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Nutritional and reproductive performance of local layer system in Vietnam

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ABSTRACT

To develop local breeds, the first action should be to investigate how the breeds have been raised and grown. The study aimed to determine nutritional practice and reproduction characteristics of Noi chickens in Ben Tre Province. A total of 90 respondents were involved with this study by a purposive sampling method. The data were collected by in-depth interview. A descriptive analysis was used for this study. The results showed that male farmers were dominant, being more than 25 years old, and labour was mostly from family member. Noi chickens were raised for laying purpose and usually integrating with other livestock at the farm. As traditional farms, farmers raised Noi chickens under semi and free-range farming system with water and feed from natural resources and still using hens to hatch eggs and produced chickens. Noi laying performance was not high and most farms did not record information of laying performance. Besides, Noi chickens have first laying egg at 22 weeks with an average of 1-2 egg per week and 2-4 cycle laying per year. The common feed was commercial feed, and farmers always mixed with other agriculture products and by-products. The nutritional value of feed was insufficient for layer production and depending on the seasons and locality with the highest crude protein 11.8 and the lowest was 4.3. It can be concluded that farmers still practice traditional method in raising Noi chickens and laying performance of Noi chicken were not high on farmer's farm.

Introduction

In recent years, thanks to no major epidemics, poultry flocks across the country have grown strongly. Poultry farming in many localities has become one of the main occupations in agricultural production, contributing to changing the structure of agricultural production sectors, helping to sustainably eliminate hunger (Dang *et al*., 2022) and reduce poverty. It is noteworthy that small-scale poultry farms sometimes exhibit a preference for indigenous breeds, as these varieties are more desirable among Vietnamese customers (Delabouglise *et al*., 2019)

In Ben Tre province, poultry farming is one of the growing industries. In particular, local chicken farming is playing a very important role in meeting the growing needs of people. The total poultry herd in the province is estimated at about 6.750 thousand heads (Ben Tre Statistics Department, 2019). Ben Tre province was well-known place in which local Noi chickens were raised. The chickens were one of local chickens in Vietnam and the breed is also kept for the purpose of being a fighting chicken (Khang *et al*., 2022). The quality characteristics and nutritional contents of chicken meat and eggs are influenced by various factors, including animal genetics, dietary sources, rearing systems, as well as handling and slaughter techniques (Ahmad *et al*., 2018). Noi chicken is one of the local chicken breeds, easy to raise, well adapted to environmental conditions and care techniques in rural areas (Khoa *et al*., 2019a). The investigation of physical attributes of free-range Noi hens has been somewhat examined in prior studies conducted by (Khoa *et al*., 2019b; Khang *et al*., 2022). The Noi chickens found in the Mekong Delta have distinct traits that set them apart from other chicken breeds. These characteristics include a yellow and black beak, yellow eyes, a red neck, reddish-green plumage, and yellow and green shanks (Khang *et al*., 2022).

Recently, research on native chickens, especially Noi chickens, has been increasingly focused, from the use of herbs to improve the nutrition of the chickens (Linh *et al*., 2020) to breeding sites (Khang *et al*., 2022), the genetics of Noi chickens (Khoa *et al*., 2019a). As other local chickens, Noi chickens are raised in many forms such as free-range farming, semi-free-range farming or visiting farming. Free-range farming currently brings positive results in terms of chicken meat quality. This approach accounts for 92% of the families engaged in chicken rearing. According to (Lan Phuong *et al*., 2015), households typically maintain a range of 5 to 50 heads/household under this system. For broilers, commercial broilers account for approximately 23.1% of the overall chicken population in Vietnam. The remaining 76.9% comprises of indigenous chickens or crossbred chickens. For laying hens, in a prior study conducted by (Nguyen Van *et al*., 2020), it was reported that the proportions were 43.3% for commercial chickens and 56.7% for local chickens. The tradition farming behaviours in Mekong delta was recorded, particularly, farmers practice feed their birds by local agricultural sources such as by products, leftover from household consumption (Linh *et al*., 2022).

