Characteristics of poultry production systems and cost-benefit analysis of mass vaccination campaign against HPAI in poultry production systems in Long An Province, South Vietnam

Đặc điểm của các hệ thống chăn nuôi gia cầm và phân tích chi phí - lợi ích của chiến dịch tiêm vắc xin phòng bệnh HPAI theo các hệ thống chăn nuôi ở tỉnh Long An

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TÓM TẮT

Đàn gia cầm của nước ta năm 2006 có khoảng 215 triệu con. Song dịch cúm gia cầm độc lực cao (HPAI) gây ra do vi rút H5N1 đã bùng phát ở hầu hết các tỉnh thành trong cả nước từ đầu năm 2004 tới nay làm hàng triệu gia cầm đã bị tiêu huỷ. Dịch bệnh H5N1 đã gây những tác động lớn cả về phương diện kinh tế và xã hội. Vấn đề đặt ra: làm thế nào để hạn chế được dịch bệnh nguy hiểm này và chiến dịch tiêm phòng bằng vắc xin có phải là một công cụ hữu hiệu? Nghiên cứu này nhằm phân loại các hệ thống chăn nuôi gia cầm với những cản trở gặp phải trong mỗi hệ thống, nhất là dịch bệnh nguy hiểm gây ra do H5N1 và phân tích về phương diện tài chính chương trình phòng bệnh bằng vắc xin cho đàn gia cầm ở mức độ địa phương từ tháng 3 tới tháng 8 năm 2007 tại tỉnh Long An, Đồng bằng sông Cửu Long. Hai hệ thống chăn nuôi gia cầm chính đã được điểm hoá (1) hệ thống chăn nuôi gia cầm quy mô hàng hoá với mức độ an toàn sinh học từ thấp tới vừa và (2) hệ thống chăn nuôi gia cầm quy mô nhỏ với mức độ an toàn sinh học thấp. Các kịch bản phân tích tài chính chi phí - hiệu quả của các chiến dịch tiêm phòng vắc xin ngừa bệnh cúm gia cầm HPAI mang lại một chiến lược tốt để tái thiết lại ngành chăn nuôi này và từ đó cũng cho thấy cần khuyến khích người chăn nuôi tiêm phòng vắc xin đầy đủ cho đàn gia cầm. Chiến lược tiêm phòng vắc xin có chi phí hiệu quả cao hơn các hoạt động tiêu huỷ gia cầm với các kịch bản tỉ số hiệu quả/chi phí BCR cao hơn từ 31 tới 78 lần.

Từ khoá: Chi phí-lợi ích, Dịch cúm gia cầm độc lực cao, đồng bằng sông Cửu Long, hệ thống chăn nuôi gia cầm, tiêm vắc xin, vịt chạy đồng.

SUMMARY

In 2006, the poultry population of Vietnam was about 215 million heads. However, between 2004 and 2008, the Highly Pathogenic Avian Influenza (HPAI) caused by H5N1 virus was broken in affected almost all provinces in Vietnam with millions of birds culled. This had large economical and sociological impacts. A question has been raised: how could Vietnam limit this epidemic? The research aims to identify the poultry production systems with their various constraints, including diseases and to evaluate the cost-benefit impact of a mass vaccination programme implemented from March to August 2007 at local level in Long An Province within the Mekong Delta. Two principal poultry farming systems are characterised: the commercial poultry production system (system 1) with low to moderate bio-security level, and the small-scale production system (system 2) with a low bio-security level. The scenarios of cost-benefit analysis of vaccination campaigns against HAPI caused by H5N1 virus give a good strategy for the restructure of poultry production and farmers' incentives to vaccinate. The vaccination is more cost effective for the farmer than culling operations, with the BCR scenarios are between 31 to 78 times more.

Key words: Cost-benefit, Mekong Delta, HPAI, poultry production systems, transhumant ducks, vaccination.

