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Production system characterization of local indigenous chickens in lower Northern Thailand

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ABSTRACT: Indigenous chickens play an essential role in Thailand's local smallholder farming system. They are raised for household consumption and extra income but also bred for sport such as fighting cock. In recent years, cockfighting has become a high-value sports challenge in Thailand. Here, our survey involving 200 households from 48 villages using both purposive and random sampling methods was carried out in five provinces of lower Northern Thailand to describe local indigenous chicken production systems and the socioeconomic statuses of farmers. Most respondents were males (87%) from the present study, and the primary purpose of indigenous chicken was fighting cock (78%). The chicken husbandry system could classify into three categories as free-range systems (18%), intensive systems (6.5%), and semi-intensive systems (75.5%). The most local indigenous chicken was left to scavenge, and farmers also provided some extra feed. The average flock size per household for roosters and hens was 3.07 and 9.06, with a total flock size of 39.23 birds. Predation (63.5%) and disease (22.5%) were the leading cause of mortality. Although most farmers could do some vaccination by themselves, their knowledge about preventing epidemic diseases and farm management were still limited. For trading, the well-trained and well-breed fighting cock (5 to 12 months old) could sell for very high prices compared with general indigenous chicken. Education about chicken genetics, welfares, and farm management is necessary and should promote sustainable development in the future.
Keywords fighting cocks; local indigenous chickens; lower Northern Thailand; production systems

INTRODUCTION

Thai indigenous chicken has played a vital role in the Thai folk's livelihood for a long time. Thai indigenous chicken can adapt well to climate, disease, low-quality feed and still reproduce regularly even with minimum management. Therefore, they can find throughout the local areas of Thailand. Concerning biodiversity, they seem to be a reservoir of genetic resources that could benefit future use (Choprakarn and Wongpichet 2008; FAO 2009b; Dorji et al. 2011). Indigenous chicken meat has a unique taste with good toughness and less fat. Therefore, their market prices are two or three times higher than the commercial broiler chicken (Jaturasitha et al., 2008; Mekchay et al., 2014). Moreover, there were no cultural or religious taboos relating to consumption like pork or beef (Abdelqader et al., 2007).

In Thailand, indigenous chicken is not raised for consumption only but is also used for specific breeding as widely known fighting cock for chicken fighting sport. This game is trendy and enshrined in a long tradition more than a millennium ago (Baker and Phongpaichit 2005). Thus, local indigenous chicken is significant to food security,

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multiple social, economic and cultural of households in rural Thailand (Choprakarn and Wongpichet 2008; FAO 2009b). Indigenous chicken populations in local areas are mainly selected and bred based on owner preferences without genotypic characterization due to poor understanding and lack of information. These breeding strategies oppose the concepts of sustainable development and will lead to the threatening risk of losing genetic diversity (Danda et al. 2010; Charoensook et al. 2013). The research works of local indigenous chicken genetic resources and production systems in Thailand are still limited. The most recent study of indigenous chicken genetics was done in the research station without surveys and sampling from the actual local chicken population (Dorji et al., 2011; Mekchay et al., 2014). Furthermore, the study in indigenous chicken production systems mainly was performed regarding the avian influenza outbreaks with little information about the local indigenous chicken husbandry, management, trading, and socioeconomic status of households (FAO 2009b; Wiratsudakul et al. 2014).

The first step to being undertaken to identify threats and opportunities for sustainable holistic development of local indigenous chicken is the characterization of production systems (Mtileni et al. 2009; Danda et al. 2010). It should be done under on-farm conditions rather than on-station experimental studies (Abdelqader et al., 2007). Therefore, this study aims to characterize local chicken production systems in lower Northern Thailand by assessing the husbandry, management, and trading systems. This investigation will benefit the conservation and utilization of local indigenous chicken resources in Thailand.

