.34
	Yes	0	73	90	
	Overall	0	50	100	

* Data were grouped by FMD country status. A country was classified as 'FMD-free' if there had been no FMD outbreak in the last ten years (n = 9) and as 'FMD-experienced' or not free from FMD if there had been an FMD outbreak within last ten years (n = 12). No statistically significant difference was evident in the scores given for the social–environmental indicators (p-value = 0.18)

FMD: foot and mouth disease

Table VIII

The relative importance scores of criteria for a foot and mouth disease (FMD) control strategy according to the preferences of 21 Chief Veterinary Officers, or their representatives, from the Asia–Oceania region, taking into consideration the time since the last FMD outbreak

Criterion	Time since the last FMD*	Rank	Minimum	Median	Maximum	*p*-value
Epidemiologic	< 1	1	80	90	100	0.42
	>1	1	80	90	90	
	Overall	1	80	90	100	
Economic	< 1	2	50	83	87	0.53
	>1	2	60	80	95	
	Overall	2	50	80	95	
Social–environmental	< 1	3	25	71	80	0.69
	>1	3	60	60	80	
	Overall	3	25	61	80	

* Two groups were formed: one where the time since the last FMD outbreak had been less than a year (n = 9) and another where the time since the last FMD outbreak had been more than one year (n = 3). Among the 21 countries, nine countries were excluded since they had not experienced an FMD outbreak. No statistically significant difference was evident in the scores given for epidemiologic, economic and social–environmental criteria (p-value = 0.39)

FMD: foot and mouth disease

Table IX

The relative importance scores of the criteria for a foot and mouth disease control strategy according to the preferences of 21 Chief Veterinary Officers, or their representatives, from the Asia–Oceania region, taking into consideration the percentage contribution of the agriculture sector to the gross domestic product

Criterion	% GDP*	Rank	Minimum	Median	Maximum	*p*-value
Epidemiologic	< 10%	1	80	90	95	0.50
	≥ 10%	1	50	99	100	
	Overall	1	50	90	100	
Economic	< 10%	2	60	83	100	0.43
	≥ 10%	2	40	86	98	
	Overall	2	40	85	100	
Social – environmental	< 10%	3	60	75	90	0.76
	≥ 10%	3	30	56	87	
	Overall	3	25	80	98	

* Data were grouped by percentage contribution of the agriculture sector to GDP. One group where the percentage contribution was less than 10% (n = 8) and another where the percentage contribution was more than 10% (n = 8). Among 21 countries, five countries were excluded due to a lack of the data. No statistically significant difference was evident in the scores given for epidemiologic, economic and social–environmental criteria (p-value = 0.44)

GDP: gross domestic product

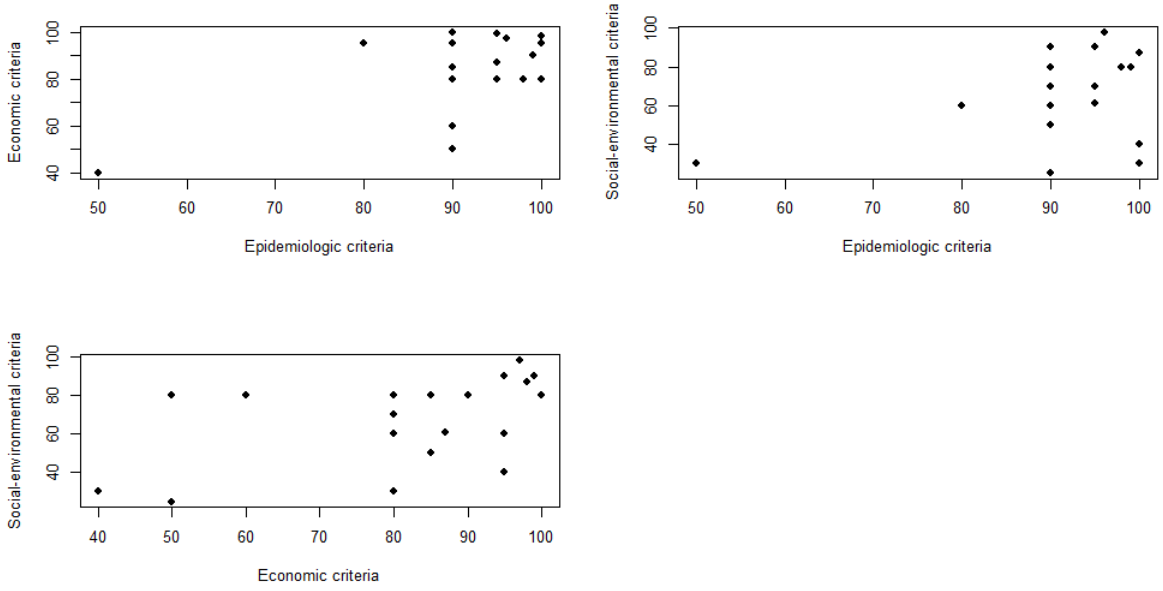

Fig. 1

Scatter plots of the relative importance of criteria according to the preferences of 21 Chief Veterinary Officers, or their representatives, from the Asia–Oceania region between epidemiologic criteria, economic criteria and social–environmental criteria

(a (up-left): between epidemiologic and economic criteria (ρ = 0.34, p-value = 0.02), b (up-right): epidemiologic and social–environmental criteria (ρ = 0.53, p-value = 0.01), c (down-left): economic and social–environmental criteria (ρ = 0.20, p-value > 0.05))