



Poultry production, marketing and consumption in Vietnam: A review of literature

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Acronyms and abbreviations

FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
GSO	General Statistics Office
HPAI	Highly pathogenic avian influenza
MARD	Ministry of Agriculture and Rural Development
PPP	Public–private partnership

Acknowledgement

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Executive summary

The International Livestock Research Institute is implementing the project 'Asian Chicken Genetic Gains (AsCGG): A platform for exploring, testing and delivering improved chickens for enhanced livelihood outcomes in South East Asia' in Cambodia, Myanmar and Vietnam, with funding from the Australian Centre for International Agricultural Research. The project 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. It began with a comprehensive literature review to understand the current knowledge base, identify research and development gaps and inform a baseline assessment. 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 the second largest meat contributor in the country. They generate the second-highest livestock husbandry-based income for most of the smallholder farmers in rural areas. The poultry species include chickens, ducks, perching ducks, geese and quail that are used for egg and meat production. In 2020, a poultry population of 512.7 million in the country produced about 1.505 million tonnes (t) of meat and 15.1 billion eggs.

The overall poultry population has shown significant growth in the previous two decades. On average, between 2000 and 2020, it grew by 5.14% per year. Although poultry production is undertaken in all regions of the country, about 85.3% of the total poultry population is distributed in four regions: the Red River Delta, Northern Midlands and Mountainous, and North Central, Central Coastal and Mekong River Delta regions.

Poultry production is the second largest contributor of total meat produced in the country, following pig production. On average, the total poultry meat production has shown 8.84% annual growth from 2000 to 2020. Similarly, the volume of egg production has also shown significant change in the previous two decades. From 2000 to 2020, on average, the total egg production increased by 7.46% per year. Despite the observed growth in production, however, Vietnam has remained a net importer of poultry meat in the past few years. According to the International Trade Centre, in 2020, the country imported poultry meat worth USD 293.2 million, mainly from the United States, Europe, Brazil and the Republic of Korea.

There has also been an increasing trend in the prices of poultry products. From 2004 to 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/person per 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 also 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 averages. Lower egg supply could be associated with lower egg productivity of existing breeds and inadequate imports, suggesting the need to improve the sector's productivity.

The poultry production systems in Vietnam can be classified into traditional/backyard non-intensive production, semi-intensive production and intensive production types. The majority of the poultry production in the country is categorized under the traditional/backyard non-intensive production system, and it contributes 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 and bronchitis. 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 per year, while improved and exotic breeds produce 144–265 eggs/hen per year. There is also significant variation in mature body size and body weight among indigenous chicken breeds. The average body weight for mature cocks ranges from 1,000 g to 5,000 g, while for hens, it ranges from 800 g to 4,000 g. Unlike indigenous breeds, improved breeds have fast growth and higher body weight.

Smallholder producers practise 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.

Poultry production plays a vital role in household nutrition and food security. 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 only declined from 28.7% to 23.7% in the rural areas.

The higher prevalence of stunting in rural areas can be associated with several causes, including lower consumption of nutrition-rich food such as poultry meat and eggs.

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

Smallholder poultry production has a multidimensional role in enhancing the livelihood of households in rural and urban areas. Poultry can be considered the poor's livestock due to their significant contributions 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 revenue, 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 aiming 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 adopting better management systems integrating farmers with input and output markets. Alternative animal breeding approaches include undertaking selective breeding on the existing genotypes as well as 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, the preferences of farmers and consumers, and sustainability.

1. Introduction

Agriculture plays a key role in Vietnam's economy. The agriculture, fishery and forestry sector contributed about 13.96% of the gross domestic product (GDP) in 2019 (GSO 2020a). From the agricultural sector, livestock production has made significant contributions to GDP. There are about 10.2 million agricultural households in the country, and 82% 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 alongside crop production activities (Delabouglise et al. 2019). The primary types of livestock include pigs, poultry, cattle and buffalo (GSO 2020a). Livestock production makes multiple contributions to households, including the supply of meat, milk and eggs for household consumption, income generation and inputs to agricultural activities.

Among the types of livestock, poultry are the most common animals owned by rural households and are the second-largest contributors 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 2020a). Poultry production involves smallholder and medium- to large-scale commercial production systems, and smallholder production accounts for the largest proportion of producers. In 2020, there were more than 8 million chicken raising households in the country; about 88.8% of them kept fewer than 50 chickens, 9.8% kept 50–199 chickens and the remaining 1.4% kept more than 200 chickens (GSO 2021). According to Desvaux et al. (2008), of 8 million poultry keepers, 65% kept chickens in flocks of fewer than 200; 25% kept waterfowl, mainly ducks; 10–15% ran commercial chicken farms with 200–500 birds; and 0.1% ran integrated industrial farms with flock sizes of 2,000–30,000 chickens. The commercial production system also supplies eggs 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 makes the most significant contributions to the livelihoods of 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, the International Livestock Research Institute has initiated a research-for-development project to test and avail high-producing and farmer-preferred poultry genotypes for smallholder producers. The project will improve the production and productivity of the poultry sector and contribute to poverty alleviation. As a first step, we conducted a literature review to understand the current knowledge base, identify research and development gaps and inform a baseline assessment. The baseline assessment will explore the evidence on current smallholder chicken production systems, chicken productivity, husbandry practices, consumer demand and the socio-economic status of smallholder poultry-keeping households in the country.