MATERIALS AND METHODS

Scope of the study

The study has conducted between 2012 and 2013 in five provinces of lower Northern Thailand. The sampling areas were the provinces of Phitsanulok (16°49′N 100°15′E), Phichit (16°26′38″N 100°20′52″E), Sukhothai (17°0′1″N 99°49′35″E), Kamphaeng Phet (16°33′29″N 99°30′40″E) and Uttaradit (17°37′47″N 100°5′48″E). In each province, two districts (*am-phoe*) with four subdistricts (*tam-bon*) within each district were chosen for surveys. We used a random sampling method to select households for interviews by picking from a list. Forty respondents in each province were interviewed. A total of 200 households in 48 villages were included.

Data collection and analysis

Data was collected through direct interviews and observations with individual local indigenous chicken raisers. Qualitative data were obtained through group discussions with chicken raisers and observation, while quantitative data was obtained by interview. The interviews were conducted using a checklist and structured questionnaire, which was managed at the chicken raiser's house with the assistance of local administrative staff and local officers from the Department of Livestock Development (DLD), Ministry of Agriculture and Cooperatives, Thailand. Information was collected on respondents' socioeconomic status, chicken husbandry management, chicken types, flock structure, farming support services, and local chicken marketing. Visual assessment of the local chicken phenotype was undertaken for morphological description based on the guideline of the Food and Agriculture Organization of the United Nations (FAO, 2009a).

This study's qualitative and quantitative variables were analyzed using frequency analysis and descriptive statistics (SPSS 1999). Significant differences between means were further determined using Duncan's Multiple Range Test; the significance level was set at 5%. The effect of the province on the different variables was estimated using the model below:

$$Y_{ijk} = \mu + P_i + G_j + e_{ijk}$$

where Y_{ij} is the dependent variable, μ is the overall mean, P_i is the effect of provinces (i = Phitsanulok, Phichit, Sukhothai, Kamphaeng Phet and Uttaradit), G_j is the gender of the household head effect, and e_{ijk} is the random residual effect.

We considered the flocks in each village in the five provinces as different breeding populations. Due to small populations and without suitable breeding programs, there may have been the possibility of inbreeding. Thus, we calculated the inbreeding rate and effective population size per breeding population by using Wright's equation (Falconer and Mackay 1996) as:

$$N_e = (4 \times N_m \times N_f) / (N_m + N_f),$$

the rate of change in inbreeding per generation was calculated as:

$$\Delta F = 1 / (2 N_e)$$

where N_e is the effective population size, N_m and N_f are the numbers of breeding cocks and hens scavenging together and mating freely, and ΔF is the inbreeding rate, respectively.

RESULTS AND DISCUSSION

Understanding the household socio-economics and the husbandry systems and management of local indigenous chickens are necessary for sustainable production and utilization. The background and socioeconomic status of respondents from this study are shown in **Table 1**. The survey indicated that indigenous chickens are widely raised in Lower Northern Thailand. The majority of respondents were men (87%), within the age range of 18 - 75, with a mean age of 49 years. Primary school was the main level of education (65%). The proportion of respondents that had a raising experience of more than 20 years was 36.5%. The mean family size of respondents was 4, and the primary source of livelihood was rice farming (46%), especially in PL province (70%). Motorcycles were the most popular method of household transport, and tractors were occasionally used for rice and crop farming. These findings indicate that the respondent are predominantly farmers, or their occupations are related one way or another to agriculture. Furthermore, in terms of socio-economics, indigenous chickens are much more beneficial as they are food for the farmer, an investment at home, and can be used for cultural and religious activities. The present result conformed to the previous study of Choprakarn and Wongpichet (2008) and FAO (2009b).

Table 1 Characteristic and socioeconomic statuses of respondents from five provinces in lower Northern Thailand

