

**Poultry Production, Marketing, and Consumption in Vietnam: A
Review of Literature**

Asian Chicken Genetic Gains Project (AsCGG)

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International Livestock Research Institute (ILRI)

2021

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Acronyms and Abbreviations

ACIAR	Australian Centre for International Agricultural Research
AsCGG	Asian Chicken Genetic Gain
DAD-IS	Domestic Animal Diversity Information System
DOC	Day-old-chicks
DRI	Daily Recommended Intake
FAO	Food and Agricultural Organization of the United Nations
GAIN	Global Agricultural Information Network
GDP	Gross Domestic Products
GSO	General Statistic Office
HPAI	Highly Pathogenic Avian Influenza
ILRI	International Livestock Research Institute
ITC	International Trade Center
MARD	Ministry of Agriculture and Rural Development
NIAH	National Institute of Animal Health
NIAS	National Institute of Animal Science
OECD	Organisation for Economic Co-operation and Development
PPP	Public Private Partnership
USD	United States Dollar
VAAS	Vietnam Academy of Agricultural Science
WB	World Bank
WHO	World Health Organization

Acknowledgement

This research was funded in part by the Australian Centre for International Agricultural Research (ACIAR) (Project Number- LS/2019/142) under the auspices of the International Livestock Research Institute (ILRI). The findings and conclusions contained within are those of the authors and do not necessarily reflect the positions or policies of the Australian Centre for International Agricultural Research.

Executive Summary

International Livestock Research Institute (ILRI) has an ACIAR-funded project called 'Asian Chicken Genetic Gains (AsCGG): a platform for exploring, testing and delivering improved chickens for enhanced livelihood outcomes in South East Asia'. The project is implemented in Cambodia, Myanmar, and Vietnam. It aims to test and avail high-producing and farmer-preferred chicken genotypes to increase smallholder chicken production and productivity as a pathway out of poverty in the project countries. The project starts with a comprehensive literature review that aims to understand the current knowledge base, identify research and development gaps, and inform a baseline assessment. Thus, this document provides the literature review findings in Vietnam. The review presents an overview of poultry production and consumption, smallholder chicken production and productivity practices; marketing of poultry products; the contribution of smallholder poultry production to household nutrition; the economic contribution of smallholder poultry production; agricultural policy, and livestock research; and finally a conclusion and research opportunities.

Poultry is the most commonly owned livestock in Vietnam, and they are the second-largest meat contributor in the country. They generate the second-highest livestock husbandry-based income to most of the smallholder farmers in the rural areas. The poultry species include chickens, ducks, perching ducks, geese, and quail that are used for egg and meat production. In 2019, there was a 481.07 million poultry population in the country that produced about 1.302 million tons of meat and 13.3 billion eggs.

The overall poultry population has shown significant growth in the previous two decades. On average, during 2000-2019, it grew by 5.06%. Although poultry production is undertaken in all regions of the country, about 67.3% of the total poultry population is distributed in four regions (the Red River Delta, Northern Midlands and Mountains, and North Central and Central Coastal regions).

Poultry production is the second contributor of total meat produced in the country, following pig production. On average, the total poultry meat production has shown 8.5% growth from 2000 to 2019. Similarly, the amount of egg production has also shown significant change in the previous two decades. During 2000-2019, on average, the total egg production increased by 6.13%. Despite the observed growth in production, Vietnam remains the net importer of poultry meat in the past few years. In 2019, the country imported poultry meat worth 261.2 million USD mainly from United States, Brazil, Korean Republic, and Poland.

There was an increasing trend in the prices of poultry products. During 2004-2015, the producer price for poultry meat grew by 9.7%. The producer price for meat was significantly higher than the producer price in exporting countries and other countries in the region. This shows that under the current production system and cost structure, it is challenging for the domestic poultry meat enterprise to compete with exporting countries and other countries in the region.

There was significant growth in the average per capita supply of poultry meat in the previous two decades. In 2018, the average poultry meat and egg supplies were 15.89 and 5.15 kg/capita/year, respectively. The average poultry meat supply in 2018 was 3.5 times greater than the average supply in 2000. The supply in 2018 was higher than the global, regional, and sub-regional averages. Conversely, the average egg supply in 2018 was lower than the global, regional, and sub-regional average supplies. Lower egg supply could be associated with lower egg productivity of existing breeds and inadequate imports, which suggests the need to improve the sector's productivity.

The poultry production system in Vietnam can be classified into traditional/backyard or non-intensive production, semi-intensive production, and intensive production systems. The majority of the poultry production in the country is categorized under the traditional/backyard or non-intensive production system, and it contributes to the largest proportion of eggs and meat produced in the country.

Traditional/backyard producers usually provide inadequate supplementary feeds, vaccination and treatment services, and housing systems. The main types of feed used in the Traditional/backyard system include broken rice, rice bran, dry potato, maize, aquatic plants, dry cassava, and kitchen waste. Due to inadequate biosecurity measures and disease outbreaks, poultry disease has been the primary production constraint in the last two decades. The major diseases identified in the literature include Avian Influenza, Fowl Pox, Coccidiosis, Newcastle disease, Infectious Bursal Disease, Bronchitis, and Coccidiosis. Traditional/backyard producers use different types of houses made from locally available materials.

There is variability in the egg productivity of different chicken breeds used by smallholder producers in the country. On average, indigenous breeds produce 50-130 eggs/hen/year, while improved and exotic breeds produce 144-265 eggs/hen/year. There is also significant variation in body size and body weight among matured indigenous chicken breeds. The average body weight for mature cock ranges from 1 kg to 5.0 kg, while for hen ranges from 0.8 kg to 4 kg. Unlike indigenous breeds, improved breeds have fast growth and higher body weight.

Smallholder producers practice breed selection to improve the performance of their flock. They use different criteria such as weight, body size, body conformation, plumage, and other phenotypic characteristics. Despite their low productivity and slow growth, smallholder producers still prefer indigenous breeds due to their adaptability to the tropical and harsh environment, reproductive factors, product taste, and other cultural and social values. The indigenous breeds-based production accounts for more than 80% of eggs and chicken meat produced in the country.

Smallholder chicken production is characterized by different production constraints that include low egg productivity of existing breeds, poor growth performance, predatory attack, high disease incidence, limited access to inputs, inadequate management, limited capacity of producers, and limited access to training.

Most smallholder producers have significant participation in the marketing of surplus poultry products. They sell products through different marketing outlets, including local markets, itinerant traders (collectors/assemblers), and other farmers in the village. The price of poultry products is associated with different quality attributes such as type of breed, size or weight, taste, and birds' health. Due to consumer preference, the prices of indigenous breed products are higher than improved or exotic breed products.

The primary marketing constraints for smallholder farmers may include unstable market or price fluctuation, the dominance of traders, lower bargaining power of smallholder producers, disease transmission, inadequate standard and grading systems, inadequate infrastructures, and limited institutional supports. Live bird marketing is considered a risk factor for disease transmission.

Vietnam has exhibited good progress in reducing stunting among children in the previous two decades. However, many children in rural areas still suffer from undernutrition, especially stunting compared to urban areas. The prevalence of stunting in urban areas reduced from 15.9% in 2014 to 6.2% in 2019. But during the same period, it declined from 28.7% to 23.7% in the rural areas. The higher prevalence of stunting in rural areas can be associated with several reasons: lower consumption of nutrition-rich food such as poultry meat and egg.

The contribution of poultry to enhance diet diversity among women and children is significant. Improving smallholder production and productivity coupled with nutrition education has paramount importance to enhancing households' nutritional security both in rural and urban areas.

Smallholder poultry production has a multidimensional role in enhancing the livelihood of households in rural and urban areas. It can be considered as the livestock of the poor due to its significant contribution to the poorest category of the population. Considering the value of home consumption, income generated from poultry production accounts for about 30-40% of the households' total income, mainly in the rural areas. The income

generated from poultry production covers the cost of medical services, medicine, school fees, and stationery for students.

Vietnam has implemented a series of agricultural policies that have resulted in significant success stories in reducing poverty and undernutrition and increasing domestic food supply and export earnings. There was an impressive result in enhancing agricultural production and productivity, particularly in the crop production sector. Despite an increasing trend in the volume of production, the productivity of the livestock sector, including poultry, remains low compared to other developing countries in the region and around the world. Research evidence suggests the need for building domestic capacity to improve livestock breeds and create innovative solutions for farmers in the country.

Research and development efforts that aim to enhance smallholder poultry production and productivity should focus on: improving the genetic potential of existing breeds, improving vaccination and medication supply chains, diversifying the local feed supply, building producers' capacity, adopting better management systems, and integrating farmers with input and output markets. Alternative animal breeding approaches include undertaking selective breeding on the existing genotypes, sourcing superior and potentially adapted breeds from elsewhere, and evaluating them for their performance in the local environment. The latter should be implemented in an integrated manner considering key value chain actors, preference of farmers and consumers, and sustainability.

1. Introduction

Agriculture plays a key role in Vietnam's economy. The agriculture, fishery, and forestry sector contributes about 13.96 % of the GDP in 2019 (GSO, 2020c). From the agricultural sector, livestock production has significant contributions to GDP. There are about 10.2 million agricultural households in the country, and 82.0% of them engage in livestock production activities (Nghia et al., 2019). A mixed farming system is the most common agricultural production system in rural areas where smallholder producers usually keep a mix of livestock species like chickens and ducks with crop production activities (Delabougliise et al., 2019). The primary type of livestock includes pigs, poultry, cattle, and buffalo (GSO, 2020c). Livestock production has multiple contributions to household livelihoods, including the supply of meat, milk, egg, household consumption, income generation, and inputs to agricultural activities.

From the type of livestock, poultry is the most common animal owned by rural households, and it is the second-largest contributor of meat in the country (Ayala-cantu et al., 2017, Dinh, 2017). There are different poultry species in the country, including chicken, ducks, perching ducks, geese, and quail, used for eggs and meat production (GSO, 2020c). Poultry production involves smallholder and medium/large scale commercial production systems, and smallholder production accounts for the largest proportion of producers. Based on the 2011 agricultural census, from 7.9 million chicken raising households in the country, about 89.6% of them keep chicken less than 50, 7.2% keep chicken from 50-99, and the remaining 3.2% of households keep chicken more than 100 (GSO, 2012). Similarly, according to Desvaux et al. (2008), of 8 million poultry keepers, 65% of them keep chicken in a small number (less than 200); 25% of them keep waterfowl, mainly ducks; 10-15% are commercial chicken farms (from 200 to 500 birds); and 0.1% are integrated industrial farms with flock size of 2,000 to 30,000 chicken. The commercial production system also supplies egg and meat to the urban population, and it has been showing significant growth since 2000 (Hanh et al., 2007).

Among the poultry species, chicken production has significant contributions to the livelihood of most rural and urban households. It generates income and supplies meat and eggs to households, especially for women and children. Considering its significant contribution to smallholder producers in the country, International Livestock Research Institute (ILRI) has initiated a Research for Development Project (R4D) to test and avail high-producing and farmer-preferred poultry genotypes smallholder producers. The project improves the production and productivity of the poultry sector and contributes to poverty alleviation. We conducted a literature review to understand the current knowledge base, identify research and development gaps, and inform a baseline assessment. The baseline assessment explores evidence on current smallholder chicken production systems, chicken productivity, husbandry practices, consumer demand, and socioeconomic status of smallholder poultry-keeping households in the country.

This review presents an overview of poultry production, marketing, and consumption activities and their livelihood contribution to smallholder producers in the country. It also highlights agricultural policy and livestock researches in the country. The review is organized into nine sections. Preceded by an introduction to the sector, the second section gives a brief overview of the methods adopted. The third section outlines the overall trends in poultry production and consumption. The fourth section examines an overview of smallholder chicken production and productivity. Section five presents poultry marketing activities followed by a summary of smallholder chicken production's nutritional and economic contribution in sections six and seven, respectively. Then section eight presents an overview of the country's agricultural policy and livestock researches. Finally, a conclusion and research opportunities are highlighted.