The previous study of (Nguyen Van *et al*., 2020) recorded the performance of two kinds of local breeds namely, Ho chicken and Dong Tao chicken, these breeds had a week performance in both eggs and growth. The study of (Khoa *et al*., 2019a; b) performed the information of Noi chickens (crossbred type) with the performance from day old chicks to slaughter phase. Additionally, some studies found morphological traits, production traits, genetic diversity of local breeds and mostly in ovo/ in vitro study. However, there was less information of how farmers raise these local breeds in local conditions. Thus, the aim of this study was to characterize the growth, laying, meat and egg performance of Noi chicken breed of Vietnam when raised in local conditions of Mekong delta.

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Materials and methods

Location

The study was conducted in Ben Tre province consisting of 3 districts of Ben Tre province, all located in Mekong delta. The survey area was following the recommended list from government officers. The purpose of choosing three districts was that is the most dynamic places for raising Noi chickens in the province and there are the largest number of Noi chickens raised in this area. Besides, the study was following the project of breeding and conserving Noi chickens in Ben Tre Province.

Data collection

The study was implemented from October 2022 to December 2022 to get data from Noi chicken farmers. A total of 90 farmers was purposively selected to this study. The selected respondents were following the criteria: (1) farmers raise Noi chickens at their farm (2) farmers join in trading Noi chickens. The study used questionnaire in the local language (Vietnamese) and supported by government officers. The questionnaire included 4 sections: The first section related to social profiles of farmers including gender, family member, age, education, labour, bird production. The second section related to farming management including farm size, the number of Noi chickens at farm (original and crossbred), housing system and farming equipment of for both egg and broiler production. The feed ingredient compositions were recorded in the third section, including feeding sources, local ingredients that may use previously, formulated feed that may use at farm and watering/feeding behaviours of farmers at farms. The samples of feed were taken to check chemical compositions at the laboratory of Tra Vinh University. The fourth section recorded the information of layer production performance including first egg period, mortality rate, egg performance per day, laying cycle per year, average body weight, feed intake.

Feed sample collection

Samples of feed were collected in a random manner from the feeders located on the farmer's farm. Dietary samples were collected and thereafter kept in a freezing equipment. The entirety of the collected samples was utilized for the purpose of determining the precise feed and nutrient consumption of the Muscovy ducks under investigation. The dry matter (DM) and crude protein (CP) content of the feed samples were determined using the AOAC procedures (AOAC, 1990).

Data analysis

The data was analysed by descriptive analysis using Statistical Package for the Social Sciences (IBM SPSS) 26.0 (IBM Corp, Armonk, NY, USA). The results were performed in term of frequency and percentage of respondents answering a question. The frequency and percentage may be higher than 90 (total of respondents) caused farmers can choose more than one answer.

Results

Social demography of local chicken farmers in Ben Tre Province

According to the results of the survey, most of farmers engaged in farming activities were of the male gender and were within the age range of 25 to 59 years. Most interviewed farmers, at 98.9%, reported that their families consisted of 3 to 5 members and were mostly engaged in farming-related activities. Farmers also affirm that they seldom engage in the practice of hiring labour for agricultural tasks on their farms. According to the data provided, it has been confirmed that most farmers have not attained a high school diploma. Furthermore, a mere 3.3% of farmers have successfully completed a bachelor's degree, while there is no reported participation in postgraduate education within this demographic. At survey farms, the predominant practice for Noi chickens is the rearing

Table 1. Farm size of surveyed farmers.

