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ScienceDirect
Agriculture, Ecosystems and Environment 119 (2007) 409–415
Agriculture Ecosystems & Environment
www.elsevier.com/locate/agee

Avian influenza, domestic ducks and rice agriculture in Thailand

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Received 14 March 2006; received in revised form 22 August 2006; accepted 1 September 2006
Available online 9 October 2006

Abstract

Highly pathogenic avian influenza (HPAI) caused by H5N1 viruses has become a global scale problem which first emerged in southern China and from there spread to other countries in Southeast and East Asia, where it was first confirmed in end 2003. In previous work, geospatial analyses demonstrated that free grazing ducks played critical role in the epidemiology of the disease in Thailand in the winter 2004/2005, both in terms of HPAI emergence and spread. This study explored the geographic association between free grazing duck census counts and current statistics on the spatial distribution of rice crops in Thailand, in particular the crop calendar of rice production. The analysis was carried out using both district level rice statistics and rice distribution data predicted with the aid of remote sensing, using a rice-detection algorithm. The results indicated a strong association between the number of free grazing ducks and the number of months during which second-crop rice harvest takes place, as well as with the rice crop intensity as predicted by remote sensing. These results confirmed that free grazing duck husbandry was strongly driven by agricultural land use and rice crop intensity, and that this later variable can be readily predicted using remote sensing. Analysis of rice cropping patterns may provide an indication of the location of populations of free grazing ducks in other countries with similar mixed duck and rice production systems and less detailed duck census data. Apart from free ranging ducks and rice cropping, the role of hydrology and seasonality of wetlands and water bodies in the HPAI risk analysis is also discussed in relation to the presumed dry season aggregation of wild waterfowl and aquatic poultry offering much scope for virus transmission.

Keywords: Highly pathogenic avian influenza; Domestic ducks; Remote sensing; Agriculture intensification; Rice paddy production

1. Introduction

The spread of highly pathogenic avian influenza (HPAI) H5N1 virus has assumed global dimensions, with a total of over 30 countries (27 February 2006) having reported H5N1, with outbreaks distributed across Asia, Europe and Africa. Direct impact in the affected countries comprises the death of people infected by the H5N1 virus (up to 20th February 2006, 92 people had died), the mortality in poultry and birds culled for disease control, and the consequences for local and international trade of poultry and poultry products.

Despite the global significance of H5N1, little is yet known about the agro-ecological conditions associated with its spread and persistence. Being among the first affected, several countries in East and Southeast Asia have been able to collate geospatial data sets on HPAI outbreaks. Given that the genesis of the H5N1 virus supposedly took place in southern China (Li et al., 2004), this evolution should be considered in conjunction with major shifts in poultry production that took place during the past 20 years. The rise of duck production in China by far exceeds that of Cambodia, Indonesia, Lao, Thailand and Vietnam combined

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doi:10.1016/j.agee.2006.09.001

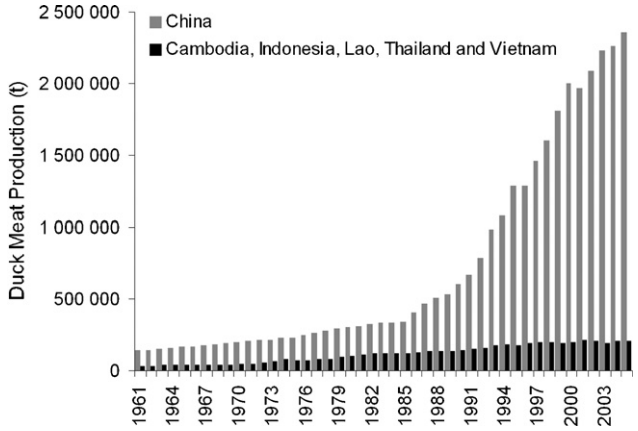

Fig. 1. Increase in duck production 1961–2005.

(Fig. 1). The production of chicken and duck meat in China between 1985 and 2005 increased by a factor of 6.9 and 6.8, respectively. If anything, these figures suggest that the analysis of the emergence and spread of HPAI viruses in Asia may benefit from exploring the agro-ecological conditions and its dynamics here.