2. Review Approach and Data Sources

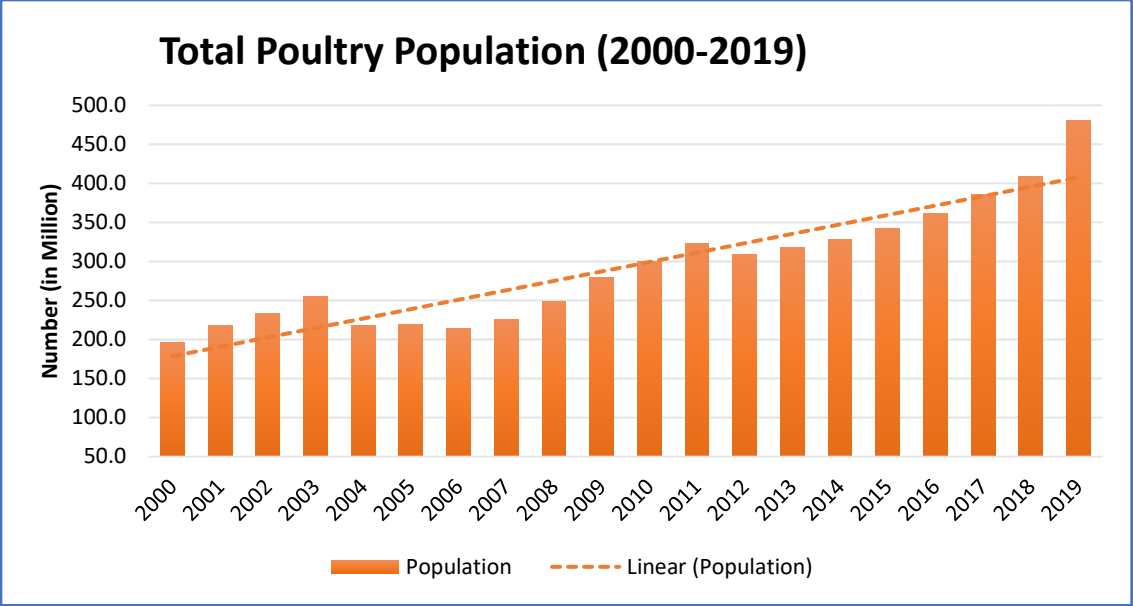
Based on the objectives outlined above, this work can be categorized as a scoping review. It focuses on exploring the breadth of available evidence and informing the country's proposed research efforts (Peterson et al., 2017, JBI, 2020). Such an approach helps to synthesis information in broader topics, in our case related to poultry production,

marketing, consumption, and identify research and development gaps (Pham et al., 2014). Diverse sources, such as published and grey articles, research reports, national and international databases, books, and policy documents have been consulted. We used time-series data from the General Statistical Office (GSO), Food and Agricultural Organization of the United Nations (FAO), and International Trade Centre (ITC) to explore trends on different indicators. Evidence on poultry production, marketing, and consumption was synthesized at the household and national level from experimental and non-experimental studies. Moreover, theoretical and conceptual evidence was summarized from policy documents and books to define concepts and explain issues.

3. Overview of Poultry Production and Consumption

3.1 Trends in Poultry Production

There has been a steady increase in the total poultry population in the previous two decades (Figure 1). In 2019, there were 481.07 million birds in the country that produced about 1.302 million tons of meat and 13.3 billion eggs. On average, during 2000-2019, the annual growth rate of the poultry population was 5.06%. However, there was a negative growth rate between 2003 and 2006 that could be associated with the Highly Pathogenic Avian Influenza (HPAI) outbreak (Hanh et al., 2007). The increase in production could be attributed to a range of factors, such as the growing demand for meat and eggs, better policy decisions, and related development interventions. For instance, the poultry sector has been the focus of government livestock transformation policy that aims to increase production, enhance quality and meet domestic market demand, contribute to national nutrition security, and reducing reliance on imported poultry products (Dinh, 2017).



Source: Compiled by authors using data from GSO (2020b)

Figure 1: Trend in Total Poultry Population in Vietnam

3.2 Regional Distribution of Poultry Production

Poultry production is commonly practiced in all regions of the country (Table 1). However, there were variations in the level of production among different regions. During 2010-2019, the Red River Delta and Central Highland regions accounted for the highest and lowest poultry population proportions, respectively. The three regions, the Red River Delta, Northern Midlands & Mountains, and North Central and Central Coastal, accounted for 67.3% of the total poultry population. A spatial analysis conducted by Epprecht (2005) also indicated a higher level of poultry production in the Red River Delta and Northern Midland and Mountain regions compared to the other regions. The same study has also documented that poultry production has a higher contribution to household income in the country's poorest areas. The spatial production variation among different regions shows the economic and social importance of the sector in different regions. Moreover, the highest proportion (68%) of commercial farms were found in the Red River Delta, Mekong River Delta, and the Southeast regions. In contrast, the lowest proportion of these farms was found in the Northern regions (Desvaux et al., 2008).

Table 1: Total Poultry Population by Regions

Region	Total Poultry Population (in Million)										
	2011	2012	2013	2014	2015	2016	2017	2018	2019	Av.	Pr.
RRD	83.2	81.3	87.9	88.9	90.9	93.7	99.1	102.8	120.1	94.2	26.0
NMMA	65.9	62.5	63.2	67.0	70.6	74.1	80.5	87.3	97.9	74.3	20.5
NCA&CCA	68.7	66.2	65.8	68.0	71.1	74.2	79.3	84.1	100.5	75.3	20.8
MRD	66.4	61.3	58.7	58.2	58.5	64.6	66.1	70.2	82.5	65.2	18.0
SE	24.1	23.3	27.4	30.0	34.3	37.9	41.8	44.7	55.3	35.4	9.8
CH	14.3	13.8	14.6	15.5	16.5	17.2	18.6	19.9	24.8	17.2	4.8
WC	322.6	308.5	317.7	327.7	341.9	361.7	385.5	409.0	481.1	361.7	100.0

RRD=Red River Delta; NMMA=Northern midlands and mountain areas; NCA&CCA= Northern Central Area and Central Coastal Area; MRD= Mekong River Delta; SE= South East; CH=Central Highlands; WC=Whole Country; Source: Compiled by authors using data from GSO (2020b)

3.3 Type of Poultry Production Systems

Most researchers classified the poultry production system in Vietnam into three: traditional/backyard, non-intensive production, semi-intensive production, and intensive production systems (Minh, 2005, Burgos et al., 2007, FAO, 2008). Other researchers such as Desvaux et al. (2008) documented three different types of classifications based on the Food and Agricultural Organization of the United Nations (FAO), Ministry of Agriculture and Rural Development (MARD), and General Statistical Office (GSO). Classification based on FAO comprises an integrated industrial system, industrial sector, semi-commercial sector, and village or backyard production systems. Classification based on MARD includes village farming systems, duck transhumant farming system, semi-industrial farming system, and industrial chicken farming system. Classification based on GSO comprises farms with more than 2000 birds per cycle (Sector 1), farms with 150 to 2000 birds per cycle (Sector 2), farms with 40 to 150 birds per cycle (sector 3), and farms with less than 50 birds per cycle (Sector 4). The majority of the country producers use extensive production systems that can be categorized under the traditional/backyard production or Sector 4 production system as they usually have less than 50 chickens (Minh, 2005). However, there is an increasing trend of shifting from the traditional/backyard production system to semi-intensive and intensive production systems where birds are produced with better management practices. A summary of the most used classifications is presented in the following section.

Traditional/backyard non-intensive production: This production system is practised by most rural households (Minh, 2005). Despite an increasing trend in the semi-intensive and intensive production system, it remains practised by 42–85% of the rural households in the Northeast-Northwest and Southeast-Mekong River Delta regions (Phuong et al., 2015). Producers in this category raise less than 50 chicken in backyards, gardens, courtyards, orchards, and often free to range on neighbouring land (Burgos et al., 2007). Local breeds (ecotypes) are predominantly used in this system, and producers get a foundation and replacement stocks from local markets or their own hatched flocks (Hanh et al., 2007, Desvaux et al., 2008). According to Desvaux et al. (2008), this production system produces about 65% of the chicken and 60% of the duck population in the country, and 92% of them are kept for broiler production. Due to the low performance and high mortality of birds, this system is considered highly inefficient (Bett et al., 2014).

Feed sources used in the traditional/backyard production system can be categorized into scavengeable and supplementary feeds (Minh, 2005). The scavengeable feed sources may include household wastes; organisms from the environment; grain by-products from crop cultivation, harvesting, and processing; green leaves and seeds; cultivated and wild fodder materials; non-conventional feeds; and agro-industrial by-products (Minh, 2005). The major types of supplementary chicken feed may include paddy rice (*Oryza sativa*), rice bran and broken rice, maize (*Zea mays*), soybean, cassava (*Manihot esculenta Crantz*) and fish meal, and other by-products (Minh, 2005, Xuan et al., 2006).

The traditional/backyard production system has a significant role in the smallholder producers' livelihood. It is the second-largest contributor of income from livestock for rural households, and in peri-urban areas, it generates substantial income to resource-poor households (FAO, 2008). Revenue generated from this production system is used to cover households' expenses such as school fees, medical expenses, and other basic needs (Bett et al., 2014). Moreover, smallholder duck production can be integrated with rice or fish production, and the ducks help to control rice crop parasites, and their manure can be used for fish production (Delabouglise et al., 2019).

Semi-intensive production: This system integrates the traditional production practices with improved technology and marketing opportunities. Compared to the traditional/backyard production system, producers in this category have a larger production scale and adopt better production technologies and management practices. Producers use either commercial strains or a mixture of local and exotic breeds with flock sizes of 51-2000 birds (Burgos et al., 2007, Desvaux et al., 2008). Improved breeds can be sourced from local hatcheries, while the local breeds can be sourced from local markets or existing flocks. Local hatcheries have a significant role in this production system, supplying foundation and replacement stocks. The hatcheries get fertile eggs from breeding farms or smallholder producers and supply the DOCs to these producers (Desvaux et al., 2008). Producers also have better access to training, credit, and information than the traditional/backyard system. This system is considered as a transition from the traditional/backyard production system to the intensive production system (Hanh et al., 2007).

In the semi-intensive production system, chicken can be kept in confinement and/or allowed to scavenge in the village. Older birds can scavenge in backyards or gardens during the day and return to their housing in the evenings. Producers use different types of poultry houses, varying from permanent shelters to makeshift enclosures. Poultry houses are usually made from locally available building materials such as brick, bamboo, and tree branches. Birds are fed with better quality and quantity of feeds obtained from diverse sources. They are provided with locally manufactured animal feeds supplemented with alternative feedstuffs, such as brewery waste, soya waste, and ensiled shrimp waste (Dong, 2005). Compared to traditional/backyard production, greater attention is given to disease prevention and treatment. Moreover, most semi-intensive farms keep a certain number of hens to produce chicks for fattening.

Like the traditional/backyard production system, eggs, meat, and live birds are produced and supplied to local markets. Usually, the quality of products is considered similar to the products obtained from the traditional/backyard production system (Hanh et al., 2007). Hence, poultry products from this system are also preferred by most consumers. Earlier

evidence indicates that from 15% to 20% of the farm households in the country are engaged in this type of production system (Hanh et al., 2007). This system is usually run as a part-time or supplemental activity, depending on a producer or individual household member's income status (Hanh et al., 2007).

