FMD IMPACT AND COST BENEFIT ANALYSIS

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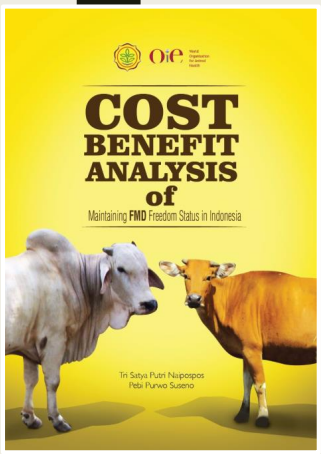

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Cost Benefit Analysis of Maintaining FMD Freedom Status in Indonesia

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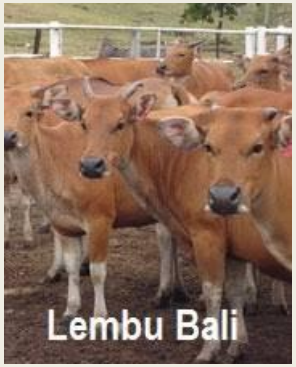
Government program to increase cattle productivity



- The GoI is currently aiming for self-sufficiency in beef to:
  - *maintain domestic price stability*
  - *make beef more affordable to consumers*
  - *support the livelihoods of local farmers*
- Target for beef self-sufficiency is to be achieved by 2025, but still need to import around 10% of the country's total demand
- **SIWAB (Sapi Indukan Wajib Bunting)** – an artificial insemination program to increase breeding productivity (launched in early 2017)
  - *provide 2 to 3 million frozen semen straws a year for cattle breeding within a six year period*
  - *another three years to make self-sufficient in the downstream sector*

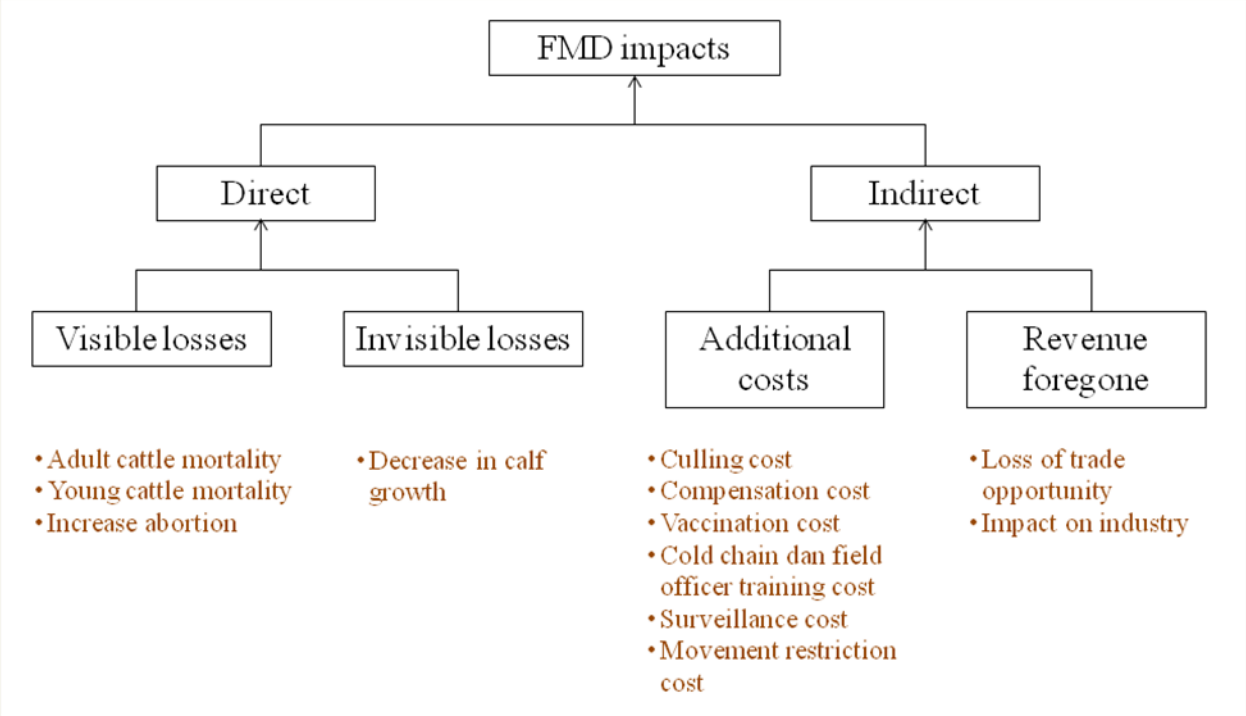
Why maintaining Indonesia's FMD freedom is critically important?