Parameters	Provinces[1]					Mean
	PL	PC	ST	KP	UT	
Gender of respondent (%)						
Male	77.5	95.0	87.5	97.5	77.5	87.0
Female	22.5	5.0	12.5	2.5	22.5	13.0
Age (years)*	52.1±0.6[a]	42.9±0.5[c]	49.8±0.4[ab]	47.1±0.6[b]	49.9±0.4[ab]	49.4±0.5
Education level (%)						
Illiterate	-	2.5	-	2.5	2.5	1.5
Primary school	72.5	67.5	67.5	67.5	50.0	65.0
Middle school	15.0	7.5	15.0	12.5	5.0	11.0
High school	5.0	10.0	10.0	7.5	20.0	10.5
Vocational certificate	5.0	10.0	2.5	2.5	15.0	7.0
Bachelor degree/higher	2.5	2.5	5	7.5	7.5	5.0
Main occupation (%)						
Rice farming	70.0	50.0	30.0	47.5	32.5	46.0
Crop farming	-	-	7.5	35.0	25.0	13.5
Horticulture	2.5	7.5	10.0	-	10.0	6.0
Livestock production	2.5	7.5	-	-	10.0	4.0
Formal employment	-	5.0	17.5	7.5	10.0	8.0
Informal employment	20.0	22.5	30.0	5.0	5.0	16.5
Tradesman	-	7.5	5.0	5.0	7.5	5.0
Chicken raising experiences (%)						
Less than 5 years	25.0	25.0	35.0	22.5	40.0	29.5
5 to 9 years	5.0	5.0	15.0	5.0	5.0	7.0
10 to 19 years	42.5	20.0	20.0	27.5	25.0	27.0
More than 20 years	27.5	50.0	30.0	45.0	30.0	36.5
Household vehicles (%)						
Bicycle	62.5	62.5	75.0	70.0	47.5	63.5
Motorcycle	90.0	97.5	92.5	97.5	100.0	95.5
Pickup truck	50.0	32.5	47.5	40.0	50.0	44.0
Tractor	52.5	10.0	40.0	65.0	27.5	39.0
Family size (no)*	4.20±0.3[a]	3.90±0.1[b]	4.05±0.2[a]	4.10±0.4[a]	3.83±0.2[b]	4.02±0.2

[1] PL = Phitsanulok, PC = Phichit, ST = Sukhothai, KP = Kamphaeng Phet, UT = Uttaradit

* Mean followed by different letters in the same row are statistically different (P<0.05)

The husbandry systems and management of local chickens in lower Northern Thailand are presented in **Table 2**. The husbandry systems found from this study could be classified into three categories based on the level of management as free-range systems (18%), intensive systems (6.5%), and semi-intensive systems (75.5 %). If chickens were left to scavenge for feed resources with no supplementation, we classified it as a free-range system. If chickens were permanently confined and supplied with balanced feed and healthcare, we classified this as an intensive system. Most local indigenous chicken husbandry systems in lower Northern Thailand were semi-intensive systems, combining both systems mentioned above. For this system, chickens were partially confined and supplemented with balanced ration feeds and healthcare; they were mainly housed at night and were allowed to scavenge within homesteads or run around for natural feed in the daytime. The most common natural feed of local chickens were earthworms, worms, termites, insects, and plant leaves. The husbandry system classification was similar to the previous studies in Thailand (FAO 2009b), Lao (Alders et al. 2004), Cambodia (FAO 2009a), Myanmar (Henning et al. 2006), Vietnam (Cuc 2010), Philippines (Cabarles Jr. 2013) and other developing countries in Asia (Bett et al. 2014). However, the percentage and ratio of each category were different.

Virtually all the local chicken raisers provided supplementary feeding for their chickens. However, the type and amount of feed depended on the crops grown and the geosocial makeup of each area. Most farmers who practiced supplementary feeding used paddy rice, corn grain, commercial feed (chicken and pig feed), and others, such as broken rice, rice bran, coconut, and noodles, depending on availability (Table 2). According to the observation, the amount of feed given was generally not enough for the chicken's requirements, especially during the crop growing and harvesting seasons. Farmers went to the fields in the early mornings and returned in the late evenings. Therefore, this result suggests that it might be better to feed chickens only once if the natural feed is plenty. This strategy would force the chicken to scavenge extensively and save some input (Choprakarn and Wongpichet 2008). In the case of fighting cocks, production was much more intensive. The owners usually took specific daily care, including a special diet, training, and sun bedding. Routine activities also included a complex range of exercises that aimed to develop muscle and improve endurance. Most of the fighting cock owners have deep knowledge and make extensive use of empirical medicine and herbs.