This review presents an overview of poultry production, marketing and consumption activities and their livelihood contributions to smallholder producers in Vietnam. It also highlights agricultural policy and livestock research in the country. The review is organized into nine sections. Following this 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 contributions in sections six and seven. Then, section eight presents an overview of the country's agricultural policy and livestock research. Finally, a conclusion and research opportunities are highlighted.

2. Review approach and data sources

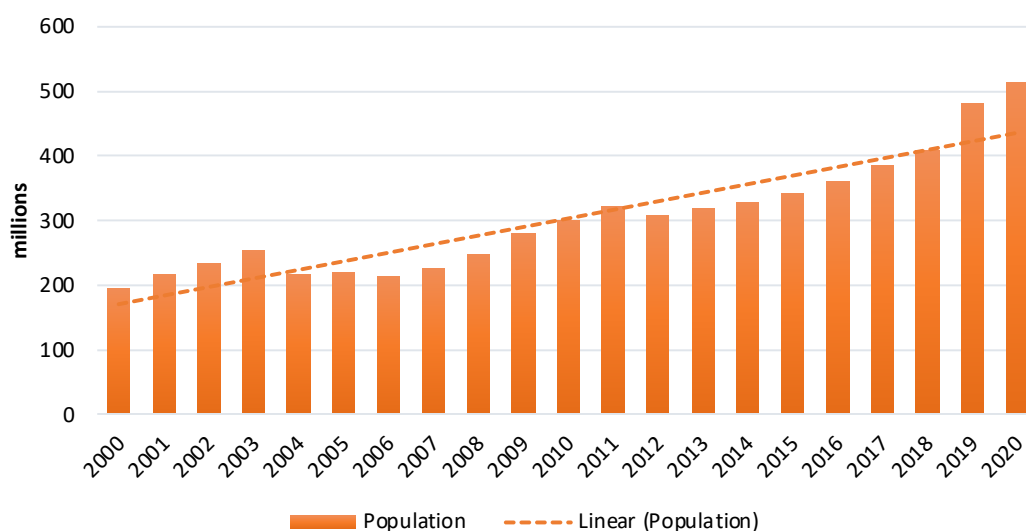
Based on the objectives outlined above, this work can be categorized as a scoping review. It focuses on exploring the breadth of available evidence and informing the country's proposed research efforts (Peterson et al. 2017; JBI 2020). Such an approach helps to synthesize information in broader topics, in our case related to poultry production, marketing and 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 Vietnam's General Statistics Office (GSO), the Food and Agriculture Organization of the United Nations (FAO) and the 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 2020, a poultry population of 512.7 million produced about 1.505 million tonnes (t) of meat and 14.7 billion eggs. On average, between 2000 and 2020, the annual growth rate of the poultry population was 5.14%. However, a negative growth rate between 2003 and 2006 could be associated with a highly pathogenic avian influenza (HPAI) outbreak (Hanh et al. 2007). The overall increase in production could be attributed to various 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, meet domestic market demand, contribute to national nutrition security and reduce reliance on imported poultry products (Dinh 2017).

Figure 1: Trend in total poultry population in Vietnam.



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

3.2 Regional distribution of poultry production

Poultry production is commonly practised in all regions of the country (Table 1). However, there were variations in the level of production among different regions. Between 2010 and 2019, the Red River Delta and Central Highland regions accounted for the highest and lowest poultry population proportions respectively. Four regions – the Red River Delta,

Northern Midlands and Mountainous, and North Central, Central Coastal and Mekong River Delta regions – accounted for 85.3% 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 Midlands and Mountainous regions compared to the other regions. The same study 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 Southeast regions. In contrast, the lowest proportion of these farms was found in the Northern Midlands and Mountainous region (Desvaux et al. 2008).

Table 1: Total poultry population by region.

Region	Total poultry population (in millions)										%
	2011	2012	2013	2014	2015	2016	2017	2018	2019	Avg.	
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
NC&CC	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 Mountainous; NC&CC=Northern Central and Central Coastal; MRD=Mekong River Delta; SE=Southeast; CH=Central Highlands; WC=Whole Country. Source: Compiled by authors using data from GSO (2020b).