- FMD is the most of important exotic livestock disease internationally and would be a major obstacle for the Indonesian cattle industry to achieve its self-sufficiency target (16 million cattle, SIWAB target in 2017-2018 is 3 million pregnant cows)
- The most common ways that FMD enters a free country like Indonesia are through:
  - *infected animals*
  - *Infected animal products (meat, dairy, hides, semen, embryos, wool etc.)*
  - *mechanical transmission (from infected clothing, footwear, equipment etc.*

Economic Impact of Animal Diseases

- Direct impacts occur if the disease directly affects the economic value of the product's quantity and quality
- Indirect impacts are caused by human reactions to the disease that:
  - *cost of control disease outbreak*
  - *wider impacts of disease on trade and the general economy*

Figure 3: Direct and indirect impact of FMD



Source: Rushton and Knight-Jones, 2013

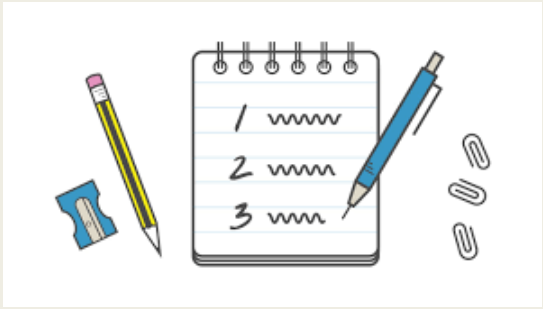
ESTIMATING ECONOMIC IMPACTS OF FMD OUTBREAK IN INDONESIA

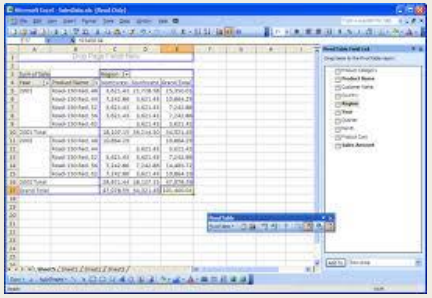
Scenario development

- A series of scenarios were developed to estimate the economic impact due to an FMD outbreak in Indonesia:
  - *most likely cause of the outbreak*
  - *species are most likely to be infected*
  - *area has the highest risk*
  - *how great the outbreak magnitude might be*

Steps to estimate the economic impact of the FMD outbreak

1. Develop underlying assumptions
2. Present FMD outbreak control strategies
3. Develop hypothetical scenarios
4. Develop FMD transmission rate model
5. Present epidemiology and economic data
6. Create worksheet model in MS Excel





Underlying assumptions

1. FMD virus can be carried into Indonesia through various ways, outbreak is assumed to most likely be transmitted through the illegal meat trade
2. From the history of FMD in Indonesia, it has predominantly infected beef cattle, so it is assumed only beef cattle are affected
3. The outbreak scenario is assumed to be the area that has a high density of cattle population
4. The epidemiology unit is a village where a group of cattle share a common environment and management practices within the extensive animal husbandry system, excluding feedlots and other species

FMD Outbreak Control Strategies

1. **Culling**, including immediate slaughtering of all infected and suspected animals as well as those exposed to infected animals, compensation for culled animals, sanitary disposal for culled carcasses and contaminated animal products, cleaning and disinfection of all barns
2. **Quarantine and movement restriction of livestock and livestock products and other materials** in the area defined as the infected zone
3. **Tracing and surveillance** to determine the source of disease, the level of disease transmission, and trace forward to new cases
4. **Vaccination** is applied in some situations, if the disease cannot be controlled by only culling and the outbreak has become wide spread
5. **Risk communication** through information, education, and communication (IEC) activities

OIE requirements to regain free status after FMD outbreak

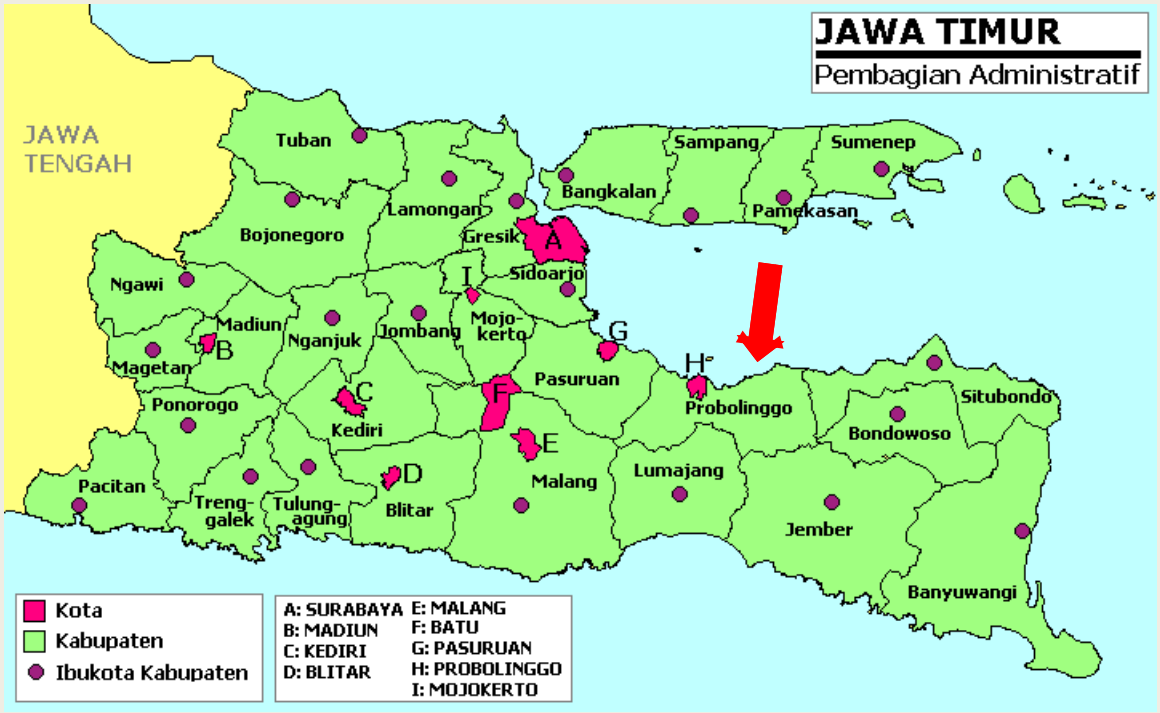
BOX: OIE Code Chapter 8.8. (Article 8.8.7.):