Indigenous chickens were the predominant population and presented in the primary poultry population sector of Thailand. As a part of the agricultural lifestyle, they are raised in villages for many purposes (Chantong and Kaneene 2011; Wiratsudakul et al. 2014). The reasons for indigenous chicken raising in this study were cash income (88%), household consumption (77%), hobbies (60%), while very few were sacrificial (3%). The main purposes of local indigenous chicken found in this survey were for fighting (78%), followed by backyard scavenging (17%), with the beauty contest for indigenous chickens being the least (3.5%) and only found in some provinces (**Table 2**).

Table 2 Local indigenous chicken husbandry systems and management

Parameters	Provinces[1]					Mean
	PL	PC	ST	KP	UT	
Husbandry systems (%)						
Free-range system	17.5	7.5	2.5	32.5	30.0	18.0
Semi-intensive system	67.5	90.0	87.5	67.5	65.0	75.5
Intensive system	15.0	2.5	10.0	-	5.0	6.5
Feed and feeding (%)[2]						
Free scavenging	80.0	75.0	90.0	80.0	92.5	83.5
Household residual	82.5	57.5	85.0	85.0	92.5	80.5
Commercial feed	42.5	52.5	62.5	47.5	52.5	51.5
Paddy rice	87.5	97.5	97.5	95.0	90.0	93.5
Corn grain	35.0	35.0	80.0	47.5	47.5	49.0
Others	15.0	15.0	30.0	25.0	20.0	22.0
Reason for raising (%)[2]						
Consumption	65.0	65.0	87.5	80.0	87.5	77.0
Cash income	92.5	95.0	90.0	97.5	65.0	88.0
Hobbies	67.5	62.5	55.0	60.0	55.0	60.0
Traditional ceremonies	10.0	-	-	-	5.0	3.0
The main purpose of chicken (%)						
Fighting	72.5	90.0	87.5	92.5	65.5	78.0
Beauty contest	15.0	2.5	-	-	7.5	5.0
Food	12.5	7.5	12.5	7.5	25.0	17.0

[1] PL = Phitsanulok, PC = Phichit, ST = Sukhothai, KP = Kamphaeng Phet, UT = Uttaradit

[2] Respondent can choose more than one choice

The mean chicken flock size per household, breeding stock, effective population size, and inbreeding rates in the five provinces of lower Northern Thailand are shown in **Table 3**. The trend of flock composition generally followed the same pattern in all the provinces. The average flock size was about 38.2 birds, ranging between 32 and 44 birds per household ($P < 0.05$). Forty-nine percent of households kept 1-2 roosters, and 86.5% kept 1-10 hens per household. According to the survey, almost all respondents had their breeding stock whilst a few raisers depended on the other farms. The average breeding rooster-to-hen ratio was 1:3 per household. The mean average flock size and the sex ratio depended on the primary purpose of the chickens. This result was comparable to FAO (2009b) and other Southeast Asian countries (Alders et al. 2004; Henning et al. 2006; FAO 2009a; Cuc 2010). The breeding stock losses depended on mortality and predation. The chicken was mainly culled for home consumption, as extra incomes, and when they get a low performance. There were few records of household flock information for breeding purposes. Breeding stocks used were about 2-3 years old, depending on their performance. The criteria for selection were, for males, high body weight, long leg, beauty, and fighting ability (fighting cocks). The selection recommendations for females were good maternal ability, good behavior during incubation, and good taking care of her chicks.

Table 3 Characteristic of breeding stocks, effective population sizes, and inbreeding rates at household levels of local indigenous chickens

