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Short communication

Validation of a geographic information system model for mapping the risk of fasciolosis in cattle and buffaloes in Cambodia

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Abstract

Maps showing gradations of risk of fasciolosis due to *Fasciola gigantica* in Cambodia were produced using geographic information systems (GIS) technology in conjunction with determinants of fasciolosis. A comparison between levels of risk predicted by the maps and field measurements of prevalence in 11 provinces ($n = 1406$) showed general agreement, which suggested the epidemiological determinants and weightings used to produce the maps were appropriate. However, due to logistical constraints, prevalence was measured at the provincial level and animals were not randomly sampled (and thus were unlikely to be representative of variability within provinces). To address this, additional field work was carried out to measure prevalence in more detail—faecal samples were collected from a randomly selected set of animals in four districts across a representative province for areas predicted to be at high risk ($n = 311$), moderate risk ($n = 268$) and no risk ($n = 262$). As with the original field survey, the results show general agreement between prevalence and risk predicted by the maps, with the best fit found for areas predicted to be at high risk.

Keywords: *Fasciola gigantica*; Fasciolosis; Geographic information systems; Control methods; Trematoda; Cambodia

Tropical fasciolosis caused by infection with *Fasciola gigantica* occurs in most humid tropical regions of the world. Cattle and buffaloes are the main hosts but other domestic animals and humans are also susceptible. Losses are mainly due to reduced meat production and draught power and lower fertility in infected animals (Spithill et al., 1999). The loss from an estimated 10% prevalence in cattle and buffaloes in the Kingdom of Cambodia was approximately US$ 17,020,000 in 2001 (Department of Animal Production and Health, Phnom Penh, 2001). Nevertheless, control is not commonly practiced as most Cambodian farmers have minimal knowledge of fasciolosis. Furthermore, areas where the disease is most important, within which extension programs for control should logically be focused, have not been defined. Collection of prevalence data to enable such areas to be mapped would be costly and cumbersome. A more cost effective alternative is the use of predictive models using geographic information systems (GIS) technology in conjunction with determinants of fasciolosis.

A number of epidemiological studies have identified determinants of fasciolosis caused by *F. gigantica* (Tembely et al., 1988; Malone, 1994; Roberts and Suhardono, 1996; Malone and Yilma, 1999; Spithill et al., 1999; Suhardono and Copeman, 2000). The risk of infection is influenced by the number and distribution

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Table 1
Results of faecal examination from different provinces in 2001/2002 and predicted risk of fasciolosis from the GIS model developed by Tum et al. (2004) generalised by province and adjusted for the known sensitivity of the technique as per Anderson et al. (1999)

Province	Sample size	Percent positive (%)	Predicted risk
Kandal	192	85.2	High
Kracheh	119	20.1	Moderate
Takeo	150	10.9	High
Kg. Speu	100	7.5	Moderate
Kg. Cham	94	6.3	Moderate
Pursat	97	6.2	Moderate
Battambang	82	5.4	Moderate
Kg. Thom	102	4.4	Moderate
Kg. Chnang	184	3.3	High
Prey Veng	125	0.2	Moderate
Svay Rieng	161	0.0	High

of animals, especially cattle and buffaloes, the presence of infected snails, and grazing management which allows animals to access herbage or water containing metacercariae. Determinants can include all factors that affect the above such as the availability and suitability of habitats for the aquatic molluscan intermediate hosts of *F. gigantica*. A relatively simple mathematical model was developed to map the areas of risk of fasciolosis in Cambodia. The model was constructed using GIS from individual data layers representing district boundaries, rivers, inundated areas, elevation, slope, agricultural land uses and cattle and buffalo density (Tum et al., 2004). A limited field survey was conducted in Cambodia in December 2001 and January 2002 to test the model. Faecal samples were collected opportunistically from 1406 cattle and buffaloes in 11 provinces, and analysed using a modified version of the Balivet egg count technique (Table 1). In general, the measured prevalence of fasciolosis was in accord with the risk predicted by the model in 7 of the 11 provinces, notable exceptions being in Prey Veng and Svay Rieng provinces where the prevalence was much lower than predicted. A likely explanation is that the distribution of animals and the use of the land within provinces were not uniform spatially and seasonally, as implied by the model. Logistical difficulties precluded the use of random sampling of animals in the province and over the seasons, so prevalence values cannot be assumed to be an accurate estimate of prevalence across each entire province due to potential selection bias. In addition, the

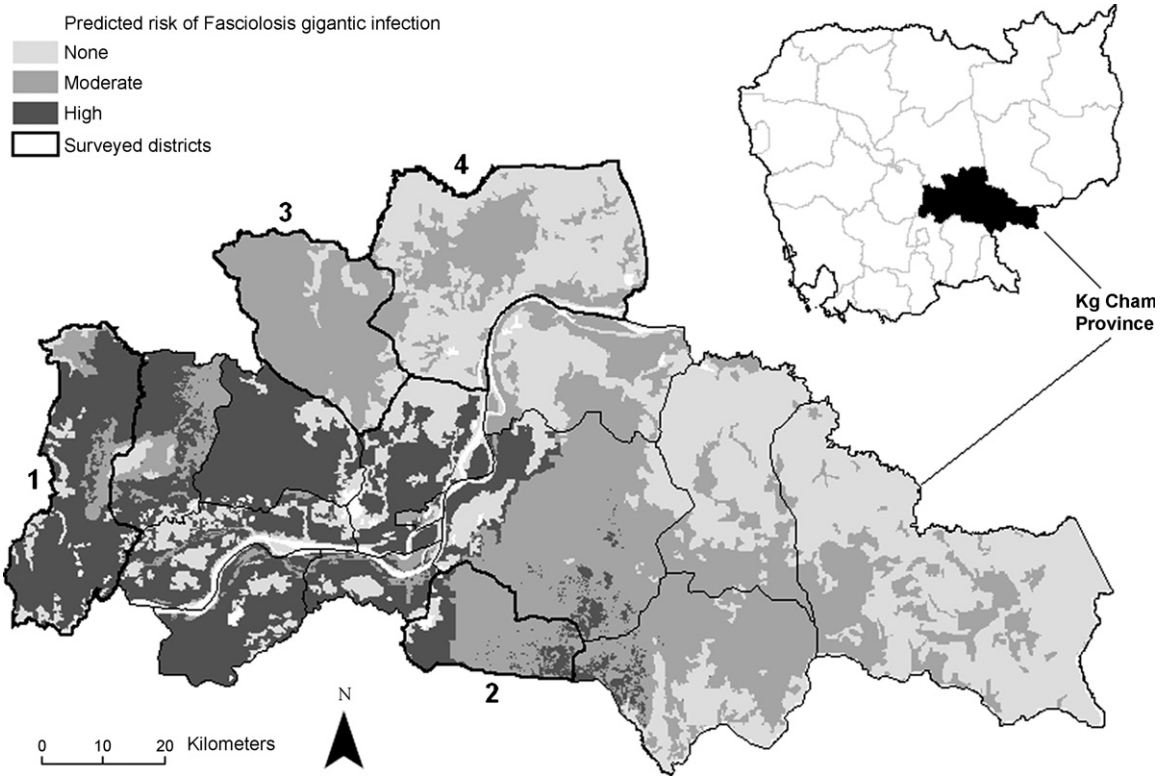

Fig. 1. The risk of transmission of fasciolosis due to *Fasciola gigantica* (adjusted by animal density) as predicted by the GIS model developed by Tum et al. (2004) for Kg. Cham province and the four districts that were surveyed for prevalence of fasciolosis in cattle to test the model.