1) 3 months after the disposal of the last animal killed where a stamping-out policy and serologic surveillance are applied; OR
2) 3 months after the disposal of the last animal killed or the slaughter of all vaccinated animals, where a stamping-out policy, emergency vaccination, and serologic surveillance are applied; OR
3) 6 months after the disposal of the last animal killed or the last vaccination where a stamping-out policy, emergency vaccination not followed by the slaughtering all vaccinated animals, and serologic surveillance are applied. However, this requires a serological surveillance based on the detection of antibodies to nonstructural proteins of FMD virus to demonstrate no evidence of infection in the remaining vaccinated population

FMD Outbreak Hypothetical Scenarios

- A hypothetical examples of a district based FMD outbreak in East Java province – Probolinggo district

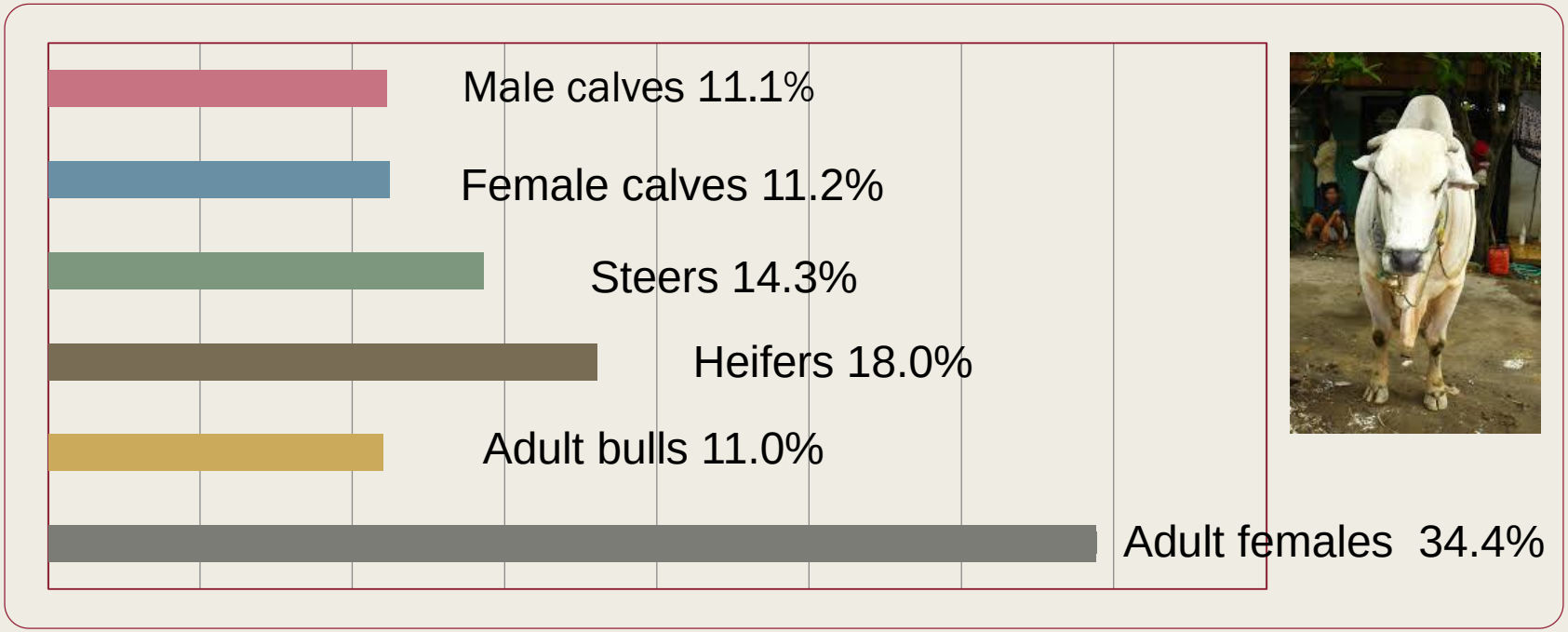
Map of East Java Province



- East Java Province is a cattle source area with a cattle population of 4,534,460 heads, which is the highest population in Indonesia (Livestock and Animal Health Statistics, 2016)

Cattle Population Structure in East Java province

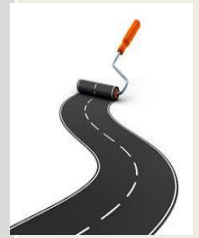
Beef cattle population structure in East Java province



Source: ICARD, 2014

FMD outbreak hypothetical scenarios

Scenario 1 – Local best case scenario	• Requires 2 weeks for detection/confirmation • Outbreak is limited to one or more villages within one district • Only a small number of smallholder farmers have infected cattle • Requires 6 months to control the outbreak
Scenario 2 – District most likely scenario	• Requires 4 weeks for detection/confirmation • Outbreak includes several subdistricts within one or more district(s) • The number of smallholder farmers that have infected cattle is relatively large • Requires 12 months to control the outbreak
Scenario 3 – Province worst case scenario	• Requires more than 8 weeks for detection/confirmation • Outbreak spreads to several provinces • The numbers of medium-scale and smallholder farmers that have infected cattle are very large • Requires 24 months to control the outbreak or if fails it becomes endemic