No	Criteria	Categories	Results	
			Freq.	%
1	Farm size (head):	No information	39	43.3
		50-100	22	24.4
		100-500	9	10
		500-1000	2	2.2
		1000-5000	16	17.8
		5000-8000	2	2.2
2	Farm size (m^2):	No information	82	91.1
		100-200	6	6.7
		200-400	2	2.2
3	Water source	Tap water	58	64.4
		Water from pond	40	44.4
		Tap water + water from pond	9	10
		Tap water + water from garlic and alcohol mixture	7	7.8
		Water from wells	2	2.2
		Water from pond + wells	1	1.1
4	Feed source	Commercial feed	84	93.3
		Feed with supplement	61	67.8
		Manufactural formulated feed	32	35.6
		Mixed feed	13	14.4

Noted: Farmers can choose more than one answer.

of layer chickens, followed by the simultaneous rearing of both broiler and layer chickens.

Local chicken farming management in small scale farmers of Ben Tre Province

The number of chickens at farms were recorded in Table 1. Most of farmers did not record how many birds are available at their farm (43.3% had no information). Small farms were predominant in the survey area, only 2 farms confirmed 5000-8000 heads in their farm. Chickens are raised around their house so that the farm size was not recorded as well with 81/90 farmers. Farmers still give water from pond to birds. Using commercial feed was confirmed in 84/90 farmers.

Integrated with other livestock at farms, farmers not only raise Noi chickens but also raise other local chickens and/or other livestock (Table 2). Besides, mostly chickens are live on the ground floor without any facilities (82.2% of surveyed farmers). As traditional raising methods, Noi chicken farmers in Ben Tre also raise their bird with free range and semi-free range farming system, only a few farmers keep their birds in cage. There were 10 criteria used for selecting Noi chicken at their farm. The highest confirmed percentage was price (egg/DOCs) with 85/90 farmers. Farmers seems to not focus on production performance criteria when choosing Noi chickens. The same with traditional raising system, farmers also used hens to hatch eggs and produce chicks. The application of machines was not common in Noi chicken farms.

Nutrition value of diets used at Noi chicken farms, Ben Tre Province.

The study recorded that farmers mainly take advantage of available feed around their living areas to raise local Noi chickens (Table 3, 4). For instances, water spinach, water hyacinth and natural grass were cut around the house or wasteland; banana tree trunks are collected after harvesting bananas in the garden; leftover rice was collected after meals; for others, usually bought from the market such as soybean meal, rice bran, rice. Regarding feeding methods, most households give feed to birds in term of mixed feed such as the combination of bran, soybean, waste of alcohol then add natural feed such as water morning glory and banana trunk. Feed the chickens 2-3 times a day depending on their leisure time. Depending on the by-products available at home and in the locality, feed formulation from each farm were not the same (Table 4). Commercial feed is the main feed that farmers have to buy, the rest is used from rice, rice bran... harvested through family farming. The sources of green vegetables supplemented by farmers are relatively diverse such as water morning glory, grass, banana trunk. Besides, Table 4 shows the nutritional composition of the feed rations used at Noi chicken farms. The nutritional value was not high in all diets. The higher crude protein recorded was the combination of 70% commercial feed in the diet.

Table 2. Farming system of Noi chicken in Ben Tre province.

No	Criteria	Categories	Results	
			Freq.	%
1	Bird species	Only Noi chickens	61	67.8
		Noi chickens and other kinds of chickens	16	17.8
		Noi chickens and other livestock	13	14.4
2	Farm floor	Ground floor	74	82.2
		Cement floor	16	17.8
		Sand floor	12	13.3
		Both ground and cement floor	6	6.7
		Ground and sand floor	6	6.7
		Husk floor	1	1.1
		Cement and sand floor	1	1.1
		Others	0	0
3	Farming methods	Semi-free range farming	59	65.6
		Free range	35	38.9
		Caging	18	20
4	Selective breed criteria	Price	85	94.4
		Egg colour	78	86.7
		Morphological traits	77	85.6
		Good health status	59	65.6
		Market segmentation	56	62.2
		Body weight	26	28.9
		Egg weight	24	26.7
		Meet/egg quality	21	23.3
		Disease resistance	19	21.1
		Egg performance	13	14.4
5	Hatchery methods	Incubation by hens	75	83.3
		Incubation without machine*	18	20
		Incubation by automatic machine	7	7.8
		Both incubation by hens and by automatic machine	7	7.8
		Incubation by hens and without an automatic machine	3	3.3

Noted: Farmers can choose more than one answer. Farmers brood the eggs by themselves without incubation machines, they put egg in the warmer and take care the eggs.