1. INTRODUCTION

In 2006, the quantity of poultry flock in Vietnam reached about 215 million heads; the annual rate of growth of the poultry flocks reduced from 14 % to 16 % during the 2004-2006 period because of the outbreak, in the early months of 2004, of the Highly Pathogenic Avian Influenza (HPAI) caused by H5N1 virus (GSO, 2006). In this way, the Southern provinces saw their herd reduced by about 26 %, with millions birds culled. An estimation of the loss caused by H5N1 virus was about 3,000 billions of Vietnam Dongs (VND) (Department of Livestock Production, 2005). The risk associated to the avian influenza on the poultry flock was large, particularly on the backyard poultry production systems (FAO, 2006). This had large economical and sociological impacts, but the outbreaks of HPAI in Vietnam limited since the end of the first vaccination campaign, the end of 2005, in vaccinated domestic poultry have been reported (Peyre et al., 2007). Before the outbreak of HPAI, income from the poultry breeding occupied about 19 % of the total household income. The Red River Delta and Mekong Delta are the two regions having the largest poultry flock in the whole country, representing about 50 % of national flock (DLP, 2005). The vaccination is a useful tool to eradicate the disease, but the cost-benefit impact of different strategies need first to be addressed at local level, where implementation is decided. The aim of this study was to characterise the poultry production systems in place, including the occurrences of diseases and to evaluate the cost-benefit impact of the mass vaccination programme implemented at local level in Long An Province, in the Mekong Delta, South Vietnam.

2. MATERIALS AND METHODS

2.1. Sampling techniques

Data were collected by interviewing the household farms who have poultry production at different scales in Long An Province. Three districts (Ben Luc, Chau Thanh and Vinh Hung) and two communes per district were selected, according to the agro-ecological patterns. The research was conducted from March to August, 2007.

2.2. Contents of the research

The research aims at the diversification of the poultry production systems, particularly the duck or transhumant duck production systems prior to conducting the cost-benefit analysis of the mass vaccination programme against HPAI. Vaccination cost and benefit both depend on the number of doses administered. To study the cost-benefit impact of vaccination we have designed a stochastic model based on different scenarios. Each scenario varies according to the number of doses and its probability of being administered. The scenarios are specific for each species (chickens and ducks) and will vary in terms of protection outcome which will be not or long term protection. In the field, the number of doses administered will depend on the vaccination coverage which varies with the poultry farming systems, the geographical areas and the outbreaks' history.

2.3. Methodology of the research

2.3.1 Data gathering

The research began by the collection of official data concerning the poultry production from the reports of the Department of Livestock Production (DLP), FAO, the General Statistics Office (GSO), the Veterinary Services and Stations and the concerned communes.

The various poultry production systems and sub-systems were then identified; the poultry farm households were selected for the interviews through the stratified sampling method. Over 64 poultry farms and veterinary agents were eventually interviewed, following a closed structure questionnaire. Information collected allow the characterization of the poultry production (sub-) systems, the scale of breeding and the realisation of the cost-benefit analysis of the mass vaccination campaign against H5N1 in these farming systems.

2.3.2 Data analysis

The administration cost per dose should include all the logistic costs (vaccine price, injection material, staff salaries, cold chain equipment, transport,…), for the selected production systems, the cost-benefit ratio of the vaccination will be evaluated in comparison to different control options at the farm and at the provincial (and possibly national) levels. The costs and benefits were evaluated at farm level, different values between species (chicken and ducks) and production types (meat birds, layers, breeders) due to different breeding times, selling weights and selling prices were accounted for in the calculations. The results were presented as Prevent Value (Benefits minus Costs) in local currency (VND) per 1,000 heads, and as Benefits/Costs Ratio (BCR) such as:

COSTS	BENEFITS
- Basic costs for vaccinating the herd (vaccine price; administration costs; equipment; training) - Opportunity cost of the time spent by the farmer to vaccinate (or help with the vaccination)	- Value of the protected herd Mean value* x number of birds/production type (meat, layer, breeder) - Saving in the cost of control measures previously used to control the disease: culling (cost of culling the herd minus compensation value for the herd)

** The mean value represents the value of the bird at half time of the breeding period ($t_{(sale)}$-$t_{(purchase)}$). Different distribution models were associated to the value of the bird: a logarithmic increase and a linear decrease for bird broilers and layers respectively; the final sale price was used for breeders.*

Table 1. Typology of the poultry production systems in Long An Province

Production systems	Sub-systems	Number of respondents (farms)	Rate (%)
Commercial poultry (system 1)	Confined chicken	10	15
	Village duck	14	22
	Mixed poultry	16	25
	Transhumant duck	12	19
Backyard poultry (system 2)		12	19
Total		64	100

3. RESULTS AND DISCUSSION

3.1. Typology of the poultry production systems

The scale of poultry breeding and the type of poultry races are really diversified in each ecological zone of Long An Province. Investigation results characterized two main poultry production systems (Table 1) according to the type of production and the level of risk with epidemic disease.