Time of detection and time required to control the outbreak

Best case scenario

Most likely scenario

Worst case scenario

Scenario 1

Scenario 2

Scenario 3

Endemic

2 weeks

1 month

2 months

6 months

1 year

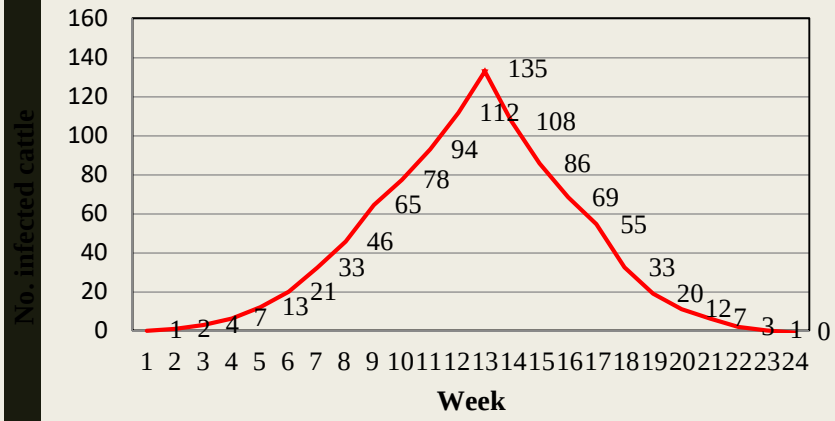
2 years

Time of detection

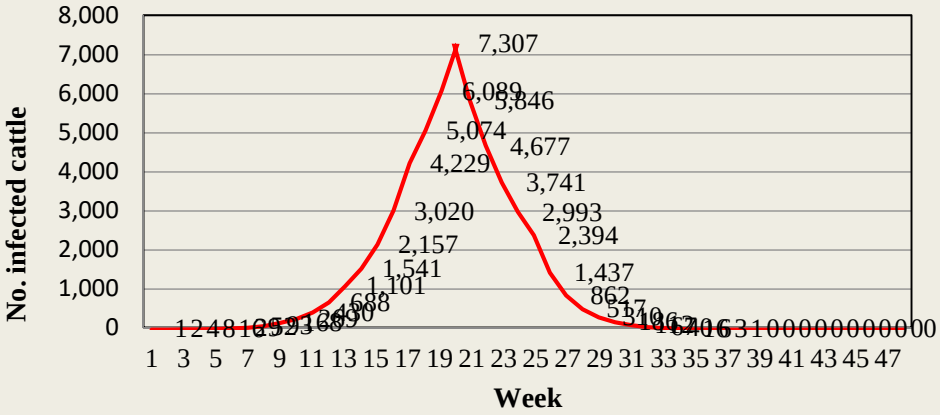
Time required to control the outbreak

FMD transmission rate model with $R_0 = 2$ for scenario 1, 2 and 3

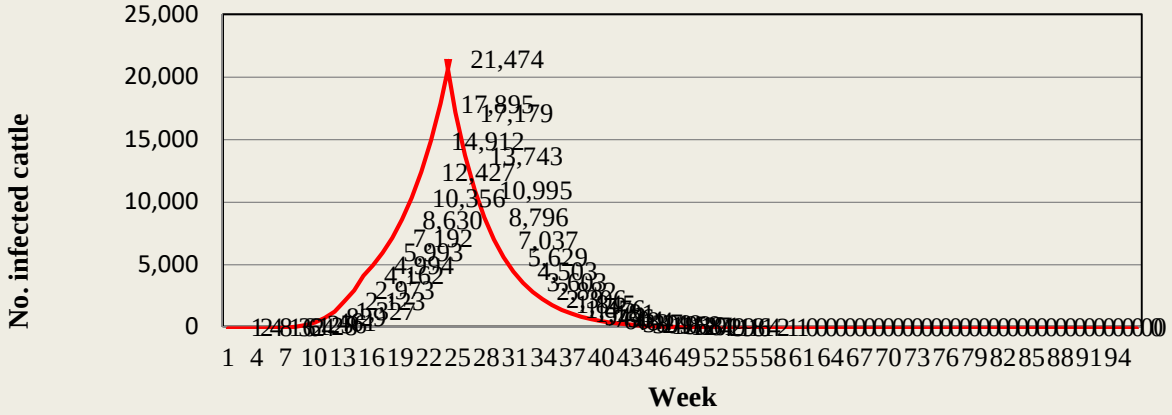
Scenario 1 (best case scenario)



Scenario 2 (most likely scenario)



Scenario 3 (worst case scenario)



Components of FMD direct impacts on cattle

Epidemiologic parameter	Value	Source
Mortality in adult cattle	2%	Wildpro (http://www.wildlifeinformation.org/)
Mortality in young cattle	5%	Wildpro (http://www.wildlifeinformation.org/)
Increase in abortion rate	10%	Doel, 2003; Singh et al., 2013
Decrease in calf growth rate	20%	Singh et al., 2013

- To calculate the increase of abortion rate as FMD direct impact, it is necessary to get average pregnancy rate in East Java province
- An overview information about of the pregnancy rate is ≤ 60% (Rosikh, 2015)