Table 3. Feed ingredients used at Noi chicken farms for all seasons.

Feed ingredients	DM	CP	EE	CF	Ash	Ca	P
Copra meal	34.6	2.24	13.1	7.8	0.63	0.02	0.05
Brewer grains	6.99	2.49	0.27	0.03	1.18	0.03	0.02
Banana trunk	3.35	0.33	0.13	1.01	0.42	0.03	0.02
Mixed vegetable	11.3	1.76	0.41	2.17	1.49	0.17	0.04
Soybean meal	24.8	4.22	2.72	3.35	2.99	0.06	0.25
Rough rice	85.7	8.02	2.39	9.71	4.85	0.02	0.39
Corn	87.1	7.15	3.31	1.13	0.72	0.01	0.17

Noted: At the time of study, sample feed did not have all ingredients. F: feed formulation, DM: dry matter, CP: crude protein, EE: ether extract, CF: crude fibber, Ca: calcium, P: phosphate.

Table 4. Chemical composition in feed formulation at survey time.

Criteria (%)	Feed composition			
	F1 (n=3)	F2 (n=3)	F3 (n=3)	F4 (n=3)
Ingredients, %				
Rough rice	30	-	50	-
Copra meal	20	-	-	-
Soybean meal	-	30	-	-
Rice bran	-	40	-	30
Commercial feed	10	10	20	30
Water morning glory	20	-	20	-
Brewer grains	-	30	-	30
Proximate analysis, %				
DM	43.8	51.1	63	55.6
CP	4.3	6.6	7.1	8.5
ME, MJ	0.5	0.6	0.8	0.7
%CP/KP	9.7	13	11.3	15.3
ME, MJ/kgDM	12.3	12.3	12.4	12.9

Noted: At the time of study, sample feed did not have all ingredients. F: feed formulation. At the time of study, sample feed did not have all ingredients. F: feed formulation, DM: dry matter, CP: crude protein, ME: metabolizable energy.

Local layer chicken production characteristics

The result of Table 5 shows that most households only raise Noi chickens, accounting for 67.8% with 61 households. We can see that the mortality rate of laying hens is of 10%, accounting for 70.0% with 63 households in total, some farmers recorded a higher mortality rate. The average weight of laying chickens was from 1.5 - 2.0 kg. The amount of feed consumed by laying hens is quite high and most farmers have not recorded this information. Feed consumption recorded in 15 farming households was greater than 4 kg/chicken. Besides, in Table 8, the hatching rate of Noi chickens was not high, the highest hatching rate was 90% and the lowest one was less than 50%. Noi chickens had 2-4 laying cycle per year and can produce an average of 1-2 egg per week.

Discussion

We can see that men are the main source of labour and account for most chicken farming households in the survey area. Men are the main source of labour in chicken farming, because men are able to do heavy work, as well as make decisions about raising animals. Linh *et al.* (2022) commented that men participate more in management activities such as vaccination, medicine, food transportation, barn repair, as well as providing chicks. recorded that male farmers in Vietnam were dominant in farming activities. Most farmers are raising chickens of working age following the labour age regulation in Vietnam, at this age farmers may have experience to make decisions at farm, and especially decisions in raising their livestock, as well as have the ability to learn and apply new protocols and technologies (Sani *et al.*, 2007). The above survey results are similar to the research of Qui *et al.* (2020), Qui *et al.* (2021) in case of swine production and (Qui and Tho, 2023) in case of poultry production. Labours from family member was predominant, the main reason is that using family workers will not have to pay labour costs, this was also recorded in the study of (Bah and Gajigo, 2019). In these areas, the education level of livestock farmers is less than a high school diploma. The level of education is low because most farming households are farmers at rural area with little access to specialized training sessions, and it may also be due to the fact that raising backyard chickens does not require too much investment and knowledge (Ursule *et al.*, 2020).