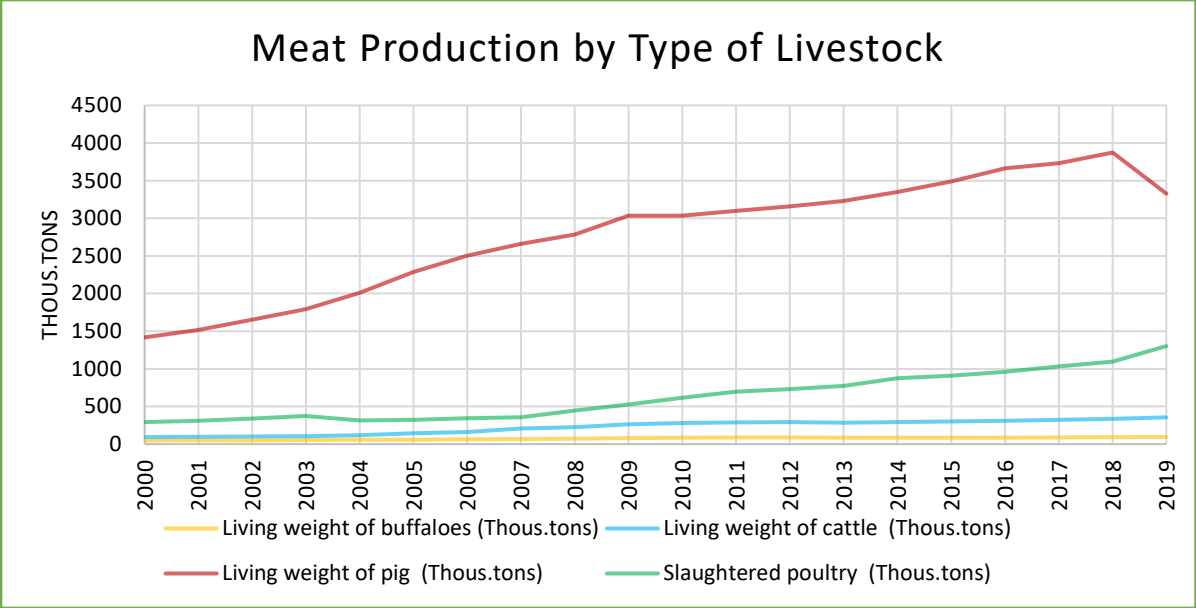
Intensive production system: In Vietnam, this production system has emerged in the last two decades as a joint business between large-scale foreign investors and domestic agribusiness (Hanh et al., 2007). In this system, the birds are kept indoors with modern housing and mechanized facilities, including semi-automatic and automatic equipment. Producers use battery cages that provide complete control of feeding systems, water supply, humidity, air movement, and waste management. Producers keep a higher number of poultry flocks than in the above two systems, usually from 2,000 to 100,000 birds. Producers adopt highly standardized management systems such as improved health and biosecurity systems and intensive feedings and watering systems. The production system is highly intensive and involves higher levels of investment in animal health, house maintenance, and flock productivity. Earlier estimates show that the average investment cost in an industrial chicken farm is about 50 to 60 million VND (3,060 – 3,670 US\$) per 1,000 birds (Hanh et al., 2007). However, due to the increasing trend in feed and other variable costs, the above figure may not represent the current investment cost.

This system includes highly specialized chicken farms (layers and broilers), ducks and geese farms, and breeding farms. Previous findings show that chicken and duck broiler farms with 2,000-11,000 accounted for more than 93% of the total intensive poultry farms (Hanh et al., 2007). Only a smaller proportion of duck and chicken broiler farms had more than 11, 000 bird sizes. However, the proportion of broiler and layer chicken farms was higher than other farms. The main products in the intensive production include eggs, meat, and breeding stock. The eggs and meat produced from these farms are sold to different buyers like assemblers, traders (wholesalers and retailers), and consumers (Hanh et al., 2007). In the broiler farms, the fattening period is much shorter than the fattening period in the semi-intensive system. Broilers reach for slaughtering between 42 and 45 days (at 6 weeks) with an average weight of 2.2 to 2.4 kg. The egg productivity

of layers is higher than the layers in the semi-intensive system. Based on the type of breeds, a hen can produce from 270 to 280 eggs per year. According to Desvaux et al. (2008), the intensive production system is well developed in the Red River Delta region of the country than other regions.

3.4 Volume of Poultry Meat and Eggs Produced

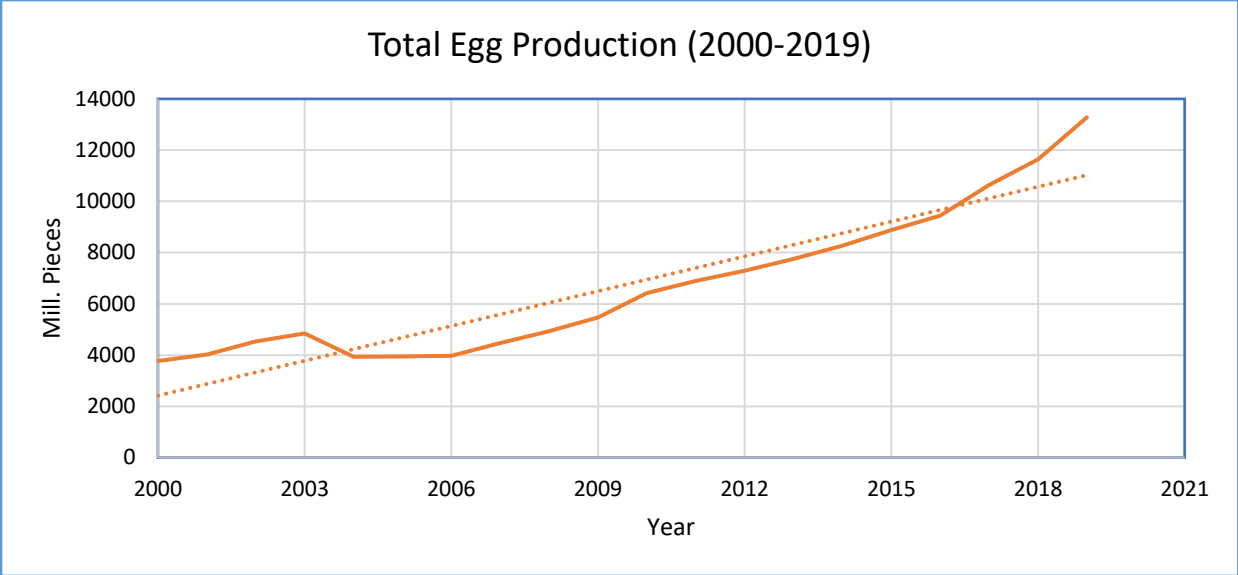
Poultry production is the second largest contributor to livestock meat produced in Vietnam (Dinh, 2017). For instance, in 2019, poultry production contributed about 18.34% of the total livestock meat supplied in the country, next to pig production (46.88%). There has been a significant increase in the supply of poultry meat in the previous two decades (Figure 2). The average annual poultry meat production grew by 8.5% from 2000 to 2019. This shows the significant contribution of the sector to increasing demand for animal source foods. The contribution of cattle and buffalo meat to the total meat production seems small and remained constant during the previous two decades. However, lower production of cattle and buffalo meat, may not necessarily indicate its low consumption. According to FAO (2021b), cattle meat import had significantly increased from 479 tonnes in 2014 to 2338 tonnes in 2019. This shows an increase in consumption of cattle meat in the above years. Limited growth in production and a higher level of import in response to the rising demand, could be possibly associated with a limited capacity of the country to expand the industry due to weather, land, and infrastructure-related issues.



Source Compiled by authors using data from GSO (2020b)

Figure 2: Total Meat Produced by Major Livestock Types

As the volume of meat produced, there was a surge in the volume of eggs produced in the previous two decades (Figure 3). During 2000-2019, on average, the total egg production was growing by 6.13%. In 2019, the country produced 13.3 billion eggs. The total egg produced in 2019 was 3.5 times higher than the total egg produced in 2000. An increase in egg production might be attributed to an increase in the productivity of chickens, mainly in commercial farms, and an expansion in the scale of production. The latter is probably associated with a change in the production system and the adoption of improved breeds and production practices. However, like the volume of meat produced, there was a negative growth from 2003 to 2006, related to the HPAI outbreak in the country (Desvaux et al., 2008).

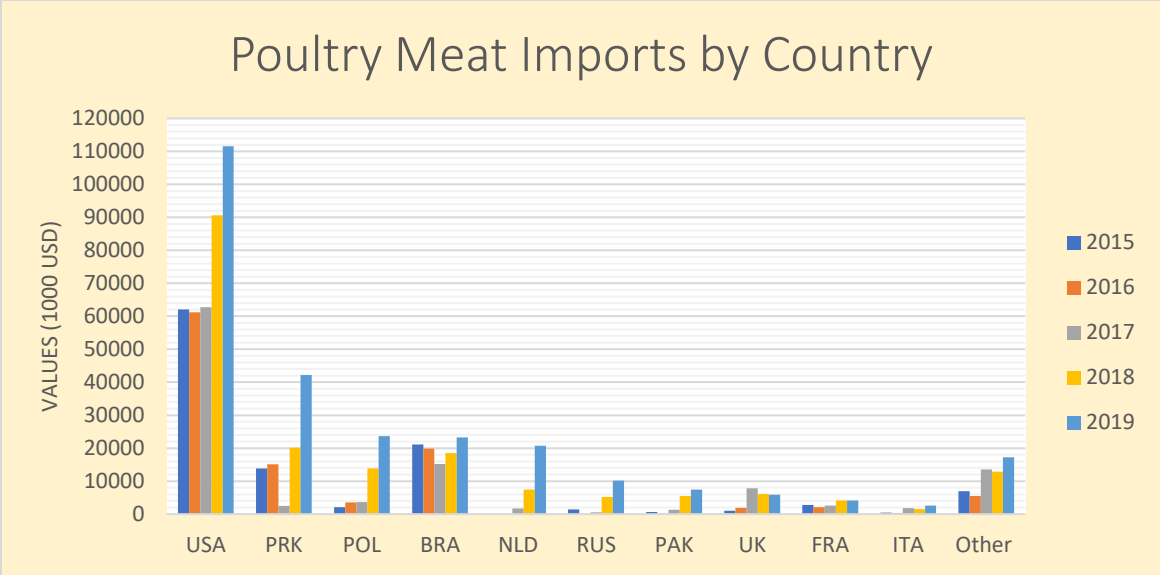


Source: Compiled by authors using data from GSO (2020b)

Figure 3: Trend in Volume of Egg Production in Vietnam

3.5 Poultry Products Import and Producer Prices

Despite an increasing trend in poultry meat production, Vietnam remains a net importer of poultry meat. In 2019, the country imported a volume of poultry meat worth 268.9 million USD (Figure 4). The value and amount of imports have shown significant growth since 2000. For example, the total value of imports in 2019 was 2.4 times the value of imports in 2005. Although the country imported poultry products from different countries, the largest proportion (75%) was imported from the United States, Brazil, the Republic of Korea, and Poland (ITC, 2021). The import from the United States took the largest share (41.5%). An increasing trend in import is seen, linked with increasing demand for poultry products due to population growth, increase in household income, and urbanization. The presence of a growing market for poultry products may create an incentive for the adoption of improved technologies and production practices. Based on OECD/FAO (2020) forecasts, Asia accounts for 53% of the global meat imports by 2029. This forecast shows the highest increase in meat import will be observed in the Philippines and Vietnam.



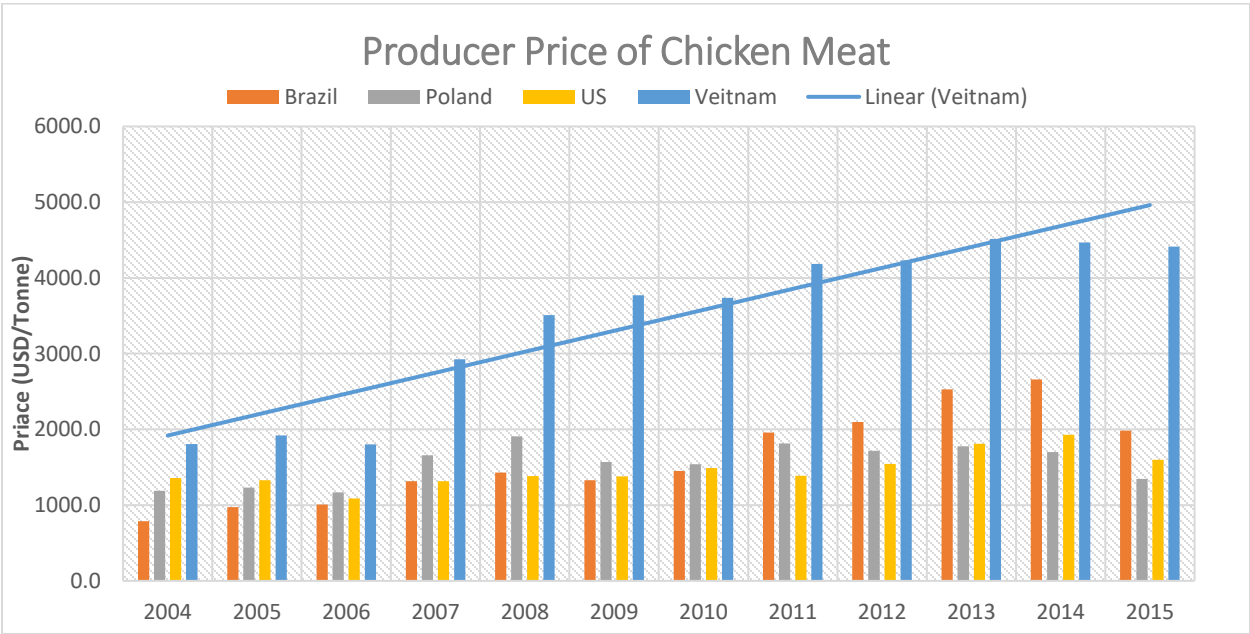
Source: Compiled by authors using data from ITC (2021)

Figure 4: Value of Poultry Meat Imported from Different Countries

A higher volume of meat imports that could be substituted domestically shows a lack of competitiveness in the poultry sector, which can be analysed using different indicators, such as producer prices. According to FAO (2021b), a producer price refers to the price received by the farmers at the farmgate. It shows the productivity and competitiveness of a product and helps to evaluate the sector's contribution to the overall economy and food security.