Economic impacts if FMD outbreak occurs

No.	DIRECT IMPACT	Total Loss Rp 000 – US$ 000		
		Scenario 1	Scenario 2	Scenario 3
1.	Loss due to adult cattle deaths	108,841	6,003,357	21,489,482
2.	Loss due to young cattle deaths	113,728	6,272,918	22,830,560
3.	Loss due to abortion	103,819	5,726,361	20,841,343
4.	Loss due to decreased calf growth	224,338	12,373.824	45,035,073
	Total direct losses	550,726	30,376,461	110,556,459
No.	INDIRECT IMPACT	Scenario 1	Scenario 2	Scenario 3
1	Culling cost	137,017	2,519,155	9,168,575
2.	Compensation cost	3,809,440	210,117,519	764,731,890
3.	Vaccination cost	1,908,147	99,305,717	1,117,168,647
4.	Cold chain & field officer training cost	325,000	550,000	850,000
5.	Surveillance cost	185,000	320,000	590,000
6.	Movement restriction cost	2,073,822	70,750,835	471,994,840
7.	Outbreak control management cost	195,000	517,000	9,319,800
8.	IEC cost	13,000	34,520	621,320
	Total indirect losses	8,646,427 (US$ 665)	384,115,546 (US$ 29,547)	2,374,445 (US$ 182,649)
	Total direct & indirect losses	9,197,153 (US$ 707)	414,492,008 (US$ 31,884)	2,485,001,532 (US$ 191,154)

B/C ratio of three different scenarios

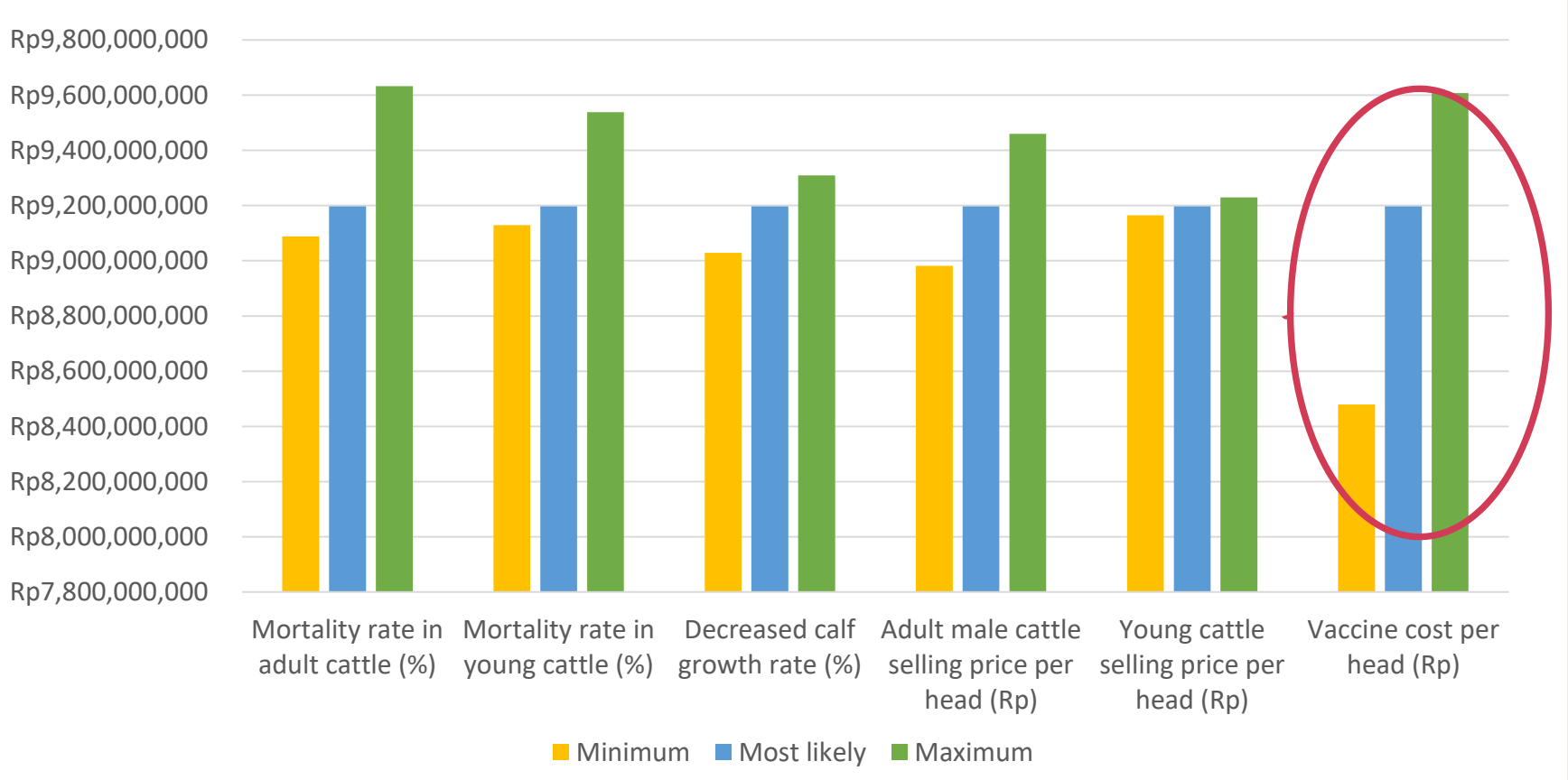
Scenario	NPV	IRR	B/C Ratio
Scenario 1	Rp 168.8 billion (US$ 12.98 million)	46,2%	4,27
Scenario 2	Rp 102.1 billion (US$ 7.85 million)	14,8%	1,43
Scenario 3	Rp 5.1 trillion (US$ 393.2 million)	-18,1%	0,32

- B/C ratio for scenario 1 indicates for each rupiah invested for outbreak control measures 4 times of the benefit is expected.
- B/C ratio for scenario 2 indicates the benefits from the outbreak control measures still outweigh the costs.
- B/C ratio for scenario 3 meaning that the costs outweigh the benefits and therefore suggesting it should not be adopted.