- *System 1*: *Commercial poultry production system*

In this system all types of poultry are raised at large scale using industrial food. Nearly all chicks are bought from specialised enterprises or from centres of poultry research. These poultry production sub-systems have a low to moderate bio-security level and the raising is very intensive but farmers' technical and epidemic sanitary knowledge is still limited. This system has four sub-systems:-

+ *Confined chicken production:* Chickens (generally breeds of *ISA Brown*, *Sasso*, *Kabir*, *Luong Phuong*) are confined or both confined and grazed on good facilities, on personal fields or gardens. This sub-system has a rather moderate bio-security level since there is no contact between birds and other animals in the same farm.

+ *Village duck production:* Cross-bred meat ducks or imported races and Muscovy ducks (such as *Hoa Lang*, *Super Meat*, *Muscovy ducks*) are popularly raised on area around villages with a low bio-security level and the birds aren't vaccinated all of vaccines.

+ *Mixed poultry production:* Large flocks of chicken broilers (Luong Phuong and Tau chicken) and ducks are raised together at large scale with a low bio-security level broilers aren't vaccinated all of vaccines.

+ *Transhumant duck production:* Different owners originating from various provinces raise their duck layers (Khaki Campelle, Super eggs), local breeds (Tau vang, Hoa Lang) and sometimes their broiler duck breeds (such as Hoa Lang and Co) in rice fields of Mekong Delta or between ecological regions for taking the paddy on rice fields. The epidemic sanitary knowledge of the farmers is still limited with a regular contact between the different flocks and wild birds.

- *System 2*: *Backyard poultry production system*

In this system, mostly local breeds of poultry are raised freely. The levels of investment are small and farmers produce their chicks themselves. According to DLP (2005), about 90 % of household farms raise chicken using this system, producing about 65 % of the national poultry production.

3.2. General characteristics of the poultry production systems

The head of the farm households in commercial poultry production system has a large experience in the domain of poultry production (from 11 to 16 years) *(Vu Dinh Ton et al., 2008).* The average age of household heads is from 40 to 48 years old. On average, each household has two labourers, generally a family couple concentrating exclusively on keeping the poultry, according 3.6 to 8.5 hours to this activity per day and per farm. Two to five additional labourers are sometimes recruited to manage the duck transhumant farms during moving periods on rice fields hence increasing the working hours allocated to poultry to 10 to 12 hours.

However, in the backyard poultry production system, head of the farm is more than 56 years old. A part of products is directly consumed in the family during the Tet festival or different celebrations and one important part of poultry are sold giving some income in cash. General characteristics of these farming systems in Long An Province are presented on Table 2.

In the commercial poultry production system (system 1), the birds are kept in the industrial mode with a low to moderate bio-security level; all birds are vaccinated against different chicken diseases. In about 40 % of the farms raising poultry under this system, the chickens are entirely confined indoors. 86 % of farms in village duck production sub-system keep their ducks on the fields around the village during daytime and confine them at night. In the mixed poultry production, 56.25 % of farms are kept their birds indoors on the night time and 43.75 % of farms kept their birds by free-grazing scavenging around the village According to the DLP, this farming system is yet limited and outputs are still low.

Various types of birds are raised on a relatively small scale with a low bio-security level in the backyard production system (system2). Most households adopting this system raise their chicken simply around their residence or in various area surrounding the village. There is practically no purchase of chicks, nor of any feed, the by-products of the farms are the basis of the alimentation of the birds. Over 83.34 % of households freely kept their birds around the farm or village or a regular contact between birds in the different households.

3.3. Structure of the poultry flock

According to result of research in Long An and Ha Tay Provinces, 53% of poultry farms raise chicken and ducks together on the same surface, there are 80% of farm households keep the chickens and 74% of farm households keep ducks or Muscovy *(T. Phan Dang et al., 2007).* The volume and the structure of poultry production flock according to the two farming systems are presented on Table 3.

