Areas of Excellence Scheme
Control of Pandemic and Inter-Pandemic Influenza

Typology of swine farms in the Red River Delta in Vietnam and analysis of their trading practices

Eugénie Baudon[1,2], Dao Thi Hiep[3], Raphael Duboz[2], Thi Thanh Pham Hoa[2], Vu Dinh Ton[3], Benjamin J. Cowling[1], J. S. Malik Peiris[1], Marisa Peyre[2]

1. School of Public Health, The University of Hong Kong, Hong Kong; 2. CIRAD, Animal and Integrated Risk Management research unit, France ; 3. Hanoi University of Agriculture, Hanoi, Vietnam

Introduction

The recent occurrence of the swine-origin pandemic influenza H1N1 in 2009 stressed the importance of the surveillance of emerging zoonotic diseases in swine at the global level. South-East Asia has been identified as a high risk zone for such emergences due to the farming practices and the high population density. The analysis of the pig value chain is a first essential step toward the development of effective surveillance strategies. Especially, the different farming systems due to their characteristics have behaviors more or less at risk for the transmission of swine diseases within the pig value chain. This study aimed to describe the different farming systems and performing a network analysis of the pig movements.

Methods

• Participatory interviews and then individual questionnaires of farmers to collect trade information to build the trade network of live pig movements from January 2011 to June 2012.

• Typology of the interviewed farms using a principal component analysis followed by a hierarchical clustering.

Five variables were included:

1) number of sows present at the time of the visit,
2) number of boars present at the time of the visit,
3) average number of fattening pigs per year in the farm,
4) number of weaners purchased and 5) sold from January 2011 to June 2012.

• Network analysis performed with calculation of centrality measures for each interviewed farmer:

In- and out-degrees = number of actors each node trades with for purchase (in-degree) and sales (out-degrees).
Weighted in- and out-degrees = total number of pigs purchased and sold respectively.
Betweenness = number of shortest paths from all the nodes to the others going through a node.

Results

The 138 familial farms interviewed were divided into four classes (Figure 1) with different characteristics (Table 1):

-**Very large closed farms:** presence of breeders and no purchase of weaners. Pigs are sold as weaners and/or fattened.

-**Large closed farms:** similar but with a lower number of pigs.

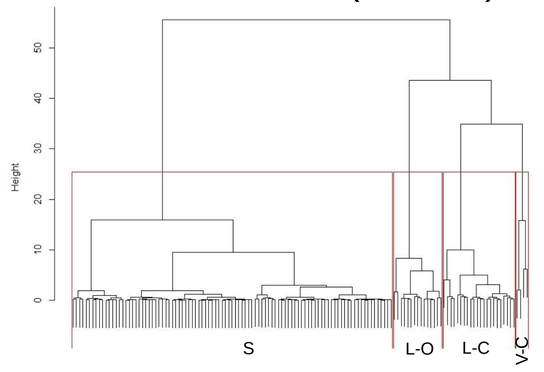
-**Large open farms:** purchase of weaners to fatten, most of them don't have sows or in a low number.

-**Small farms:** low number of pigs, different practices.

The trade networks in Van Lam and Van Giang districts show very different organizations (Figure 2). They have 3 nodes in common that connect the 2 giant components.

The farms practicing breeding (V-C and L-C) had the highest out-degrees and betweenness meaning they sell a large number of pigs and connect many nodes together. The L-O class had the highest in-degrees due mainly to their important purchase of weaners (Table 2).

Figure 1. Farm typology divided into four classes.
V-C: very large farm with "closed" system,
L-C: large farms with "closed" system,
L-O: large farms with "open" system,
S: small farms with open and closed systems.
'Height' represents an arbitrary distance between the different classes.



Class	Number of sows	Number of boars	Number of weaners sold	Number of weaners purchased	Number of fattenings per year	Total number of farms // in Van Lam / in Van Giang
V-C	172 (70-250)	5 (3-6)	2475 (0-6980)	0 (0-0)	1435 (600-2100)	4 // 1 / 3
L-C	30 (10-70)	1 (0-5)	277 (0-1320)	0 (0-0)	291 (0-700)	22 // 5 / 17
L-O	0 (0-4)	0 (0-0)	0 (0-0)	502 (280-970)	336 (140-900)	15 // 0 / 15
S	2 (0-13)	0 (0-0)	5 (0-61)	69 (0-253)	77 (15-300)	97 // 43 / 54

Table 1. Mean (Min-Max) of the different variables for the different classes of swine farms identified.