Sensitivity Analysis

- Sensitivity analysis is used to assess:
  - *whether the assumption or estimation used in a model is important or not*
  - *the impact of an error or inaccuracy of the assumed values used in the model*
- Six parameters of direct impact and indirect impact analyzed to determine whether or not the assumed values have impact to the final result (total loss due to the outbreak)
- Those values are estimated values which are less convincing or less certain

Sensitivity analysis of the total economic loss if an FMD outbreak occurs



The most sensitive parameter is the vaccine cost per head, therefore purchase of a low price FMD vaccine during an outbreak can significantly determine the amount of loss incurred

Limitation of the CBA results

- The outbreak only occurs in one species and one production system, it does not provide any calculation if the outbreak has spread further and infected other species
- By excluding these, the assumption can be made that the potential economic loss would likely be far greater than has been estimated using the developed scenarios
- Other limitations such as the assumptions required, especially in predicting the benefit obtained is only from the direct impact of the outbreak control measures implemented
- The numbers used are singular and cannot be tested against a confidence interval to include uncertainty

Cost benefit analysis study of FMD control and eradication

Country	FMD Endemic	Economic Return	C/B Ratio	Reference
Philippines	No	Commercial pig producer is estimated to obtain 8.4% benefit from eradication investment, compared to only 4% smallholder pig producers	1.6-12.0 (depends on the export volume)	Randolp et al, 2002
Laos	Yes	Vaccination program cost runs quite effectively	5.3	Nampanya et al., 2015
Thailand	Yes	If eradication cannot be obtained by 2020, the return remains positive without export, but on a lower level	3.73-15.0 (depends on the export volume)	Perry et al., 1999
Cambodia	Yes	The successful FMD control program is expected to prevent estimated loss of US$ 135 million	1.4	Young et al., 2014
U.S.A.	No	All strategies including vaccination are economically efficient and appropriate, whereas additional strategy such as culling, is not efficient and inappropriate (B/C 0.05 to 0.8)	5.0-10.1	Bates et al., 2003

ESTIMATING POTENTIAL LOSSES FROM FMD AT NATIONAL LEVEL

Potential losses from FMD

Impacts on Cattle Production

Impacts on Trade

Impacts on Industry

FMD impacts on Indonesia's farmers, trade and non-agricultural sector

Some commodities in small quantities exported to various countries, but the economic impact of trade restrictions of an FMD outbreak incursion in Indonesia is not too significant

Impacts on cattle production	• Farmer financial losses
Impacts on Trade	• Impact on sugarcane tops export • Impact on raw leather exports
Impacts on Industry	• Impact on meat and processed meat exports • Impact on domestic prices • Impact on tourism industry

Benefits of an FMD free status

- Benefits can be assessed from:
  - *the direct costs that can be saved such as financial benefits borne by the farmers when their livestock are not affected by FMD, and*
  - *indirect costs such as costs due to trade restriction, and costs incurred due to the impact on the non-agricultural sector (Dillon, 2006)*
- Others state that generally in FMD-free countries, the economic costs that can be saved from active surveillance, increased biosecurity and awareness during peace time and eradication costs during an outbreak (Beyi, 2012)

Financial Analysis

Parameters in unvaccinated village and vaccinated village against FMD

Parameter	Unvaccinated village	Vaccinated village
Total population	260 heads	260 heads
Mortality rate	7.8%	0%
Morbidity rate	61%	1%
Vaccination rate	0%	100%

The difference in mortality, morbidity, and vaccination rate in vaccinated and unvaccinated villages are obtained from study conducted by Rast et al., 2010 in Laos and adapted to Indonesian condition

Total cost estimation per head with assumption that sick cattle is sold

Cost (Rp)	Unvaccinated village		Vaccinated village	
	Total (Rp)	Cost per head (Rp)	Total (Rp)	Cost per head (Rp)
Mortality rate (%)	101,400,000	390,000	0	0
Morbidity rate (%)	3,766,750	14,488	61,750	238
Weight loss (kg)	1,084,824,000	4,172,400	17,784,000	64,800
Vaccination rate (%)	0	0	11,700,000	45,000
Total	1,189,990,750	4,576,888	29,545,250	113,638

Financial losses at national level

Estimation of FMD financial costs at national level

Variable	Number	Remarks
No. of infected cattle	201,951	The number assumed incurred in 8-weeks onset of the outbreak (see Chapter III – scenario 3)
Financial costs per head saved at the village level	Rp 4,463,250	The numbers obtained from the above calculation
TOTAL	Rp 901.357.800.750 (US$ 69.335.215)	

- To extrapolate this number into the national level requires an assumption of the number of infected cattle during the outbreak
- The difference between total financial costs that can be saved between the unvaccinated and vaccinated village is Rp 4,463,250 per head – Rp 901.4 billion at national level

Indirect impacts on industry from infectious animal diseases

- *Ripple effects* include impacts on livestock and livestock products price, and upstream and downstream activities along the cattle value chain
- *Spillover effects* include impacts other than to the agricultural sector, such as on tourism and the sectors related to public services
- *Effects on wider society* can include exposure to zoonotic risk, which is a threat to public health