Table 2. Characteristics of poultry production systems in Long An Province

Systems / Characteristics	Commercial poultry production system				Backyard production system
	Confined chicken production	Village duck production	Mixed poultry production	Transhumant duck production	
Age of head of farm *(years)*	43.70	47.00	47.56	40.33	56.25
Habitants per farm *(persons)*	4.20	4.43	5.19	4.58	5.00
Labourers per farm *(persons)*	2.20	2.57	3.06	2.83	2.08
Poultry devoted labourers per farm *(persons)*	1.50	1.21	1.50	2.50	1.08
Poultry production working hours	3.60	5.50	4.75	8.54	2.00

(hours/day/farm)

Table 3. Current structure of the poultry flock according to poultry production systems (head of poultry/household/year)

Systems / Type of birds	Commercial poultry production system				Backyard production system
	Confined chicken production	Village duck production	Mixed poultry production	Transhumant duck production	
Hen layers	400	3	25	7	18
Chicken broilers	692	36	1,040	47	48
Duck, Muscovy duck layers	-	284	325	2,238	45
Duck, Muscovy duck broilers	0-50	1,128	876	3,360	129
Other (geese, etc.)	-	0-5	0-5	-	0-2

3.4. Cost - benefit analysis of vaccination campaign against HPAI

3.4.1. Organization of vaccination campaign against HPAI

The vaccination programme against HPAI caused H5N1 virus on the bird flocks are directed from the central government to villages in the regions, provinces, districts, communes and villages. Vaccines are imported and given to the provinces and then distributed to districts and communes. The surveillance programme of H5N1 virus is financed on equal part from the State budget and the provincial budgets. There is a steering committee at each of level from the Ministry of Agriculture and Rural Development to the provinces (Department of Agriculture and Rural Development), then to districts (Office of Agriculture) and finally to the communes (People's Committee). In addition, some groups of vaccination are organized at communal and village levels. Most of the birds are vaccinated directly at the farm.

The State organized two vaccination campaigns against H5N1 per year but there is an additional vaccination in between campaigns since 2006 in this province. Since July 2007, it is mandatory to vaccinate every new bird flock. In Long An Province, a budget of about 3.5 billions VND is allocated annually for the campaigns against H5N1. About 8 % of this budget is spent on training of veterinary agents, 5 % on animal census, 10 % on equipment and almost 77 % on vaccination. The birds are vaccinated two doses per campaign for the layers, breeders. The broilers, having a life cycle below 60 days are vaccinated one single dose (Long An Veterinary Service, 2007).

3.4.2. Farmers' practices facing an infection with HPAI

Many bird flocks were HPAI infected in the period of 2003-2005. After the waves of HPAI on bird flocks in Vietnam, a large number of farms had been vaccinated against some birds' diseases such as Newcastle, Gumboro and against avian influenza (Vu Dinh Ton et al., 2008). However, still many chickens were found infected by H5N1 virus after the vaccination campaigns against avian influenza. Before appropriate authorities officially proclaimed the avian influenza being caused by H5N1 virus, most breeders ignored the danger of this epidemic disease. In the backyard production system, the value of poultry flock isn't as important as in the commercial system; birds are consumed in the family or are sold on local markets. Farmers'

practices during an HPAI outbreak are presented on Table 4 showing that the majority of the *system 1 farmers* tend to sell culled poultry at low prices (68%) in opposition with system 2 farmers where consumption of dead culled poultry is limited (14%).

Table 4. Farmers' practices during an HPAI outbreak

Practices	Commercial poultry production system (system 1 - %)	Backyard production system (system 2 - %)
Total culling	64	86
Partial culling (only sick animals)	4	-
Partial culling + treatment	4	-
Treatment	12	-
Confinement	8	-
Rapid sale of live animals	4	-
Consumption or sale of dead animals	68	14
No information	4	-

Sample size system 1 = 25; system 2 = 7.