Parameters	Provinces[1]					Mean
	PL	PC	ST	KP	UT	
Number of the rooster (%)						
0	2.5	5.0	-	2.5	-	2.0
1-2	32.5	57.5	55.0	55.0	45.0	49.0
3-4	15.0	17.5	22.5	30.0	37.5	24.5
5-7	7.5	17.5	15.0	12.5	12.5	13.0
8-10	37.5	2.5	2.5	-	-	8.5
>10	5.0	-	5.0	-	5.0	3.0
Average rooster (no.) *	2.78±0.3[a]	2.75±0.20[a]	3.43±0.3[b]	2.75±0.2[a]	3.63±0.1[b]	3.07±0.1
Number of hens (%)						
0	-	-	5.0	2.5	-	1.5
1-5	55.0	52.5	47.5	37.5	22.5	43.0
6-10	30.0	40.0	40.0	57.5	50.0	43.5
11-20	15.0	7.5	2.5	2.5	17.5	9.0
>20	-	-	5.0	-	10.0	3.0
Average hen (no.) *	6.50±0.4[a]	6.05±0.5[a]	13.20±0.7[b]	6.28±0.4[a]	13.28±0.6[b]	9.06±0.1
Flock size (%)						
1-20	32.5	20.0	20.0	22.5	22.5	23.5
21-50	35.0	45.0	40.0	25.0	42.5	37.5
51-100	25.0	27.5	32.5	42.5	17.5	29.0
>100	7.5	7.5	7.5	10.0	17.5	10.0
Average size (no.) *	39.95±1.6[b]	38.45±1.5[b]	44.23±1.4[c]	32.10±1.6[a]	40.40±1.2[b]	39.03±0.5
N_e[2]	7.79	7.56	10.89	7.65	11.40	9.17
F[3] (%)	6.42	6.11	4.59	6.54	4.38	5.45

[1] PL = Phitsanulok, PC = Phichit, ST = Sukhothai, KP = Kamphaeng Phet, UT = Uttaradit

[2] N_e = effective population size per breeding population at household level

[3] F = inbreeding rate per generation at household level

[4] Respondent can choose more than one choice

* Mean followed by different letters in the same row are statistically different (P<0.05)

The effective population size is a parameter used to estimate the rates of inbreeding and genetic drift; these parameters depend on the number of breeding individuals in an ideal population (Abdelqader et al., 2007). Based on Wright's equation (Falconer and Mackay 1996), it is found that the effective population size (N_e) ranged from 7.56 to 11.40, with a mean of 9.17. The inbreeding rate per generation (ΔF) ranged between 4.38% and 6.54%, with a mean of 5.45% in five provinces (**Table 3**). Many studies have been done about the production systems characterization of local indigenous chickens and fighting cocks in Southeast Asian countries (Alders et al. 2004;

Henning et al. 2006; FAO 2009a; FAO 2009b; Cuc 2010). However, no information has been reported about the parameters of N_e and ΔF. Our present study, therefore, reports these calculated parameters for the first time. The effective population size estimated in this study was 50% less than the actual population size. The estimated inbreeding rate was higher than the acceptable level of 1-2% per generation (Henson 1992). These results suggest that the breeding population was small and had a risk of inbreeding. Inbreeding causes a loss of genetic diversity, often associated with reduced reproductive fitness, and may lead to extinction (Frankham et al., 2002). The suggestion is that chicken owners should be educated by the government officer or local cooperation about chicken mating management to reduce inbreeding (Okeno et al., 2013).

Furthermore, especially in fighting cocks, our study found that most local chickens were crossbred with many imported exotic breeds. They were bred based upon fighting performance without genotypic conservation and scrutinized breeding programs. This breeding strategy opposed sustainability concepts incorporating both conservation and utilization from indigenous genetic resources (Charoensook 2011; FAO 2014). These circumstances will lead to the risk of losing the valuable genetic resources of Thai indigenous chickens.

The results of chicken disease control and the provision of extension services are shown in Table 4. Predation was the primary cause of chicken death in the study area (63.5%), caused mainly by dogs in the villages, followed by disease (22.5%). Newcastle disease and fowl cholera accounted for the most significant diseases in local chickens annually, which agreed with Choprakarn and Wongpichet (2008). The highest chicken death rate was observed during the season changes, and 71% reported chicken disease outbreaks. When endemic disease occurred, some owners moved their chickens to the crop fields far from villages. This situation reduced the chicken mortality rate to some extent. To prevent disease, the local indigenous chickens of 66% of respondents had a vaccination, of which 87.9% was done by the owner themselves (Table 4). Newcastle disease (86.3%) and infectious bronchitis vaccines (80%) were widespread in five provinces of the study, followed by fowlpox (50.7%) and cholera vaccines (47.9%). Some owners could identify the differences between Newcastle disease and fowl cholera and also pointed to the time of outbreaks.