Table 5. Layer performance of Noi chickens in Ben Tre Province.

No	Criteria	Categories	Results	
			Freq	%
1	First egg period	22-26	61	67.8
		26-30	21	23.3
		No recorded information	4	4.4
		<22	4	4.4
2	Mortality rate	<10%	63	70
		10-12%	26	28.9
		No recorded information	1	1.1
3	Average egg production per week	No recorded information	65	72.2
		1	20	22.2
		2-Jan	5	5.6
4	Laying cycle per year	No recorded information	54	60
		4-Mar	18	20
		3-Feb	14	15.6
5	Average body weight (kg)	1.8-2.0	55	61.1
		1.5-1.8	35	38.9
6	Feed intake (kg/bird/ week)	No recorded information	67	74.4
		>4.0	15	16.7
		<1.5	4	4.4
		1.5-3	4	4.4
7	Hatch rate (%):	No recorded information	29	32.2
		80-90%	18	20
		70-80%	14	15.6
		50-70%	12	13.3
		>90%	9	10
		<50%	1	1.1

Noted: Farmers can choose more than one answer.

Based on the results, poultry households mainly use backyard and the main form of livestock farming used by households is semi-free-range farming. Raising chickens on the floor give chickens a chance to eat insects, plants, leftover that is on the floor. Besides, Lan Phuong *et al.* (2015) also pointed out that semi-free-range chicken raising method is commonly applied in Vietnam by nearly 70%, especially for indigenous chicken breeds with relatively low growth ability. The preferred incubation method used by farmers is natural incubation because most households raise livestock in a small, spontaneous manner, using natural egg incubation will save a lot of production costs, as well as be suitable for the scale of livestock production. The practice of household farming continues to primarily depend on indigenous breeds, which are distinguished by their ability to withstand a range of local environmental adversities (Bettridge *et al.*, 2018). Semi-free-range farmers keep fewer than 50 chickens or the mean flock sizes were 40 for chickens, 81 for ducks (Delabouglise *et al.*, 2019).

Taking advantage of available food sources reduces farming costs, so most people raising chickens achieve good economic results. However, the growth ability of chickens was low because of overutilizing by-product sources, and the crude protein and energy from mixed feed was not enough for chicken's performance. That is also a limitation in raising local Noi chickens on a small scale and in households in Ben Tre. According to the research results of (Rashamol and Sejian, 2018), native livestock that have adapted to local environmental conditions, will be more easily accessible to rural livestock farmers, as the number of resources and feed ingredients available in rural areas. Besides, native chickens can also growth efficiently without needing a lot of drugs or antibiotics to control diseases. In addition, raising chickens in the form of free-range or semi-free range allows the chickens to forage and find parasites on paddy

field such as golden apple snails and insects, thereby taking advantage of an amount of protein from the rice field (Delabouglise *et al*., 2019). Linh *et al*. (2022) conducted a survey on poultry with similar results, the use of animal feed at poultry farmers still does not meet their nutritional needs. However, chickens could find the alternative nutrition from the raising environment. The results also showed that local Noi chickens in Ben Tre province have a lower nutrient intake than their needs, especially for crude protein. The cause may be that farmers have not received recommended information through training sessions about the nutritional needs of local Noi chickens. Most recommendations on nutritional needs for local Noi chickens are mainly based on documents for commercial broilers. Moreover, it may be because feed for Noi chickens also depends on the available of natural resource (Linh *et al*., 2022). The use of free feeding option has been found to enhance the laying performance of native chickens (Iskandar, 2011), so serving as an effective environmental enrichment strategy. This approach has been demonstrated to stimulate foraging activity, ultimately resulting in an enhancement of animal welfare. Therefore, the provision of free feeding choice is seen as a significant determinant in enhancing poultry wellbeing inside cage rearing methods (Chen *et al*., 2018).