There was a steady increase in the producers' price of poultry meat in the last two decades in Vietnam. For instance, in 2019, the annual average producer price for chicken meat was about 4259.1 USD/Tonne, while the price in 2000 was 1486.7 USD/Tonne (FAO, 2021b). This shows that the price in 2019 was 2.86 times the price in 2000. Figure 5 presents the trend in producer prices of chicken meat in Vietnam and exporting countries from 2004 to 2015. On average, the producer price in Vietnam grew by 9.7%. In addition to its steady increase, the producer price in this country was significantly higher than the producer prices in the exporting countries. For example, in 2015, the average annual producer price in Vietnam was 2.76, 3.28, and 2.22 times the average annual producer prices in the USA, Poland, and Brazil. This reflects, internationally, the

Vietnamese poultry meat production is highly uncompetitive in the current production and cost structure.



Source: Compiled by authors using data from FAO (2021b)

Figure 5: Producer Prices of Chicken Meat in Vietnam and Exporting Countries

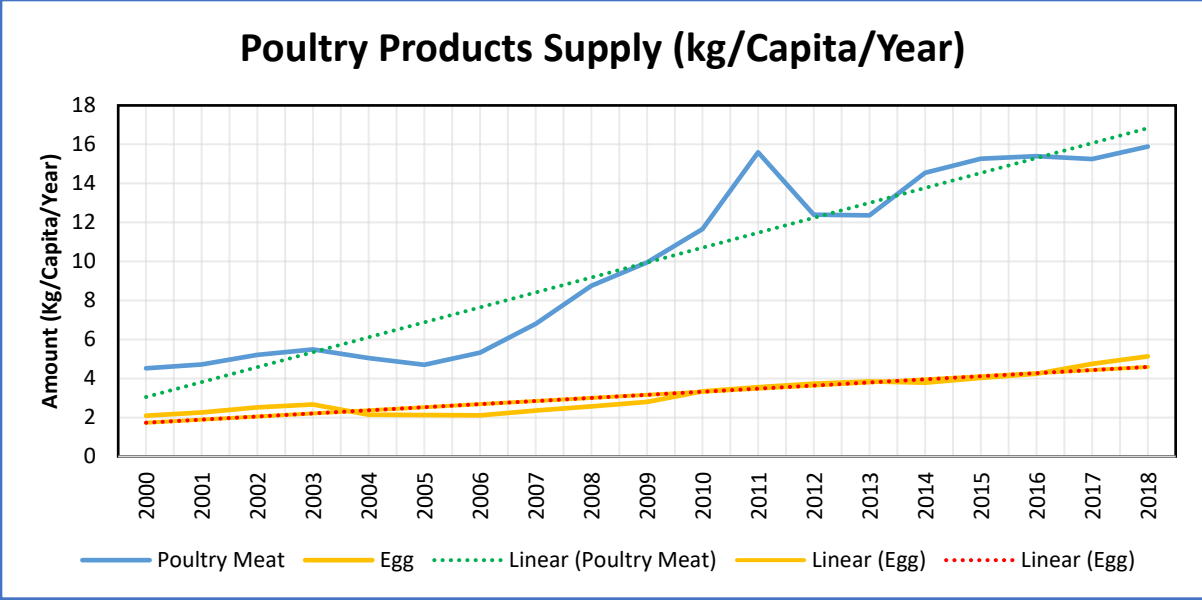
Like in the international market, a lack of competitiveness is evident in the regional and sub-regional markets. For example, the chicken meat producer price in Vietnam was 1.8, 1.9. and 2.6 times higher than the producer prices in China, Malaysia, and Thailand, respectively (Table 2). Moreover, unlike the neighbouring countries, there was an increasing trend in chicken meat producers' prices in Vietnam. A steady increase in producer price in Vietnam may suggest the need for enhancing the production and productivity of the sector through policies and strategies on production, marketing, and pricing of poultry products.

Table 2: Producer Price of Chicken Meat and Egg in Vietnam and Neighbouring Countries

Year	Meat Producer Price (USD/Tonnes)				Egg Producer Price (USD/Tonnes)			
	China	Malaysia	Thailand	Vietnam	China	Malaysia	Thailand	Vietnam
2010	2484.5	2204.2	1687.7	3735.4				
2011	2910.2	2222.2	1919.0	4186.4	1345.2	1688.5	1579.4	2623.5
2012	2839.9	2347.2	1690.2	4230.6	1259.9	1618.8	1317.8	2543.3
2013	3041.0	2412.0	1759.5	4515.7	1359.1	1745.5	1593.4	2762.9
2014	1902.7	2337.4	1641.4	4465.9	1090.8	1797.2	1522.2	2700.3
2015	1894.1	2022.8	1399.4	4413.4	911.1	1493.6	1256.7	2703.1
2016	2009.3	2049.0	1322.4	4093.1	985.6	1325.8	1337.2	1473.0
2017	1681.4	2011.4	1373.0	3852.8	1105.5	1240.1	1248.8	2908.2
Average	2345.4	2200.8	1599.1	4186.7	1151.0	1558.5	1407.9	2530.6
Ratio	1.8	1.9	2.6		2.2	1.6	1.8	

3.6 Average Supply of Poultry Meat and Eggs

A boost in production and import has also led to an increasing trend in eggs and meat per capita supply during the previous years (Figure 6). According to FAO, during 2018, the average supplies of egg and poultry meat were 15.89 and 5.13 kg/capita/year, respectively. The estimated average meat supply was higher than the global (15.55 kg/capita/year), regional (10.08 kg/capita/year), and sub-regional (13.57 kg/capita/year) average supplies. As indicated above, the observed increase in meat supply could be associated with the rise in domestic production and an increase in meat import (Figure 2, and Figure 4). Unlike the meat supply, the average egg supply was significantly lower than the global (9.68 kg/capita/year), regional (10.08 kg/capita/year), and sub-regional average supplies (7.06 kg/capita/year). The growth trend in egg supply was also lower than the growth trend for meat supply. This could be associated with inadequate domestic egg production and lower egg import. An increasing trend in poultry product consumption and a lower level of domestic supply may suggest the need for research and development interventions that improve the production and productivity of the sector in the future.



Source: Compiled by authors using data from (FAO, 2021b)

Figure 6: Trend in Poultry Products Supply in Vietnam

The increasing trend in poultry product supply could also be driven by increasing demand for meat consumption in the country, which is associated with increased income, population growth, and urbanization. However, changes in the development processes and their associated economic and social dynamics have also significant contributions. According to Hansen (2018), the main contributing factors for increasing meat consumption in Vietnam include a change in the systems of meat provision, meat intensification of traditional meals, the import of meat-intensive eating practices, increasing prevalence of eating out, the positive social connotations attached to meat as a symbol of development and progress.

4. Smallholder Chicken Production and Productivity

4.1 Type of Chicken Breeds

Chicken production is the second most crucial livestock production activity in Vietnam (NIAH, 2003). Like other countries, chicken breeds in Vietnam can be categorized as indigenous/local, hybrids, and exotic breeds. Vietnam is considered the origin of several indigenous chicken breeds or ecotypes in Asia (Phuong et al., 2015, Van et al., 2020).

However, there is no consistent report on the number and type of indigenous or local breeds in the country. According to NIAH (2003), there are more than 18 indigenous breeds in Vietnam that include Ri, Ho, Mia, DongTao, TauVang, Ac White, Ac Black, and Choi (fighting). On the other hand, a study conducted by Phuong et al. (2015) shows that there are about 30 indigenous chicken breeds. Another study conducted by Moula et al. (2011) shows that there are 14 indigenous breeds. Despite the variability in the reported number and type of breeds, the above figures show the availability of diverse indigenous chicken breeds in the country.

The indigenous chicken breeds account for more than 80% of the total chicken population in the country (NIAH, 2003). Most of them are produced for meat, eggs, medicine, fighting/fancy, and mixed purposes (NIAH, 2003, FAO, 2008). Among the indigenous breeds, Ri chicken is the most popular breed found in northern Vietnam. It accounts for more than 90% of the chicken population in the region's traditional/backyard production system (FAO, 2008, Moula et al., 2011). Moreover, the country has unique and rare chicken breeds like the Dong Tao and Ho chicken breeds (Van et al., 2020). These chickens have a large body size, higher body weight, and about five different colours. There is a strong demand for these chickens related to a higher preference of consumers for their meat. As a result, the prices of these chickens are 3 to 4 times higher than other chicken breeds. Historical evidence shows that these chickens are offered to the King as a gift during special occasions (FAO, 2008). In the villages where these breeds originate, crossbreeding has not been allowed in a continued effort to preserve their genetic identity and maintain niche markets.

The presence of diverse indigenous breeds presents an opportunity to improve the production and productivity of the poultry sector in the country. Nevertheless, researchers have documented that the productivity of most indigenous breeds is still very low even under an intensive management system (Akter et al., 2004, Phuong et al., 2017, Van et al., 2020). Existing evidence suggests the need for improving productivity through innovative research and development approaches.

As indicated above, the proportions of exotic and hybrid chicken breeds under the traditional/backyard production system are very small. Some improved chicken breeds and strains (commercial hybrids) are also available in this production system (NIAH, 2003, FAO, 2008). For instance, according to NIAH (2003), until 2003, there were about 24 hybrid and exotic chicken breeds in the country. These include Kabir, Tamhoang, Luongphuong, Thaihoa, Egypt, ISA, Hyline, Lohman, Hubbard, Sao, Golden. Similarly, according to FAO (2008), the country has different exotic chicken breeds imported or developed for a semi-intensive production system. This may include TamHoang, Luong phuong, Kabir (Israel), and Sasso, ISA Colour breeds. These breeds are used for meat, egg, or both meat and egg production under smallholder semi-intensive production systems. Researches have documented that some crossbreeds have better productivity than most indigenous breeds (Coi et al., 2006). Nevertheless, the trends in the level of utilization of these breeds seem mixed. Based on NIAH (2003), there was an increasing, decreasing, and average utilisation level after introducing them.

The country has imported high producing chicken strains for the intensive and industrial production system in the previous few decades. Some of these are Arbor acres, Ross-208, Rose-308 and Rose-508, Avian, Lohman, Cobb 707, Hubbard; and egg breeds such as Leghorn, Goldline-54, Miravia, Brown Nick, Hisex Brown, Hiline, and ISA Brown (FAO, 2008, Thang et al., 2010a). These commercial lines are used for meat and egg production. These genotypes require higher input but produce more eggs and meat than strains kept in the semi-intensive system.

4.2 Chicken Management

As indicated above, smallholder chicken production can be either traditional/backyard production and/or semi-intensive production systems. The main factors that distinguish these production systems are flock sizes, type of breeds used, type of management system, the purpose of production, level of market integration, and other infrastructural and institutional issues (Tung and Costales, 2007). For instance, compared to the traditional/backyard production system, producers in the semi-intensive production

system keep many chickens. The significant components of poultry management that affect the production and productivity of farms include feeding, breeding, recording, health and biosecurity, and housing system. Although the traditional/backyard production system is primarily based on scavenging feeds, smallholder producers that adopt this system provide supplementary feeds from local sources. This may include broken rice, rice bran, dry potato, maize, aquatic plants, dry cassava, kitchen waste (FAO, 2008, Moula et al., 2011). However, producers provide standardised feeds in the semi-intensive production system either sourced from local markets or own farms.