Table 5. Results of the partial budget analysis of the use of vaccination versus culling against HPAI at the farmer's level considering different scenarios

Scenarios	Systems	Present Value (PV) (1,000 VND/1,000 heads	Benefits / Costs Ratio (BCR) (95% confidence limits)	Infected farms (% in 2004 – 2005)
Total culling with declaration to the local veterinarian (with compensation◦)	System 1	33,668	78 (74 – 82)	12
	System 2	39,340	67 (64 – 70)*	72
Total culling with sales of dead or culled animal at low price (around 50 % less)	System 1	21,819	49 (47 – 50)*	68
Total culling with sales of dead or culled animal at low price (around 50 % less) and declaration (compensation◦)	System 2	12,272	31 (28 – 33)*	8
Rapid sale of dead or live animals at low prices (or consumption for system 2)	System 1	20,956	47 (45 – 48)*#	4
	System 2	22,309	38 (36 – 39)	14
Other	System 1	-	-	8

◦ *Compensation = 10,000 VND/adult; 5,000 VND/young. Source: Results of research, 2007*
** Statistically significant difference with scenario total culling with compensation (P<0.05)*
 # Statistically significant difference with scenario total culling with sales at low prices (P<0.05)

This has not always been the case and it seems that the awareness program on avian influenza performed by the government since 2005 has greatly influenced the change in farmers' behaviour, farmers having opted for the backyard production system becoming more aware of the necessity to consider health related issues (Table 4).

3.4.3. Vaccination versus culling for HPAI control

The epidemic sanitary knowledge of the breeders is still limited in the province. The sick birds are normally treated in duration from three to five days. If the birds can't survive after this duration, they are quickly sacrificed to intermediary collectors with very bad price (only equal from 15 % to 25 % of normal price). In the system 1, there are 65 % of farmers who have quickly sacrificed to collectors (Vu Dinh Ton et al., 2008). Since the end of the first vaccination campaign in the country (the end of 2005), limited outbreaks in non-vaccinated domestic poultry farms have been reported. The results of a mass vaccination campaigns against HPAI caused by H5N1 virus by the cost-benefit analysis at local level in this province are presented on Table 5.

In this study, the high BCR obtained are due to the fact that most of vaccination costs are not covered by the farmers themselves but are rather subsidised. The production costs are not accounted for in the calculation and punctual calculation is based on the value of the flocks at the time of the interview. The results on the table 5 show that the scenarios are more cost effective for the farmer than culling, with BCR between from 31 to 78 times more. The benefits are significantly lower for backyard than for commercial production systems, minus 15 % with $P<0.05$, probably due to the lowest value of their flocks. Based on this research and FAO report 2006, vaccination costs are about 650 VND per bird in one campaign in Long An Province.

The results on Tables 4 and 5 show that vaccination benefits vary according to the farmer's attitude to an outbreak of diseases. The compensation represents 20 % of the benefits (with long repayment delays: around 6 months) whereas selling the flocks at low prices accounts for nearly 50 %. Reinforcement of the awareness campaigns and some modification on the compensation scheme could help changing these practices. Most farmers stopped breeding poultry for a long time (from 3 to 24 months) after the last wave of outbreaks in 2004-2005. Large farms (> 300 birds) were mostly affected and interrupted the production during one to two years; smaller farms (< 300 birds) only stopped breeding for 3 months. Lack of cash flow and disease occurrence uncertainly could be the main reasons for these delays. These productivity losses should be included in an annualized cost-benefit analysis.

4. CONCLUSION

The scale of poultry production and types of bird races are really diversified in each ecological zone of the Long An Province. The production system 1 (commercial production sub-systems) has a low to moderate bio-security level. The raising is very intensive but farmers' technical and epidemic sanitary knowledge is still limited. The confined chicken production sub-system has a rather moderate bio-security level since there is no contact between birds and other animals in the same farm. The production system 2 (backyard production sub-system whereby the birds are free ranged around the farm and the village) has low bio-security level.

The measure of vaccination against the Highly Pathogenic Avian Influenza (HPAI) caused by H5N1 virus on the poultry flocks has contributed to prevent with the vaccinated flocks. The results of cost-benefit analysis of vaccination campaigns against HAPI give a good strategy for the restructure of poultry production in Vietnam. The vaccination is more cost effective for the farmer than culling with BCR scenarios are between 31 to 78 times more. But it is still to research on the socio-economic themes for better understanding the causes of next avian influenza waves and farmers' incentives to vaccinate.

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