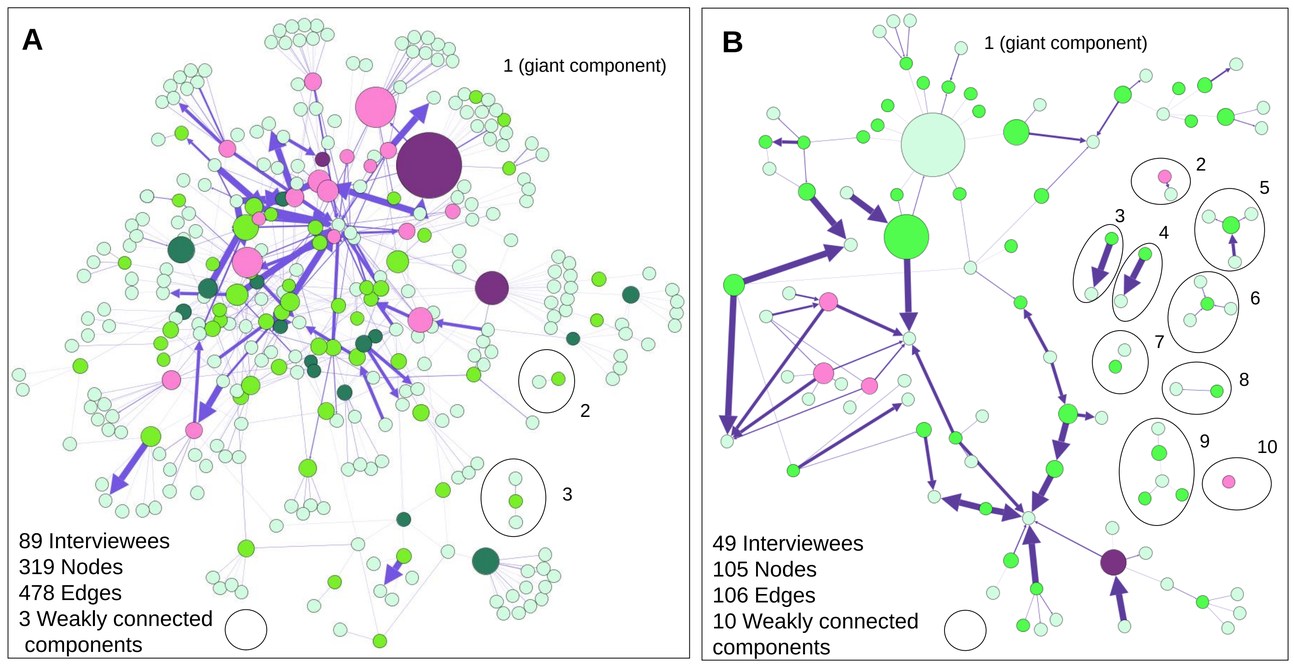


Figure 2. Trade networks of the movements of pigs as described by the interviewed farmers.

A: In Van Giang disctrict.
B: In Van Lam disctrict.

Means:	in-degree	out-degree	weighted in-degree	weighted out-degree	betweenness
V-C	2	8.5	71	2484	24
L-C	1.2	3.6	14	277	6.1
L-O	2.5	0.1	502	0	0.4
S	1.7	0.3	70	5	0.4

Table 2. Mean of centrality measures for each class in the overall trade network (excluding pigs for slaughtering as it is a endpoint for disease transmission).

Discussion

The very large closed farms (V-C), as well as the large closed farms (L-C) to a lower extent, showed high out-degrees and betweenness suggesting their potential role in disease spreading along the chain. The high in-degrees observed for the large open farms (L-O) and secondarily for V-C and the small farms (S) suggest these farms may be more at risk of disease introduction compare to the L-C class. However, these hypotheses must be tested, therefore a risk analysis and a transmission study will be carried out to describe better the potential routes for the spread of swine influenza viruses within the pig value chain.

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