Poultry health is the primary management concern in the smallholder chicken production system. Disease and mortality of birds remain important production and productivity constraints, especially in farms that adopt multispecies poultry production (Carrique-Mas et al., 2019, Delabouglise et al., 2019). Disease outbreak is the most common incident during the brooding period, and mortality reaches peaks during the first 5–10 weeks (Carrique-Mas et al., 2019). Avian Influenza, Fowl Pox, Coccidiosis, Newcastle disease, Infectious Bursal Disease, Bronchitis, and Coccidiosis are the main types of poultry disease in the country (Carrique-Mas et al., 2019, Delabouglise et al., 2020). According to Delabouglise et al. (2019), birds affected by disease experience different symptoms. Major symptoms may include lethargy and weariness; digestive symptoms (diarrhoea, flatulence, or abnormal colour of faeces); lower respiratory tract symptoms (dyspnea or amplified respiratory sounds); sudden death; swollen crop; paralyzed wing; anorexia; cyanosis; and symptoms related to the upper respiratory tract (runny nose). Moreover, Vietnam is one of the developing countries affected by HPAI (Delabouglise et al., 2020, Hoang et al., 2020). HPAI has posed major poultry production, marketing, and consumption risks in the country (Hanh et al., 2007, Burgos et al., 2008, Alders et al., 2014, Figué and Desvaux, 2015). Like producers in other developing countries, smallholder producers in Vietnam have limited disease prevention and treatment practices (Thang et al., 2010b). Success in the control and prevention of the re-occurring high disease prevalence along the smallholder poultry value chain depends not only by addressing the biological and environmental aspects but also by enhancing the socio-

economic behaviour of producers, traders, and consumers (Burgos et al., 2008, Fournie et al., 2012, Sealy et al., 2019).

Smallholder chicken production and productivity are also highly associated with the type and quality of housing. Smallholder chicken producers in the country adopt different types of poultry housing systems. Producers use local materials such as bamboo, cement, straw, wood, and sheet metal to construct houses (Moula et al., 2011). The type and quality of poultry housing could be associated with the type of production system adopted by a farmer (Desvaux et al., 2008). In the traditional/backyard production system, producers mainly use free-ranging chickens within the household compound or village during the day. The birds may be kept inside the residential house or in a shelter constructed outside during the night. In the semi-intensive production system, chickens are mostly kept in a confined house during the day and the night. However, compared to the intensive production system, there is less investment for housing in the semi-intensive production system. There are also variations in the type and quality of housing systems used for layer and broiler production systems. According to Delabouglise et al. (2019), smallholder producers keep young chickens and broilers indoors compared to layer-breeder chicken. Layer-breeder chickens are kept outdoors, mainly either unconfined or in pens.

4.3 Chicken Egg and Meat Productivity

4.3.1 Productivity Performance of Local Chicken

The primary goals for smallholder chicken-keeping are meat and egg production for consumption and income generation. Chicken breeds' production and productivity performance under a smallholder production system depend on genetic, environmental, and management-related factors. The productivity of chicken can be measured using different indicators such as days to sexual maturity, growth rates, egg production, egg hatchability, chick survival rates, culling ages, and others. In Vietnam, on average, an indigenous hen reaches for egg-laying in 4-10 months, and a hen and breeding male chicken are kept from three to five years (Moula et al., 2011, Do et al., 2019). Using data

from the Domestic Animal Diversity Information System (DAD-IS) of FAO, a summary of some indigenous chicken breeds' main performance indicator is presented in Appendix A.

Studies show the growth and egg production performance of eight local Vietnamese chickens under on-farm and on-station conditions. The ecotypes are Mia, Dong Tao, Ho, Choi, Ac, Ri, H'Mong, and TauVang. The live weight of Mia chicken is 800–900 g at 60 days old and 3,500–4,000 g and 2,500–3,000 kg for cocks and hens at 140–150 days, respectively. Mia hens lay 55–60 eggs per year (Lung and Long, 1994). Dong Tao chicken is one of the local chickens raised in Vietnam. This breed is known for its good meat. It reaches between 700–800 g at 60 days old and 3,200–4,000 g at 140 days, while the hens' weight 2,300–3,000 g. Like other local ecotypes, egg production ranges from 55 to 65 eggs per year (Lung and Long, 1994). Ho chickens are characterized by their slow movement and large body size among Vietnamese local chicken ecotypes. At-50-days-of-age, the live weight of males is 2,500 g, and the live weight of females is 1,750 g. At 8–11 weeks old, it is 3,692 g for males and 2,235 g for females. The egg from Ho weighs on average 53.3 g (Thien et al., 1994). According to Duy et al. (2015), the average number of eggs per clutch is 12.73 (a minimum of 7 and a maximum of 19); the average number of clutches is 5.23 (a minimum of 4 and maximum of 7), and the average number of eggs per year is 66.8 (a minimum of 28 and maximum of 126).

The other local chicken, the Choi chicken breed, is used for cockfighting, and farmers tend to keep more cocks for that purpose. In rural areas, cockfights are held annually during Vietnamese festivals. The cocks and hens have similar feather colours, usually black, grey, white, and brownish, five-colour, apricot, and white with grey. The leg colour is typically black, white, ash-grey, yellow, or slate; skin colour is red; ears are yellow, black, red, white, and deep brown; and the comb colour is pea or chestnut. The shanks of Choi chickens are very strong. At birth, the body weight is 32.2 g. At 16 weeks, the weight is 1,370.0 g for males and 948.16 g for females. The survival rate is relatively high, at an average of 98.9%. The adult bodyweight is approximately 2,836.60 g for males and 2,445.2 g for females. The age-at-first-egg for Choi is 211.08 days. Egg production is

54.04 egg/hen/year, of which 82.26% are first-class (Anh et al., 2008). Ac hens, on the other hand, lay 90–95 eggs/year. There are different feather colours in Ac chickens: skin, legs, meat, bone are black (Thien et al., 1994). The other local chicken ecotype H'Mong lays 70 eggs per year (Cuc et al., 2002). The eight-month egg production of these local chicken show lower performance. The AC, H'Mong, Mia, and Ri produced 63, 72, 74, and 94 eggs per bird in eight months under on station management conditions, respectively.

The Ri chicken is among the most popular native breeds found in northern Viet Nam. The growth performance of this breed is documented in various studies. Moula et al. (2011) conducted a study that shows that the average weight of a day-old-chick is 25.71-30.31 g; at 12 weeks, the male weighs 919.65-1174.63 g, and the female weighs 745.38-929.96g. At week 19, the male weight reaches 1705.62-1971.2 g, and the female reaches 1140.4-1431.0 g. H'Mong breed originated from the Son La regions, but they are also kept in other regions of Vietnam. The productive and reproductive performance of the H'Mong chicken breed is well documented in the literature (Cuc et al., 2006, Phuong et al., 2017). According to Phuong et al. (2017), the average age-at-first-laying is 151.67 days, and at this age, a hen achieves a body weight of 1318.23-1329.84 g. The average egg productivity is 12-13 eggs/hen/clutch with an average egg weight of 41.9 (Cuc et al., 2006), and at-42-weeks-of-age a hen produces 24.12 eggs/hen with a laying rate of 17.23% (Phuong et al., 2017).

Despite their significant role in households' socio-economic and nutritional status, low production and productivity are documented for existing indigenous breeds (Duy et al., 2015, Phuong et al., 2017, Van et al., 2020). The productivity performance of most breeds remains to be low even under an improved management system (Akter et al., 2004, Van et al., 2020). As a result, research and development efforts need to focus on improving the genetics of these breeds either through selective breeding programs or by introducing more productive yet locally adapted breeds, considering the preference of producers and consumers.

4.3.2 Productivity Performance of Exotic and Crossbred Chickens

The productivity of a few imported breeds developed for semi-intensive production in Vietnam was reported by FAO (2008). For instance, at 12 weeks, broilers of TH 882, Jiangcun, and Lương phương weight 1,850, 1,810, and 1,986 g, respectively. The hens for these breeds produce 144 (TH-882), 158 (Jiangcun), and 171 (Lương phương) eggs per year. Similarly, Kabir and Sasso breed hen produces 187 and 197 eggs per year, respectively. The weight and survival rate of crossbreds obtained from exotic and Vietnamese chicken have also been documented by FAO (2008). According to this study, at 12 weeks of age, Kabir x ♀ Jiangcun and Ri x ♀ Kabir strains weight 2,230 and 1,683 g, respectively. At the same age, these breeds have a survival rate of 93.3% (Kabir x ♀ Jiangcun) and 93.5% (Ri x ♀ Kabir). A cross between the ISA-Brown industrial strain and Vietnamese local (Ri) breed (ISARI) breed gave 184.2 eggs/year (Hoan et al., 2016). The productivity of major exotic breeds has also been documented by FAO (2008). According to this study, layers of imported poultry strains produce 135-265 eggs per year, while broilers weigh 2.1-2,5 kg at 49–56 days.

4.4 Breed Selection and Trait Preferences

Smallholder producers keep chicken for different purposes. According to Moula et al. (2011), the major purposes of poultry keeping include meat production, egg production, traditional purposes, and food security. To maximize different production objectives, producers undertake breed selection activities that improve the productivity of their flocks. Smallholder producers select chicken breeds using their own traditional practices (Desvaux et al., 2008). They use different selection criteria such as body weight, body size, body conformation, plumage, and other phenotypic characteristics (Moula et al., 2011). Researches show that most smallholder producers prefer indigenous breeds due to their adaptation, resilience, brooding behaviour, low cost of production, scavenging ability, premium output prices, a taste of meat or eggs, and other socio-cultural reasons (Moula et al., 2011, Phuong et al., 2015, Van et al., 2020). Indigenous breeds are less likely to be preferred for laying performance, longevity, and conservation-related motives.

Their main use, adaptability, reproductive and specific characteristics of some indigenous breeds are summarized in Appendix B.

4.5 Major Production Constraints

The smallholder production system suffers from various production and productivity bottlenecks (Minh, 2005, Moula et al., 2011, Bett et al., 2014, Delabougliise et al., 2019). These include low egg productivity of existing breeds, poor growth performance, predatory attack, high disease incidence, limited access to feeds, inadequate management, limited capacity of producers, and limited access to training. As indicated above, the highest proportion of the chicken population in the country is indigenous breeds characterized by low egg and meat production, and they are susceptible to various diseases. Researches show that indigenous breeds-based smallholder production is not competitive due to the lower productivity of the indigenous breeds and higher unit costs associated with increasing inputs price (Akter et al., 2004). HPAI outbreaks seem the major production challenge among existing poultry diseases, as indicated by Thang et al. (2010b). Moreover, smallholder producers have limited access to information and training compared to medium and large-scale commercial producers. For instance, according to a study conducted by Thang et al. (2010b), only 4% of the households head participated in poultry-related courses in the study areas.

5. Poultry Products Marketing

5.1 Overview of the Poultry Market

Marketing of poultry products is the main activity in all poultry production systems. Like the medium/large-scale commercial producers, smallholder producers also have significant participation in the marketing of poultry products (Tung and Costales, 2007). There is a distinction in the level, intensity, and marketing approaches among different production systems. As shown above, in the traditional/backyard production system, rural households produce fewer eggs and live birds mainly for their consumption and generate additional income. Therefore, they sell a limited number of live birds and eggs in the local

markets to cover household expenses such as medical services, school fees, and children's books. As indicated above, the demand for local chicken products is higher than others due to quality attributes and consumer preference for local breeds (Jennifer et al., 2009). Some studies show that higher income is associated with more consumption of indigenous chicken, indicating a niche market for these chicken products (Jennifer et al., 2009). Developing niche markets and premium payment where possible is beneficial to conserve animal genetic resources.