Consumer preferences affect selling prices, so choosing chicken breeds that suit consumer tastes has a great impact on the efficiency of farming. In most of the farms surveyed, farmers' criteria for choosing varieties depend largely on price. Most livestock farmers face some difficulty in capital (Qui *et al*., 2020), so choosing breeds based on price is inevitable. According to research by (Whitley, 2021), the process of selecting animals for breeding stock production and marketing mostly revolves around the consideration of breed features, animal conformation, achievements, and animal pedigrees. As similar, the results of this study showed that farmers also pay attention to choosing disease-free, fast-growing breeds that are resistant to diseases. The high death rate is because control has not been done well and there are no measures to prevent diseases properly as well as not ensuring the implementation of biosecurity. Besides, most people sell broiler chicken through traders or consume locally (Qui and Tho, 2023), prices are often suppressed, and epidemics cannot be controlled leading to a serious decrease in the selling price of chickens (Wilson *et al*., 2022). The lack of housing system and free breeding mainly makes management and disease prevention care for chickens quite difficult. When there is an epidemic, it is impossible to isolate chicken flocks to prevent epidemics. Besides, the intensification of small-scale systems is hindered by various constraints, including inadequate availability of high-quality feed, vaccinations, and medications, as well as insufficient finance. Additionally, the absence of a solid market further exacerbates these challenges. A contributing factor to this situation is the lack of farmer organization (Wilson *et al*., 2022).

The age of first egg laying in Noi chickens varies between farmers due to inappropriate use of food and the nutritional composition of the diet is not guaranteed. Laying hens need a suitable diet to be able to synthesize 1 g of eggs, so using a diet that does not correspond to the age of laying may be the cause of this difference. In the study of (Dang *et al*., 2022), the first egg of Noi hens occurred at range of 161-168 days, while reaching 5% of egg production was between 25-26 weeks of age which was alike the results of this study, and Noi layers can produce egg up to 50 weeks of age. Besides, the hatch rate was also alike the study of (Dang *et al*., 2022) with from 80-81% rate of embryonated egg. The egg-laying rate and productivity of indigenous chickens are limited in reaching their optimum potential compared to other chicken breeds. This is due to the influence of genetic traits, genes, and the quality of care provided to the hens (Linh *et al*., 2022). Nguyen Van *et al*. (2020) also observed that variations in agricultural practices, dietary patterns, and genetic factors may serve as potential explanations for this disparity. Additionally, the mortality of Noi chickens raising in farmer's farm was not high, it was in contrast to the study of (Carrique-Mas *et al*., 2019) who indicated that high mortality of 2.6 chickens/100 chickens/week was recorded in small-scale Mekong Delta flocks. One possible explanation is that Noi chicken exhibits a greater capacity for environmental resilience compared to other chicken breeds.

Conclusion

Most farmers in Ben Tre province are male and aged 25-59, with a large proportion of family members involved in farming activities who have not completed high school. Small farms are predominant, with 82.2% of surveyed farmers raising chickens on the ground floor without facilities. Traditional raising methods include free range and semi-free-range farming, with hens used for hatching eggs and producing chicks. Feeding methods vary, with mixed feeds including bran, soybean, waste of alcohol, and natural feed like water morning glory and banana trunk. Feed used for Noi chickens was low in nutrition composition. Noi chickens have a mortality rate of less than 10%. Besides, the average feed consumption is high while the hatching rate of Noi chickens is not high, with the highest being 90% and the lowest being less than 50%.

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Conflict of interest

The authors declare no conflict of interest.

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