Source: Agra CEAS Consulting, 2007

Table 21: Estimation of FMD economic impacts at national level

Impacts	Costs in Rp	Costs in US$
FMD financial impacts at national level	901.4 billion	69.3 million
FMD impacts on sugar cane tops export	622.9 million	47.9 million
FMD impacts on raw leather export	880.8 billion	67.7 million
FMD impacts on meat and processed meat export	43.6 billion	3.4 million
FMD impacts on domestic prices	942.5 million	72.5 million
FMD impacts on tourism industry	6.5 trillion	500.5 million
Total	9.9 trillion	761.3 million

- The total annual losses at national leval is Rp 9.9 trillion (US$ 761.3 million)
- This indicates that the indirect impact such as on tourism which is the spill-over effect incurs 66% or more than half of the total indirect impacts
- If all industries and trade related to agricultural sector are accounted for, then the proportion is 25%

Economic loss of FMD in a number of countries

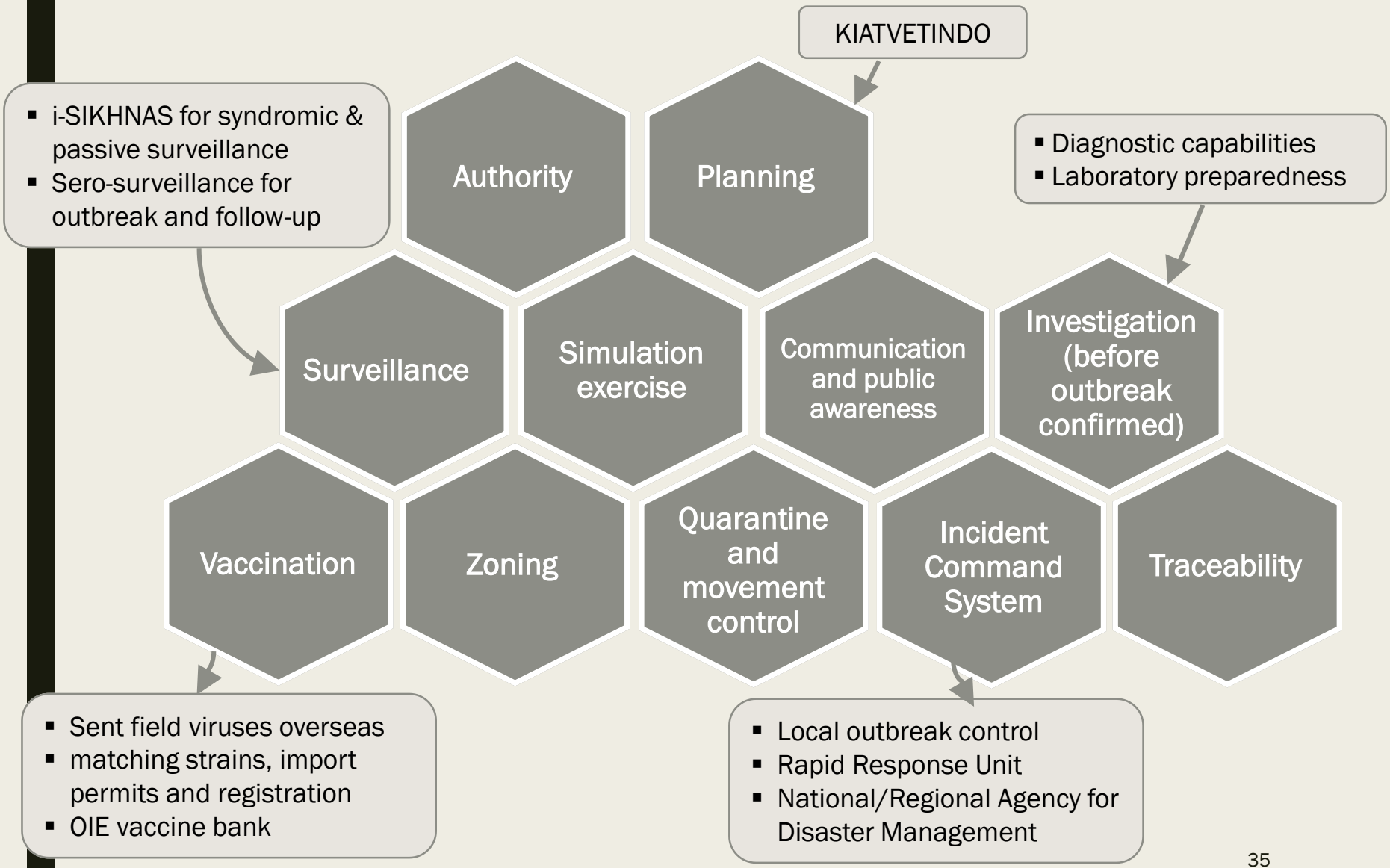
Country	Scope	Species	Total loss per year	Reference
India	National, per year	Cow, buffalo, sheep, goat and pig	12,000-14,000 crore (US$ 1.87-2.18 billion) (Rp 21.9-29.2 trillion)	Singh et al., 2012
Pakistan	Village, 6 months	Cow, buffalo	Rs. 27,448,000 (US$ 322,918) (Rp 4.3 billion)	Gorsi et al., 2011
Ethiopia	National, per year	Cow	1.354 billion birr (US$ 61 million) (Rp 812.9 billion)	Jemberu, 2016
Laos	National, per year	Cow and buffalo	US$ 13,512,291 (Rp 180 billion)	Nampanya, 2015
Laos	Village, per year	Cow and buffalo	US$ 30,881 (Rp 411.6 million)	Nampanya, 2015
Australia	National, 10 years	All susceptible livestock	>AUS$ 50 billion (>US$ 39.7 billion) (>Rp 529.8 trillion)	Buetre et al.,2013