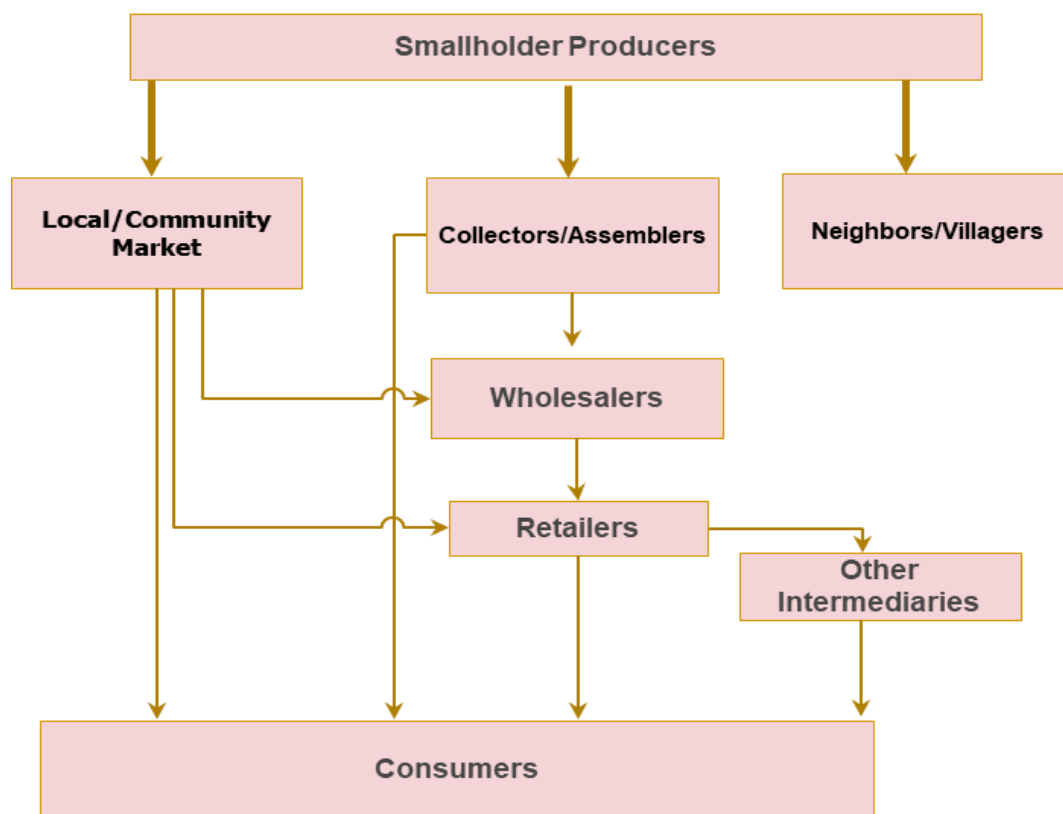
Like the traditional/backyard system, producers in the semi-intensive system mostly use poultry products for home consumption and income generation. Nevertheless, the marketing surplus in the semi-intensive system is significantly higher than the surplus in the traditional/backyard system, which could be associated with better production and productivity. A study conducted by Tung and Costales (2007) shows that increased production and productivity of smallholder producers would increase the volume of consumption and marketable surpluses. The products in the semi-intensive system are usually sold on the farm to traders or other intermediaries. Traders re-sell the products to consumers in the city or urban markets. Some small traders slaughter live birds before selling. Compared to the traditional/backyard system, producers in semi-intensive production are more integrated into the market (FAO, 2008). Unlike the traditional/backyard and semi-intensive systems, poultry products marketing in the intensive system is more organized and standardized. Producers in this system usually make a formal contractual agreement with traders and slaughterhouses before selling products (FAO, 2008).

Empirical evidence also shows the association between poultry products marketing and agroecology or locations of the producers. Producers in the highland areas have a lower volume of production and market participation than producers in the midland and lowland areas (Tung and Costales, 2007). Price received by smallholder producers in lowland areas was higher than the price received in highland and midland areas. The difference in market participation and selling price could be explained, among other things, by

access to markets, availability of marketing infrastructure, and the difference in supply and demand of poultry products.

5.2 Marketing Channels in Smallholder Production

Smallholder poultry producers have different marketing channels to sell poultry products. According to Tung and Costales (2007), there are three possible marketing outlets: local markets, itinerant traders (collectors/assemblers), and other farmers in the village (Figure 7). Producers sell live birds and eggs to wholesalers, retailers, and local consumers in the local market channel. Wholesalers, in turn, sell the largest proportion of products to retailers and the rest to other intermediaries and occasionally directly to consumers. Usually, retailers sell products to consumers in the urban markets and sometimes to other intermediaries that supply products to other consumers and buyers. The itinerant traders are the major marketing outlet for eggs and live birds in the smallholder production system (Tung and Costales, 2007). These buyers collect products and sell them to wholesalers and retailers. In the third marketing outlets, other farmers in the village, producers sell poultry products to other farmers either for reproduction or consumption purposes. Sometimes the poultry products may pass through multiple traders and actors that have mixed roles.



Source : Adopted from Tung and Costales (2007)

Figure 7: Smallholder Marketing Channels

The live bird market can be a retail, wholesale, or mixed market where retailing and wholesaling activities are conducted (Fournie et al., 2012). Based on the volume of birds traded, the live bird market can be categorized into small, intermediate, and large live bird markets. According to Fournie et al. (2012), there is a difference in the sources of live bird supply in each market category. In the small markets, most chickens are sold by smallholder producers or traders, and other traders or local consumers purchase the chickens. Chickens for the intermediate live birds' markets are supplied primarily from medium-scale farms and sometimes from smallholders and other farms. On the other hand, large-scale commercial farms are the main sources of chicken in the large markets. The above live bird markets can be periodic or open every day where the periodic market opens for some days in a month.

5.3 Pricing of Poultry Products

The price of poultry products is associated with different quality attributes such as type of breed, size or weight, taste and health of birds, and other seasonal and cultural factors (Burgos et al., 2008). Indigenous chicken products produced in the extensive or scavenging system fetches a higher price than exotic chicken breeds products produced in a confined or intensive system (FAO, 2008, Jennifer et al., 2009). The HPAI outbreak in the country has also resulted in a significant change in live bird marketing activities and created a higher demand for certified eggs and meat in the supermarket. Researches show that consumers are willing to pay premium prices for credible and certified local chicken products (Burgos et al., 2008).

Under a smallholder production system, the price of poultry products is determined through negotiation between sellers and buyers. Yet, smallholder producers have poor bargaining power over their buyers due to limited access to information and adequate marketing opportunities. Unlike smallholder producers, medium/large-scale commercial producers have better bargaining power, and usually, they receive a better price than smallholder producers (Tung and Costales, 2007). There is also a seasonal difference in the prices of poultry products. For instance, Tet and the Chinese New Year (late January or early February) periods are usually associated with higher poultry market prices and higher volume of sale, up to 100% increase in the volume of sale (Delabouglise et al., 2017). In the festival season, poultry production and trading activity significantly increase to meet the increasing demand for meat and eggs (Delabouglise et al., 2017).

5.4 Marketing Constraints

Access to better market opportunities is a good incentive for technology adoption and improving production and productivity. For smallholder producers, inadequate market infrastructures, limited institutional supports, unstable market or price fluctuation, the dominance of traders and lower bargaining power smallholder producers, disease transmission, and inadequate standard and grading systems are the major marketing constraints (Hanh et al., 2007, Tung and Costales, 2007, Thang et al., 2010b, Sealy et

al., 2019). Researches have documented that infrastructure and institutional aspects of market access are keys for increasing the market participation of smallholder producers (Tung and Costales, 2007). Continual input and output price fluctuations usually lead to significant instability in the level of production. Disease incidence affects the marketing of live birds and meat in different ways. For example, during a disease outbreak, the birds are usually sold at lower prices or consumed at home due to a lack of adequate demand or as a result of regulatory measures taken by the government (Delabouglise et al., 2020). Furthermore, existing live bird trading practices are considered a major risk factor for HPAI transmissions, affecting marketing activities (Sealy et al., 2019).

6. Household Nutrition and Poultry Products Consumption

6.1 Nutritional Status of South-East Asian Countries

The nutritional status of households can be measured in various ways. Undernutrition and vitamin and mineral deficiencies are the most common indicators used to assess household nutrition in developing countries. Undernutrition remains a crucial challenge to global health and development. More than half of the total undernourished people globally (about 381 million people in 2019) are found in Asia (FAO et al., 2020). Although the proportion of undernutrition in the Southeast Asian region decreased tremendously from 31% in 1990 to 10% in 2015, 16% of the children under 5 years of age are still moderately to severely underweight (Bao et al., 2018).

Undernutrition can be assessed using different indicators such as underweight, stunting, wasting, and overweight. Among these indicators, stunting is the most used indicator as it shows the cumulative effect of undernutrition and infections since and before birth. It is a consequence of chronic nutritional deprivation that can begin during and even before pregnancy due to maternal malnutrition and other adversities. Empirical data indicate that, in 2018, 21.7% of the world's children under five years are stunted, and this prevalence increases to 25.4%% in southeast Asia (FAO, 2021b). In 2019, 40 and 50% of stunted children lived in Africa and Asia, respectively (FAO et al., 2020). This shows that nine out of ten stunted children are found in these regions.

Child undernutrition could be associated with high child mortality and morbidity, poor mental and cognitive development, and lower educational attainment and economic productivity in adulthood (Black et al., 2013, Sudfeld et al., 2015). For example, short maternal stature, a long-term consequence of stunting in girls, is further associated with fetal growth restriction, leading to neonatal death and stunting in the next generation (Black et al., 2013).

Vitamin and mineral deficiency indicators may include anaemia, vitamin A deficiency, and iodine deficiency. Maternal and child anaemia is the most reported indicator of vitamin and mineral deficiencies in developing countries. The main contributing factors for anaemia are dietary iron deficiency, Vitamin A deficiency, and Beta-thalassemia trait (Gardner and Kassebaum, 2020). Anaemia has detrimental health implications, particularly for mothers and young children. They have multi-factorial causes involving complex interactions with nutrition, serious consequences for maternal and child survival and health, healthy pregnancies, cognitive development, and work productivity (Balarajan et al., 2011). The prevalence of Anemia in Southeast Asian countries is among the highest in the world (WHO, 2015, Sunuwar et al., 2020). For instance, according to WHO (2008b), the prevalence of anaemia in southeast Asia was 65.5, 48.2, 45.7% among pre-school age children, pregnant, and non-pregnant women, respectively. The prevalence is higher than the global average and represents the highest regional average in the world next to Africa.

According to the South East Asian Nutrition Surveys, Nutrition is an important factor for healthy growth and development in children. Dietary guidelines recommend a well-balanced diet including all major food groups for sufficient intake of necessary macro-and micronutrients (Bao et al., 2018). Researches showed that a large proportion of children in Southeast Asia did not meet their daily recommended intake (RDI) of many nutrients such as calcium, iron, vitamin C, and vitamin D (Bao Khanh et al., 2016).

6.2 Nutritional Status of Children and Women in Vietnam

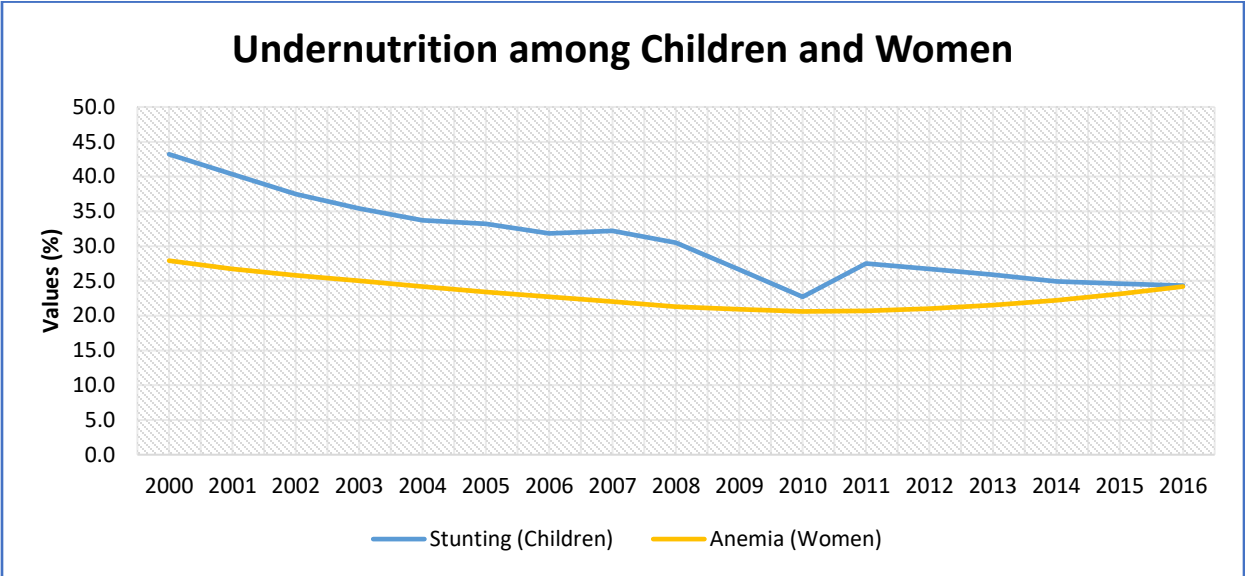
In Vietnam, about 1.9 million children under 5 years of age suffer from stunting (UNICEF, 2021). These children have an increased risk of mortality, illness and infections, delayed

development, cognitive deficits, poorer school performance, and fewer years in school. The mortality rate for children under five years is 16 per 1,000 live births, and nearly 45% of these child deaths are attributable to various forms of undernutrition (Chuc et al., 2019). Vietnam has exhibited good progress in reducing stunting since the previous two decades. For instance, child stunting had decreased from 43.2% in 2000 to 24.3% in 2016 (Figure 8). On average, the prevalence of stunting has decreased by 3.3% during the above period. Similarly, according to GSO (2020a), under-five stunting had reduced from 24.9 in 2010 to 19.9% in 2019.