As for sources of information about chicken husbandry and healthcare, it was found that the raiser mainly obtained these from friends or relatives (65%), followed by local government officers (46.5%), radio or television (49.5%), and magazine or newspapers (49.0%). A few farmers got information by using the internet (9%). Agricultural collaborations were found in some villages (46.5%). Although farmers could get support from local government officers, the officers were not frequently available. The support of livestock health care was not provided across all villages, especially in remote rural areas. Some owners used human medical supplies for their chickens. These included antibiotics and insecticides. Moreover, local herbs were trendy among owners to keep their chicken healthy. These herbs were used quite satisfactorily for disease prevention and parasite eradiation.

Table 4 Chicken disease control and the provision of extension services

Parameters	Provinces[1]					Mean
	PL	PC	ST	KP	UT	
Disease outbreak (%)						
Yes	67.5	85.0	70.0	72.5	60.0	71.0
No	32.5	15.0	30.0	27.5	40.0	29.0
Chicken vaccination (%)						
Yes	62.5	65.0	65.0	67.5	70.0	66.0
No	37.5	35.0	35.0	32.5	30.0	34.0
Vaccinator (%)						
Owner	72.0	96.2	92.8	88.9	89.3	87.9
Officer	28.0	3.8	7.2	11.1	10.7	12.1
Type of vaccines (%)[2]						
Newcastle disease	84.0	62.0	96.2	92.6	92.9	86.3
Infectious bronchitis	68.0	77.0	84.6	83.3	87.0	80.0
Fowl pox	36.0	57.7	57.7	54.2	47.8	50.7
Fowl cholera	44.0	46.2	38.5	54.2	56.5	47.9
Infectious coryza	4.0	11.5	15.4	29.2	34.8	19.0
Combined vaccines	20.0	23.1	15.4	16.7	52.2	25.5
Agricultural collaboration (%)						
Yes	60.0	37.5	57.5	42.5	35.0	46.5
No	40.0	62.5	42.5	57.5	65.0	53.5
Source of information (%)[2]						
Local officer	60.0	37.5	67.5	67.5	47.5	51.0
Radio/TV	40.0	40.0	42.5	50.0	75.0	49.5
Magazine/Newspaper	35.0	45.0	52.5	42.5	70.0	49.0
Friend/Relative	65.0	57.5	45.0	77.5	80.0	65.0
Internet	2.5	2.5	12.5	12.5	15.0	9.0

[1] PL = Phitsanulok, PC = Phichit, ST = Sukhothai, KP = Kamphaeng Phet, UT = Uttaradit

[2] Respondent can choose more than one choice

Thailand experienced four major epidemic outbreaks of highly pathogenic avian influenza H5N1 (HPAI H5N1) between 2004 and 2006. Occasional cases were reported until late 2008 (Chantong and Kaneene 2011). It was also a disease of economic importance that directly affects the poultry business of the country. It has estimated that more than 65 million birds are destroyed to halt the outbreaks, and the government spent more than one billion Thai baht (THB) to compensate poultry owners. Most of the outbreaks reported in Thailand concerned the existence of traditional backyard chickens and free-range duck raising systems (FAO 2009b; Chantong and Kaneene 2011). However, even though no information about HPAI H5N1 outbreaks in Thailand has been reported, sustaining disease surveillance and prevention are still strongly recommended (Wiratsudakul et al. 2014).

Thai indigenous chicken is one of few agricultural products that have never faced a price problem. Historically, they have had a high demand whilst the supply has consistently remained low. The price of indigenous chicken sold for meat was between 50 and 100 THB per kilogram, depending on the season and special occasions (Table 5). Chickens were sold live, and the size varied from 1-kilogram body weight up to old parent stock. The most popular age of chicken sold for meat was between 5 and 8 months old (52.5%). Indigenous chicken owners sold their birds mainly to local traders at farmhouses (52.5%). Some farmers preferred to sell chicken at local markets in towns (26%) by themselves, as they could receive a higher price. The survey revealed that farmers did not sell indigenous chicken eggs for consumption; this was in agreement with Choprakarn and Wongpichet (2008) and FAO (2009b).