In previous work, the geospatial distribution of HPAI H5N1 outbreaks in Thailand during the second wave of disease outbreaks was analysed, using outbreaks reported from the second half of 2004 to mid 2005 (Gilbert et al., 2006). The results demonstrated a very strong association between HPAI outbreaks and the density of free grazing ducks. There were approximately 13 million free grazing ducks in Thailand with the traditional husbandry characterized by frequent rotation of duck flocks in post harvest rice paddy fields, feeding on leftover rice grains, insects and snails as part of an integrated pest management system (e.g. Teo, 2001). These results also suggested that post-harvest rice paddy fields, which are equally attractive to wild birds and poultry, may have acted as a meeting point between the two. With laboratory studies indicating that domestic ducks may develop HPAI H5N1 virus sub-clinical infections (Hulse-Post et al., 2005), the frequent movements of duck flocks, brought together in night shelters which are often located within villages, and from where live birds and eggs enter the market chain, made healthy ducks important potential virus transmitters and amplifiers of infection (Songserm et al., 2006).

The duck production cycle is closely intertwined with rice cropping because the latter provides the duck feed. Most rice fields in the eastern part of Thailand produce only one crop per year whereas crops located in the central plains permit the production of two or even three crops per year. Exploratory analysis of the duck-rice associations suggested that the double rice crop areas sustain the free grazing duck system, because these crop areas provide year-round feed in the form of post-harvest rice paddy fields. In recent years, substantial progress has been achieved in both satellite sensor capability and data analysis methods application to predict rice crop distributions. For example, it is nowadays possible to routinely map and monitor rice paddy agriculture (Xiao et al., 2005, 2006) and cropping intensity in Asia, using images from the moderate resolution imaging spectroradiometer (MODIS) sensor onboard the NASA Terra satellite. The satellite-based algorithms permit the production of maps and monitoring of cropping intensity, the crop calendar (planting and harvesting dates) and irrigation practices at moderate spatial resolution (250–500 m) and in near-real time fashion.

The objective of this study was two-fold. First, it aimed to characterise the association between duck numbers and the availability of harvested rice paddy fields, using duck census and contemporal rice statistics in Thailand. Second, the study aimed to quantify the geospatial association between free grazing duck census and rice production intensity as predicted by Xiao et al. (2006) rice detection algorithm. This information could be applied to predict the areas at risk of HPAI in Thailand. In complement, the discussion also addresses how similar method could be applied to other countries in Southeast Asia, some of which with identical rice-duck farming associations, but where agricultural statistics are only available at coarse spatial (e.g. national or provincial levels) and/or temporal resolution (e.g. at annual scale).

2. Material and methods

Duck census data were collected from October to mid-November 2004 during the ''X-ray'' survey, organised by the Department of Livestock Development (DLD, Bangkok, Thailand) and involving the participation of several hundreds of thousands inspectors searching door-to-door for evidence of HPAI presence. These inspectors collected detailed information on domestic poultry numbers and species in each and every farm and household. For the present study two poultry variable were extracted from the

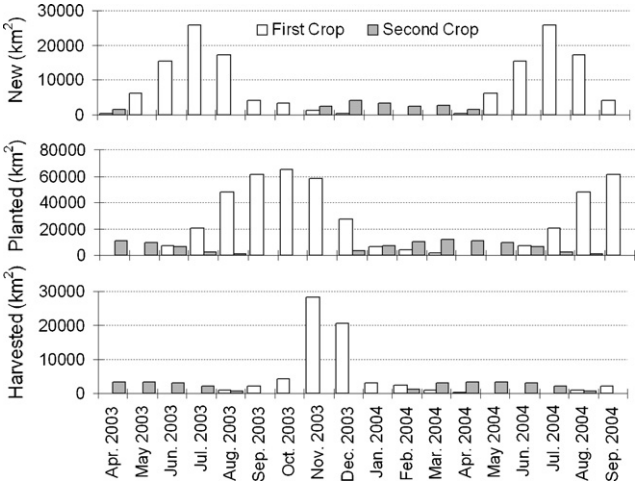

Fig. 2. Monthly distribution of the areas or rice paddy fields newly planted, under crop and harvested in Thailand (the actual data run from April 2003 to 2004 for the first crop, and September 2003 to 2004 for the second crop).