There is significant variability in the prevalence of undernutrition between locations, gender and age of households, and households with different socio-economic statuses. Resource-poor households that live in rural areas are mostly affected by undernutrition. For example, while the prevalence of stunting in urban areas reduced from 15.9% in 2014 to 6.2% in 2019, in the same period, it reduced from 28.7% to 23.7% in the rural areas. This does not only show higher stunting prevalence in rural areas than urban areas but also a slower rate of reduction in the rural areas. Moreover, overweight and obesity have become a national concern, affecting 5% of children and 8% of women. At the same time, twice as many women are underweight (referred to as the double burden of malnutrition) (Benny et al., 2018). The prevalence of underweight among women of reproductive age is 18% (Cuong, 2018). This is still higher than the prevalence of overweight in Vietnam, and it is the highest among younger women (under 30) in the North Central and Coastal areas and the Red River delta.

Iodine deficiency is another nutrition-related concern in Vietnam. According to a national survey on iodine deficiency, the median urinary iodine concentration among the general population was 83 ug/L in 2008, which is below the adequate levels established by WHO. The proportion of school-age children with low urinary iodine concentration is estimated to be 54% (Roos et al., 2019). Close to a third of children under five and women of reproductive age are anaemic. According to FAO, there is little progress in reducing these numbers among children and women in recent years (Figure 8). Moreover, the report

shows that anemia prevalence among women and children is highest in the North Midlands and mountain areas.



Source: Compiled by authors using data from FAO (2021b)

Figure 8: Proportion of Stunted Children and Prevalence of Anaemia among Women

Iodine deficiency has resurfaced as a significant public health concern due to relaxing mandatory salt iodization laws (Codling et al., 2015). Anaemia continues to affect 29% of children under five and non-pregnant women, caused by micronutrient deficiencies such as iron and vitamin A and potentially other non-nutritional factors (Campbell et al., 2018). There was also a moderate reduction in the prevalence of anaemia among reproductive-age women (Figure 8). It reduced from 27.9% in 2000 to 20.6% in 2010 and raised again to 24.2% in 2016. The prevalence decreased during 2000-2010 and started increasing since 2011. The average annual reduction was about 0.84%, which was below 1%.

6.3 Household Diet Diversity and Poultry Products Consumption

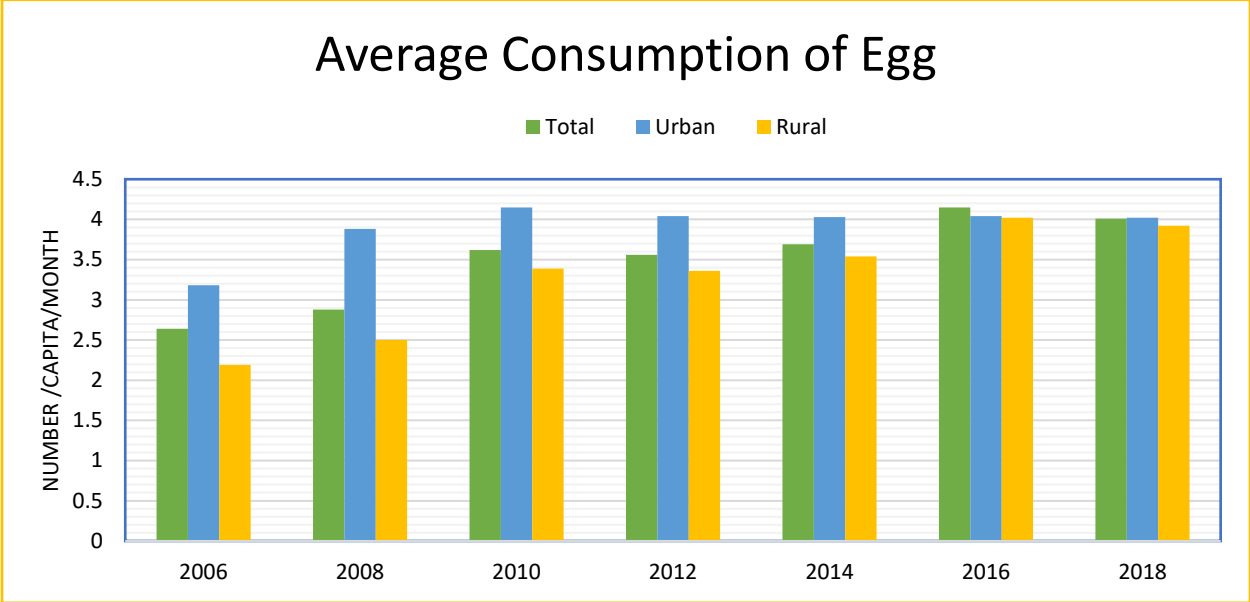
Researches show that Vietnam is in a nutrition transition, and there is a positive change in nutrition outcomes (Harris et al., 2020). The supply of different food groups has increased significantly in the previous decade, and there has been a change in household dietary diversity. Household preference for food is shifting from rice-based consumption

towards animal proteins, including chicken meat, eggs, vegetables, and fruits (Bairagi et al., 2020). A study conducted by Nguyen et al. (2013) shows that from the seven food group consumed, the average maternal and child dietary diversity were 4.6 and 4.4, respectively. According to WHO (2008a), the reported child diet diversity was above the minimum cutoff point that indicating a good status in dietary diversity of household consumption. However, research evidence shows that poor households have not experienced significant increases in food consumption, calorie intake, and dietary diversity of the same magnitude as non-poor households (Mishra and Ray, 2009, Harvey et al., 2018). Moreover, micronutrient deficiencies of particular concern in Asia include iron, zinc, vitamin A, iodine, and calcium deficiencies (Herforth et al., 2020).

In developing countries, including Vietnam, smallholder poultry production is an integral component of the livelihoods of poor rural households, and this is likely to continue for the foreseeable future (Thornton, 2010). Chicken production is primarily a woman's enterprise. In addition to various socio-cultural uses, the main outputs from family chicken production are used as a source of high-value nutrition (ideal for the most vulnerable members of the household, such as pregnant women, children, and the sick). Eggs are an important source of energy and provide 27% of an adult's daily requirements for selenium, 25% for vitamin B12, 23% for choline, 15% for riboflavin, 13% for protein, 11% for phosphorus, 9% for vitamin D, 9% for folate, 8% for vitamin A, 6% for iron, and a small amount of zinc (Miranda et al., 2015). Moreover, the global meat industry, mainly in Asia, is growing quickly, and demand in 2035 will increase by 45% (Mulder, 2017). Hence, there is a tremendous opportunity for income growth through improved chicken production, and this will help to improve household food security in the region (Iannotti et al., 2014).

There was an increasing trend in the monthly consumption of poultry products in Vietnam. According to the household survey results (GSO, 2019), the average number of monthly egg consumption increased from 2.64 per person in 2006 to 4.01 per person in 2018 (Figure 9). The average egg consumption in urban areas was higher than the consumption in rural areas, but there was a decreasing trend. Despite the observed increasing trend, the reported average consumption looks small. Moreover, when the

average consumption is disaggregated by five income quantile groups, in 2016, households in the first and fifth quantile consumed 2.9 and 4.9 eggs/person/month, respectively (GSO, 2020a). This shows an existing difference in consumption of poultry products among different population groups.



Source: Compiled by authors using data from GSO (2019)

Figure 9: Average Household Egg Consumption

Poultry meat is the main type of meat consumed by rural and urban households. Like egg consumption, as indicated above, there was a significant increase in the consumption of poultry meat. According to Phuong et al. (2014), almost all of the households (94.7%) in the country consume poultry meat, and poultry meat consumption constitutes 30.41% of the total household meat expenditure budget next to pork meat expenditure (52.68%). The share of beef meat from other livestock includes about 9.13 and 7.78%, respectively. Although the data is not disaggregated by animal type, in 2018, the average household meat consumption was 2.18 kg/person/month (GSO, 2019). The average urban and rural consumption in the same year was 2.24 and 2.15 kg/person/month, respectively. This shows the presence of a slight difference between urban and rural areas.

The data on poultry meat consumption and the share of poultry meat consumption from total meat consumption indicates the role of poultry production in households' nutritional

and food security. Due to urbanization, rapid population growth, and a growing desire for a healthy lifestyle, household demands for poultry products will increase in the future. Poultry meat will account for the largest proportion (44%) of the global meat consumption in the following decades (OECD/FAO, 2020). In Vietnam, since poultry egg and meat production are mainly in the hands of small-scale producers, the existing capacity in production is unlikely to meet the growing local demand. This is due to a lack of knowledge and access to production innovation, lack of capital, and limited ability to prevent and control diseases (Rupa, 2019).

Researchers suggest the need for food production and consumption policies that enhance the availability and access of nutrient-rich foods to enhance household diet diversity (Harris et al., 2020). This may include consumption of poultry meat, which is rich in protein and low in fat, and consumption of eggs that are rich in vitamins, minerals, and various powerful nutrients. Enhancing smallholder poultry production has a significant contribution to providing high-quality protein in rural people's diets, especially for women and children, where traditional foods are highly dominated by carbohydrates (Farrell, 2013). Moreover, interventions that include behavioural change communication will substantially contribute to promoting maternal and child dietary diversity and encouraging mothers to feed young children (Nguyen et al., 2013).

Approaches to improve child and women nutrition in Vietnam should focus on the continued improvement of infant and young child feeding (IYCF) practices, particularly early breastfeeding initiation, exclusive breastfeeding, timely introduction of complementary food, and feeding frequency. Policy and programmatic interventions should focus on strengthening universal salt iodization policies and implementation and addressing high malnutrition rates among ethnic minorities and the poorest segment of the population (Graziose et al., 2018). When poultry production and nutrition education interventions are implemented together, they synergistically increase egg and poultry meat intake to a higher level with minimal cost and long-lasting effects. Therefore, poultry interventions targeting increased egg and meat need to have a vital nutrition promotion component for effective behaviour change in egg feeding practice. A baby-friendly poultry

system (environmentally safe) is essential for the maximal benefit from the increased egg and chicken meat.

Despite the overall positive progress in household nutritional status, the progress made among poor rural and some ethnic minority households is inadequate (Thang and Popkin, 2004, Mishra and Ray, 2009). This needs scaling-out of well-proven nutrition interventions, building strong and more coordinated partnerships for nutrition, and addressing determinants of nutrition through multisectoral approaches (Mbuya et al., 2019). In this regard, improving the production and productivity of smallholder poultry production has a multidimensional contribution as it enhances access of households to nutrition-rich poultry meat and eggs and improves income that can be used to purchase other food items (Marangoni et al., 2015, Wong et al., 2017)

7. Economic Contribution of Smallholder Poultry Production

Smallholder poultry production is the most crucial source of livestock-based income for resource-poor households. It is the source of readily available and cheap protein for the poorest income quintile group in the country (Burgos et al., 2008). In Vietnam, most rural poor households depend on poultry for income generation and consumption of egg and meat (Epprecht et al., 2007, Moula et al., 2011). Poultry production has a crucial role in poverty reduction, employment creation, reducing inequality, and women empowerment (Epprecht, 2005, Burgos et al., 2007, Bett et al., 2014). As shown above, it is the second most important livestock-based income source in the country. According to FAO (2008), poultry production contributes about 30.0% of farmers' income in rural areas. Considering the value of poultry products consumed in the household, Moula et al. (2011) estimated that poultry production accounts for 40% of household income. However, the amount of income generated from different production systems has significant variability. For instance, Thang et al. (2010b) reported that while commercial producers generate 30-60% of household income, smallholder producers in the traditional/backyard production system generate about 8% household income. The lower level of income contribution in

the traditional/backyard system could be associated with the lower production and productivity of the sector.