Although the price of indigenous chicken was about 2-3 times higher than commercial broilers (Jaturasitha et al. 2008), it was deficient compared to the cost of fighting cocks. Cockfighting in Thailand is a flourishing industry, including the manufacture and supply of feed, medicine, and equipment for arena operations and chicken handling (Safman 2010). The price of a fighting cock ranged from 400 to 10,000 THB per bird, with costs between 500 and 2,000 THB found mainly in this observation. The market value of a fighting cock was established by the owner's reputation, fighting statistics, and style in the pits. The desired age was between 9-12 months old (43.5%); the price tended to go down for younger fighting cocks. Almost all fighting cock owners did not prefer to sell their cocks at the arena (14%). Thus, their house was the most popular place for trading (65.5%); another selling style was delivery to customers by transportation companies. The trading systems of local indigenous chicken in five provinces of lower Northern Thailand are summarized in **Table 5**.

Table 5 Local indigenous chickens trading systems in lower Northern Thailand

Parameters	Provinces[1]					Mean
	PL	PC	ST	KP	UT	
Trading for consumptions						
Age of chickens (%) [2]						
3 to 4 month	27.5	10.0	5.0	15.0	25.0	16.5
5 to 8 month	57.5	67.5	67.5	42.5	27.5	52.5
9 to 12 month	5.0	2.5	5.0	2.5	2.5	3.5
Price per kilograms (%) [2]						
50-70 THB	65.0	40.0	20.0	7.5	7.5	28.0
71-90 THB	17.5	40.0	45.0	35.0	22.5	32.0
> 90 THB	2.5	-	7.5	17.5	25.0	10.5
Trading places (%) [2]						
Owner's house	75.0	50.0	62.5	52.5	22.5	52.5
Fresh market in town	25.0	30.0	22.5	15.0	37.5	26.0
Trading for cockfighting						
Age of chickens (%) [2]						
3 to 4 month	2.5	-	-	5.0	2.5	2.0
5 to 8 month	17.5	20.0	17.5	25.0	15.0	19.0
9 to 12 month	30.0	62.5	55.0	52.5	17.5	43.5
> 12 month	15.0	2.5	2.5	5.0	2.5	5.5
Price per a chicken (%) [2]						
< 500 THB	27.5	12.5	17.5	22.5	5.0	17.0
500-1,000 THB	30.0	47.5	42.5	35.0	17.5	34.5
1,001-2,000 THB	40.0	50.0	42.5	35.0	20.0	37.5
2,001-3,000 THB	10.0	12.5	17.5	37.5	10.0	17.5
3,001-4,000 THB	10.0	12.5	12.5	17.5	7.5	12.0
4,001-5000 THB	15.0	7.5	2.5	10.0	10.0	10.0
> 5,000 THB	10.0	22.5	22.5	40.0	20.0	23.0
Trading places (%) [2]						
Owner's house	60.0	77.5	70.0	85.0	35.0	65.5
Cockfighting arenas	15.0	7.5	17.5	15.0	15.0	14.0
Others	2.5	5.0	5.0	2.5	5.0	4.0

[1] PL = Phitsanulok, PC = Phichit, ST = Sukhothai, KP = Kamphaeng Phet, UT = Uttaradit

[2] Respondent can choose more than one choice.

CONCLUSIONS

This present study was the first to compare local indigenous chicken production systems of five provinces in lower Northern Thailand. The occupations of the chicken owners are related to agriculture or are predominantly farmers. Most of them are still poor and have a lack of education. In terms of disease control of chickens, the support from the government and the knowledge of disease surveillance is still limited. Chicken crossbreeding with exotic breeds based on owner preferences without scrutinized breeding programs is widespread. Most smallholders have not increased their production due to a lack of information. Therefore, education about chicken genetics, local feed, and farm management is necessary and should be promoted. The results from this study will be helpful to government institutions and development agencies to develop policies and plan sustainable development projects in the future.

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