ESTIMATING FMD PREPAREDNESS COST

Some assumptions of the likelihood if an FMD outbreak occurs in Indonesia

1) Outbreak is not detected quickly (within a few days), so it could have already spread significantly into a wider area
2) The outbreak control actions (e.g. culling and compensation) are delayed or difficult to perform according to international standard procedures, due to the weak legal power
3) The capacity of the response is not sufficient to manage such an FMD outbreak, so the response of the central and local governments as well as the livestock community tends to be overwhelmed by the emergencies
4) The capacity of the human and physical resources to conduct the destruction and disposal of livestock on a large scale remains questionable given Indonesia has limited experience
5) Regaining freedom status is difficult to achieve within 3 or 6 months, following the appropriate actions for controlling the outbreak as these may not be effective or not comply with the principles of emergency response

FMD Preparedness Activities



Vaccination during FMD outbreak

- A policy indicating when vaccinations are to be implemented during an outbreak should already be established considering a range of factors
- Selection of vaccine strains is not only influenced by small cross-protection capabilities between serotypes, but also genetic and antigenic variations between serotypes (Brückner and Saraiva-Vieira, 2010)
- Preparation of specific plans for the supply of vaccine during the outbreak, including matching strains, import permits and registration
- Preparation of a communication plan to obtain the necessary vaccine during an outbreak from an OIE vaccine bank
- An alternative is the preparation of a plan to contract an international manufacturer to provide commercial vaccines

Estimation of annual cost required for FMD preparedness

Preparedness activities	Unit Cost (Rp)	Cost Estimation	Remarks
Sero-surveillance (8.000 samples/year)	Rp 400,000 per sample	Rp 3,200,000,000 (US$ 246,154)	Unit cost including diagnostic kit, equipment, quality assurance, and training
Simulation (100 person/year)	Rp 6,000,000 per pax	Rp 600,000,000 (US$ 46,154)	Unit cost including logistic, travel, accommodation and material
Outbreak investigation (conducted 3 times each year with sampling of approximately 100 samples)	Rp 1,200,000 per sample	Rp 360,000,000 (US$ 27,692)	Contingency cost required to conduct outbreak investigation including sending samples to laboratory
Vaccination (250,000 heads)	Rp 45,000 per dose	Rp 11,250,000,000 (US$ 865,385)	Contingency cost to purchase vaccines if outbreak occurs. Unit cost includes operational
Communication and public awareness improvement (1.000 village/year)	Rp 300,000 per village	Rp 300,000,000 (US$ 23,077)	

Estimation of annual cost required for FMD preparedness (cont.)

Preparedness activities	Unit Cost (Rp)	Cost Estimation	Remarks
Quarantine and traffic control (40.000 heads/year)	Rp 25,000 per head	Rp 1,000,000,000 (US$ 76,923)	
Outbreak Command Center (25.000 heads)	Rp 15,000 per head	Rp 375,000,000 (US$ 28,846)	Emergency funds if outbreak occurs to establish Outbreak Command Center in outbreak area and the operational of URC team
Identification and livestock database (livestock traceability) (15.000 heads)	Rp 150,000 per head	Rp 2,250,000,000 (US$ 173,077)	Cost to build database and electronic devices required for livestock identification
Total cost		Rp 19,335,000,000 (US$ 1.5 million)	
Total comtingency cost		Rp 11,610,000,000 (US$ 893,077)	
Total required cost		Rp 7,725,000,000 (US$ 594,231)	

Summary

- The result of the CBA shows that if an FMD incursion occurs in Indonesia:
  - *every effort should be made to restrict the outbreak to a scenario 1 to have the maximum B/C Ratio of the cost of control measures against the economic impact*
  - *Although scenario 2 is more likely to be occur in a country such as Indonesia, the result that the benefits are only slightly larger than the costs*
  - *Scenario 3 should be avoided as much as possible since the costs outweigh the benefits and potential losses may be unrecovered, even over an extended period*
- The total estimated losses in a year for Indonesia are estimated to be Rp 9.9 trillion (US$ 761.3 million), which includes:
  - *the financial loss in cattle production*
  - *impacts on trade*
  - *impact on industry including declining domestic cattle price and beef sales as a consequence of the ripple effect, and decrease in tourism expenditures as the spill-over effect*

Summary (cont.)

- Indonesia needs to develop its FMD emergency preparedness to a more higher level to:
  - *prevent the risk of exposing Indonesia's cattle herd to FMD*
  - *protect the livestock sector to achieve its beef self sufficiency target*
  - *minimizing the risk from importation of deboned beef from countries or zones still infected with FMD*
- The annual FMD preparedness budget required to protect the Indonesian livestock assets and economy are Rp 7.7 billion (US$ 594,231) plus a contingency cost of Rp 11,6 billion (US$ 893,077) which include outbreak investigation and vaccination
- The magnitude of the risks of an outbreak and the potential economic impact of FMD determine the level of investment needed to protect a country's territory from the FMD threat

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Thank you

Terima kasih

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