Most smallholder producers who keep indigenous breeds generate income to support other livelihood activities (Bett et al., 2014). The income from the egg and live bird sales is used to cover the cost of medical services, medicine, school fees, and children's books (FAO, 2008). In addition to their economic contribution, local breed chickens have different social and cultural values in Vietnam. Some breeds are used for religious purposes, gifts, entertainment (cockfighting), medicinal, and pets (FAO, 2008). For instance, Ac chicken breed is used as a traditional medicine for different parts of society, such as pregnant women and children.

The role of smallholder poultry production in poverty alleviation is documented in various researches (Mack et al., 2005, Wong et al., 2017). Similarly, the contribution of poultry production to poverty reduction has also been explored by empirical researches in Vietnam (Islam and Jabbar, 2005, Epprecht et al., 2007). Moreover, since the smallholder production system is usually owned, managed, and marketed by women, it has significant implications for poverty alleviation and household food security. Most of the poorest households in the country have access to livestock like poultry than access to land, which indicates the contribution of the sector to enhance the livelihood of poor households. This suggests that agricultural policies should support livestock production in general and poultry production, particularly to reduce poverty and improve the well-being of households in the country (Maltsoglou and Rapsomankis, 2005).

8. Overview of Agricultural Policy and Livestock Research

Vietnam has implemented a series of agricultural policies since the 1980s. The policies focused on increasing food production through availing sufficient land for rice production, strengthening research and extension, and building farmers' knowledge and skills in production and marketing (Yen et al., 2017). Food security has been a policy concern for the government of Vietnam, and previous policies have resulted in significant success stories in reducing poverty and undernutrition and increasing domestic food supply and export earnings (OECD, 2015, Tam et al., 2016). The country has moved from a food importer to one of the world's major food-exporting countries. Despite the above success stories, there are emerging concerns on the quality and sustainability of agriculture growth and patterns of development due to low profitability of smallholder farmers, low agricultural worker productivity, low or mixed product quality, and low value-addition (WB, 2016). For instance, smallholder rice producers were being pushed out of rice farming and prevented from engaging in alternative production strategies. As a result, researchers like Gorman (2019) showed that focusing on monoculture-based production will further erode smallholder producers' livelihood and lead to agrarian crises.

According to WB (2016), Vietnam will experience increasing urbanization, expansion of the middle-class population, and changes in dietary patterns & food expenditures (reduced consumption of rice and increased consumption of animal products, fruits and vegetables, and processed foods). This will alter the food policy agenda to become more multi-dimensional and provides greater consideration for nutritional outcomes rather than increasing agricultural outputs (WB, 2016). Agricultural policies that target positive nutritional outcomes should enhance inclusive growth, surplus production, well-function markets, sustained productivity growth, property rights, food safety standards, efficient allocation of capital, and well-functioning pricing systems (Petersen, 2017). This suggests the need for making smallholder producers at the centre of the policy-making process.

In Vietnam, growth in agricultural production has been supported by research and development efforts (Yen et al., 2017). Research activities have been an integral part of the agricultural policy formulation and implementation process. There were different reforms in the research and extension approaches during the agricultural policy reforms.

For instance, before 2005, there were 30 various research institutes (28 research agencies and 2 universities) under MARD (OECD, 2015). Then, in 2005, these research agencies were reorganized into 16 institutes (12 research centres and four universities) to achieve greater coordination and efficiency. According to Agricultural Science and Technology Indicators (ASTI), there are about 44 research institutes comprising 33 government agencies and 11 higher education institutes (Stads et al., 2020).

The research agencies have different focus areas: plant and animal genetics, biotechnology, plant and animal breed selection and distribution, agronomy, forest science, water resource management, veterinary, aquaculture, agricultural engineering, and post-harvest technologies and others. While the Vietnam Academy of Agricultural Science (VAAS) is the main body that oversees major crop research activities, the National Institute of Animal Science (NIAS) leads research on livestock, including poultry, cattle, swine, sheep, and goats (Stads et al., 2020). Although the agricultural research and development efforts have remained underfunded (i.e. 0.20% of GDP in 2017), recently, the country has also introduced new directives that improve the research and development efforts in biotechnology, post-harvest processing, crop seeds, livestock, and fishery breeds (OECD, 2015, Stads et al., 2020). For instance, the country has Passed a National Animal Husbandry Law in 2018 that was considered a landmark to promote the development of Vietnam's livestock industry (GAIN, 2019). The law encourages individuals and institutions to apply science and technologies in livestock production that improve the productivity, quality, efficiency, and competitiveness of the livestock sector.

According to Stads et al. (2020), Vietnam has good research performance compared to some countries in Southeast Asia. The research efforts have given better focus to the livestock sector than other countries in the region. These researchers have also forecasted that Vietnam will have the highest agricultural productivity growth in investing in livestock and fisher research than in crops, indicating the vital role of livestock in the overall economy. Compared to other livestock species, the attention given to poultry research and development looks encouraging in the previous few years. Poultry research and development activities took the largest share of livestock research (Stads and Hai, 2006). But most of the poultry research to date inclined toward disease prevention and

management activities. The attention is given to genetic improvement, access to services and markets, and other management issues seem inadequate.

The inadequate attention given to productivity improvement research could be easily observed from the steady and lower productivity growth of smallholder poultry production in the previous decades. As indicated above, chicken breeds' egg and meat productivity under the smallholder production system are significantly lower than other commercial breeds. Research evidence suggests the need for building domestic capacity to improve animal breeds and develop innovative production and marketing solutions for farmers (Van et al., 2020). Research and development efforts should provide adequate attention to productivity-enhancing technologies, marketing, profitability, and institutional buildings (OECD, 2015, WB, 2016). Therefore, policy actions should focus on re-orienting agricultural researches, extension services, improving farm management skills, improving the institutional design of agricultural research and development, and enhancing smallholder's production and income diversification.

Research and development efforts that aim to enhance smallholder poultry production and productivity should focus on: improving the genetic potential of existing breeds, improving vaccination and medication supply chains, diversifying the local feed supply, building producers' capacity, and integrating farmers with markets. Sustained outcomes in the above areas demand integrated interventions that need the active engagement of both public and private actors, which is widely known as a public-private partnership (PPP). Although it needs further research, the vital role of PPP to transform the agricultural sector is documented in various studies (Hartwich et al., 2007, Ferroni and Castle, 2011, Rankin et al., 2017). In the poultry sector, the public sector may focus on creating a favourable environment. In contrast, the private sector engages in product development such as improved breeds, vaccination, medicines, and low-cost feed (Hartwich et al., 2007, Ferroni and Castle, 2011, Rankin et al., 2017).

9. Conclusion and Research Opportunities

Poultry production plays a significant role in the overall economy and livelihood of smallholder farmers and other resource-poor households in Vietnam. This sector comprises smallholder production and the rapidly growing medium/large-scale commercial and integrated production systems. However, smallholder production is the most common production system practised by most households in different regions of the country. This production system has multiple contributions to rural and peri-urban producers. It supplies cheap and nutrient-rich foods and helps to generate income to support other livelihood activities. Smallholder poultry production has an incredibly significant economic contribution to most resource-poor households in the rural and peri-urban areas. However, this production system will have lower productivity due to the dominance of the country's low-input-low-output indigenous breed-based production system. As a result, it will not be competitive with the rapidly growing commercial production system and foreign farms that export cheap eggs and meat. This will have many uncertain impacts on the livelihood of smallholder producers and suggests the need for pro-poor and inclusive interventions that enhance the productivity and competitiveness of the sector while taking appropriate measures to conserve the existing domestic animal biodiversity.

The productivity and competitiveness of indigenous breed-based production can be enhanced through improved genetics, better management systems, and integrating producers with better input and output markets. Approaches to improve the genetic potential may include building the local capacity in breed selection and introducing high-yielding and locally adapted improved breeds. This requires comprehensive research and development efforts in breed identification and testing, evaluating farmers' preferences, and establishing sustainable delivery systems for chicks and other inputs. Moreover, innovations that improve health services delivery systems, such as vaccination and medication supply chains, will have significant contributions.

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Appendix A: Performance Indicators of Vietnamese Domestic Breeds

Common Name	Weight (kg)		Egg/Year			Egg Weight (gm)	Birth Weight (kg)		Maturity Age		Age First Parturition
	Male	Female	Mean	Min	Max		Male	Female	Male	Female	
Ga Ac	1.0	0.8	93	91	95	30	0.020	0.020	4.0	3.5	4.0
Ga Choi	5.0	4.0	50			50	0.032	0.030	5.5	6.0	7.0
Ga Dong Tao	4.8	3.8	70			52	0.035	0.035	5.0	5.5	6.5
Ga Ho	4.5	3.5	55	50	60	51	0.033	0.031	7.5	8.0	10.0
Ga Mia	3.0	2.0	80	70	90	55	0.030	0.030	4.0	5.0	6.0
Ga Mong	3.5	2.5	85	75	90	45	0.300	0.300	4.7	4.7	5.0
Ga Ri	2.7	1.4	120	90	130	45	0.028	0.028	4.0	4.0	4.5
Ga Tau Vang	2.5	1.8	120	95	130	45	0.032	0.032	4.0	4.0	5.0
Ga To	5.0	3.0	130	120	140	50	0.320	0.300	4.0	4.0	5.0
Ga Tre	1.2	0.8	60	40	70	40	0.016	0.016	5.0	5.0	6.0
H'mong	2.4	1.8	60	40	75	50	0.029	0.029	4.0	4.0	4.5
Oke	2.5	1.5	83	60	90	45	0.030	0.030	3.0	4.0	5.0
Te	1.6	1.3	95	80	120	45	0.025	0.025	4.0	4.0	4.5
Tien Yen	1.5	2.5									
Vanphu	2.2	1.9				35	0.025	0.025	4.0	4.5	5.0

Source: Compiled by the the author using data from FAO (2021a) 1-5 0.8-4

Appendix B: Main use, Adaptability, and Some Specific Characteristics of Indigenous Breeds

Common Name	Main Use	Adaptability	Specific Reproductive Characteristic	Specific Characteristic of Product	Management System
Ga Ac	Meat, Medical	Tropical Climate	Low reproductive rate	Slow growth	Semi - intensive
Ga Choi	Fancy, Meat	Tropical Climate	Low reproductive rate	Slow growth	Semi - intensive
Ga Dong Tao	Fancy, Meat	-	-	-	Semi - intensive
Ga Ho	Hobby, Meat	Tropical Climate	Low reproductive rate	Slow growth	Intensive
Ga Mia	Fancy, Meat	Well adapted to Vietnam	Low reproductive rate	Slow growth	Semi - intensive
Ga Mong	Fancy, Meat				Semi - intensive
Ga Ri	Eggs, Meat	Well adapted to Vietnam	Low reproductive rate	Slow growth	Extensive (non-backyard)
Ga Tau Vang	Eggs, Meat	Adapted to Vietnam	-	Good meat	Extensive (non-backyard)
Ga To			-	-	-
Ga Tre	Fancy, Meat	Well adapted to Harsh Conditions	-	-	Extensive (non-backyard)
H'mong	Eggs, Meat	Well adapted to high cold mountain	-	Good meat	Extensive (non-backyard)
Oke	Meat	Well adapted to Harsh Conditions	-	Good meat	Extensive (non-backyard)
Te	Meat	Normal, not as good as other	-	-	Extensive (non-backyard)
Tien Yen	Fancy, Meat	-	-	-	-
Vanphu	Meat	-	-	-	-

Source: Compiled by the authors using data from FAO (2021a)