

**The Risk of Foot and Mouth Disease Entering  
China through the Movement of Animals from  
Upper Mekong Region Countries**

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## **DECLARATION**

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

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## **ABSTRACT**

In the Greater Mekong Sub-region (GMS), Foot and Mouth Disease (FMD) is the most important trans-boundary animal disease affecting the livelihood of livestock owners. To contribute to the long term goal to control FMD in south-eastern Asia, the South East Asia and China FMD Campaign (SEACFMD) has been implementing a progressive control approach based on sound epidemiological inputs and principles. A major risk to the regional program is the emergence of new strains of FMD including the Pan-Asia topotype serotype O, the serotype type A and the serotype Asia 1 that was confirmed in China at the beginning of 2009.

Due to the rapid development of China, the price of meat and its demand have grown quickly over the past ten years. This trend has resulted in an increase in the number of livestock moving from south-eastern Asian countries to China. Although Chinese law and the import-export policy prohibit these movements, these informal movements pose a high risk of introducing new serotypes to China and spreading the disease to FMD free areas in China.

Prior to the study reported here, there was little information written in English concerning the development of veterinary science in China and the history of FMD outbreaks in the country. This study collected and analysed existing historical records of FMD in China, and hypothesised on the potential source of the disease for China. Subsequently, the study collected and analysed existing data on FMD from countries in the Upper Mekong Region to understand the disease's epidemiological pattern. Epidemiological tools, such as Geographical Information Systems (GIS), risk

assessment and epidemiological modelling, were used to study the epidemiology and the patterns of FMD spread into Yunnan and Guangxi Provinces in China.

This epidemiological study was the first study to evaluate the risk posed by informal animal movements between countries in the Upper Mekong Region and China. It was designed to provide the epidemiological basis for progressing zone status for FMD in the Upper Mekong Region with particular emphasis on the Yunnan and Guangxi Provinces. A systematic analysis was undertaken to evaluate the compulsory vaccination policy in China. The opinions of Chinese veterinary workers were also collected to identify the current problems with the control of FMD in China.

Foot and Mouth Disease was probably introduced into China from Europe in the 19<sup>th</sup> century. However the research reported in this thesis found that the current highest risk to China was through the movement of animals along the Mekong River, compared to movement along alternative land routes. The two most important factors influencing this risk were: the prevalence of FMD in the exporting country; and the control strategy adopted in China. The current control of FMD in China is based on compulsory vaccination of livestock and the prohibition of livestock movements between south-eastern countries and China. Although the vaccination program has been very successful in China, with more than 70% of animals protected, this strategy requires significant amounts of government financial support and could be more effective if targeted to areas of highest risk. The results of this research indicate that it is not feasible or possible to prevent all livestock movements into China from neighbouring countries. It is recommended that an intensive FMD vaccination program is developed

and implemented in the GMS to reduce the number of susceptible animals in the region. It is also recommended that the movement of livestock/animal products between the Upper Mekong Region countries and China be legalised through the development of formal and appropriate import regulations. Adopting these practices and developing an active surveillance system should help reduce the spread of FMD within the Greater Mekong Sub-region.

## GLOSSARY

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<b>Abbreviation</b>	<b>Name</b>
<b>AB-CRC</b>	Australian Biosecurity Cooperative Research Centre
<b>ACIAR</b>	Australian Centre for International Agricultural Research
<b>ADB</b>	Asian Development Bank
<b>AgELISA</b>	Antigen Enzyme-Linked Immunosorbent Assay
<b>ASEAN</b>	Association of Southeast Asian Nations
<b>BEI</b>	Binary ethylenimine
<b>BHK</b>	Baby Hamster Kidney
<b>Brunei</b>	The Nation of Brunei
<b>CBR</b>	Cost Benefit Ratio
<b>C.I.Q</b>	China Entry-Exit Inspection and Quarantine Bureau
<b>CFT</b>	Complement Fixation Test
<b>China</b>	People's Republic of China
<b>DIVA</b>	Differentiation of Infected from Vaccinated Animals
<b>EDA</b>	Exploratory Data Analysis
<b>ELISA</b>	Enzyme-Linked Immunosorbent Assay
<b>EuFMD</b>	European Commission for the control of Foot and Mouth Disease
<b>FAO</b>	Food and Agricultural Organisation
<b>FMD</b>	Foot and Mouth Disease
<b>FMDV</b>	Foot and Mouth Disease Virus

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<b>Abbreviation</b>	<b>Name</b>
<b>GDP</b>	Gross Domestic Product
<b>GIS</b>	Geographical Information Systems
<b>GMS</b>	Greater Mekong Sub-region
<b>Guangxi Province</b>	Guangxi Zhuang Autonomous Region
<b>HPAI</b>	Highly Pathogenic Avian Influenza
<b>LAMP</b>	Loop Mediated Isothermal Amplification
<b>LAOS</b>	Lao People's Democratic Republic
<b>LFD</b>	Lateral Flow Device
<b>LPBE</b>	Liquid-Phase Blocking ELISA
<b>LSD</b>	Least Significant Difference post-hoc test
<b>mAb</b>	Monoclonal Antibodies
<b>MOA</b>	Ministry of Agriculture of the People's Republic of China
<b>mPCR</b>	multiplex Polymerase Chain Reaction
<b>MTM</b>	Malaysia-Thailand-Myanmar region
<b>NCBI</b>	National Center for Biotechnology Information
<b>NIH</b>	The National Institute of Health (United States of America)
<b>NSPs</b>	Nonstructural Proteins
<b>OIE</b>	Office International des Epizooties (World Organisation for Animal Health)
<b>OIE RCU</b>	Office International des Epizooties Regional Coordination Unit
<b>OIE SRR</b>	OIE Sub-Regional Representation

<b>Abbreviation</b>	<b>Name</b>
<b>PCP-FMD</b>	Progressive Control Pathway for Foot and Mouth Disease
<b>PCR</b>	Polymerase Chain Reaction
<b>PLA</b>	The Peoples' Liberation Army
<b>RRL</b>	Regional Reference Laboratory
<b>RT-LAMP</b>	Reverse Transcription-Loop Mediated Isothermal Amplification
<b>RT-PCR</b>	Reverse Transcription-Polymerase Chain Reaction
<b>SEA</b>	South East Asia
<b>SEACFMD</b>	OIE South East Asia and China Foot and Mouth Disease Campaign
<b>SEAFMD</b>	South East Asia Foot and Mouth Disease Campaign
<b>Singapore</b>	The Republic of Singapore
<b>SRR</b>	OIE Sub-Regional Representation
<b>SRR SEA</b>	OIE Sub-Regional Representation for South East Asia
<b>TAD</b>	Trans-boundary Animal Disease
<b>UMWG</b>	Upper Mekong Working Group
<b>US\$</b>	United States of America dollar
<b>VI</b>	Virus Isolation
<b>VNT</b>	Virus Neutralization Test
<b>WRL</b>	World Reference Laboratory
<b>WRLFMD</b>	World Reference Laboratory for Foot and Mouth Disease
<b>YASVI</b>	Yunnan Animal Science and Veterinary Institute



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<b>Abbreviation</b>	<b>Name</b>
<b>Y TSAVDL</b>	Yunnan Tropical and Subtropical Animal Viral Disease Laboratory

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