3.3 Types of poultry production systems

Most researchers classify the poultry production systems in Vietnam into three types: 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), have documented three different types of classifications based on the definitions of FAO, Vietnam's Ministry of Agriculture and Rural Development (MARD) and 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 systems, semi-industrial farming systems and industrial chicken farming systems. Classification based on GSO comprises farms with more than 2,000 birds per cycle (Sector 1), farms with 150–2,000 birds per cycle (Sector 2), farms with 40–150 birds per cycle (Sector 3), and farms with less than 50 birds per cycle (Sector 4). The majority of the country's producers use extensive production systems that can be categorized under the traditional/backyard 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 Northern Midlands and Mountainous, Southeast and Mekong River Delta regions (Phuong et al. 2015). Producers in this category raise less than 50 chickens in backyards, gardens, courtyards, orchards and often free-range on neighbouring land (Burgos et al. 2007). Local breeds (ecotypes) are predominantly used in this system, and producers get 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 these 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*), including bran and broken rice, maize (*Zea mays*), soybean, cassava (*Manihot esculenta*), fish meal and other by-products (Minh 2005; Xuan et al. 2006).

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

Semi-intensive production: This system integrates 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 51–2,000 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 day-old chicks to these producers (Desvaux et al. 2008). Producers also have better access to training, credit and information than in 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, chickens 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 evening. 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, soybean 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 15–20% 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's 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 control feeding systems, water supply, humidity, air movement and waste management. Producers keep a higher number of poultry than in the above two systems, usually 2,000–100,000 birds. Producers adopt highly standardized management systems such as improved health and biosecurity systems and intensive feeding and watering systems. The production system is highly intensive and involves higher levels of investment in animal health, house

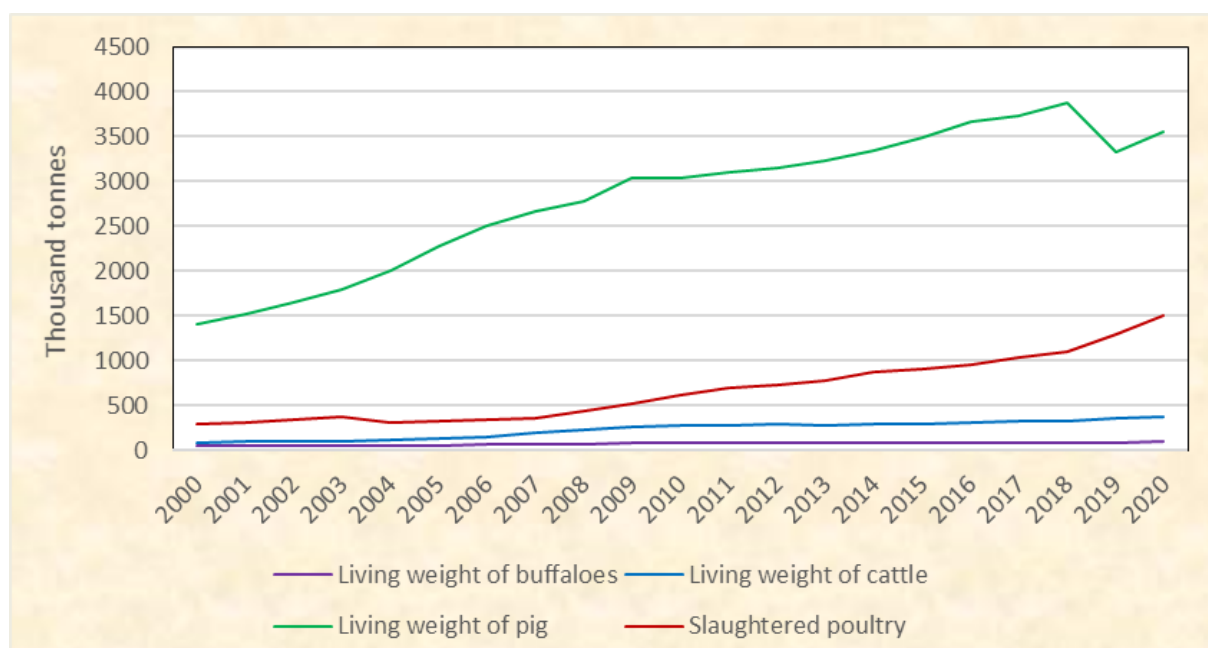
maintenance and flock productivity. Earlier estimates show that the average investment cost in an industrial chicken farm is about 50–60 million Vietnamese dong (USD 3,060–3,670) per 1,000 birds (Hanh et al. 2007). However, the above figure may not represent the current investment cost due to the increasing trend in feed and other variable costs.

This system includes highly specialized chicken farms (layers and broilers), ducks and geese farms and breeding farms. Previous findings showed that chicken and duck broiler farms with 2,000–11,000 birds 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 birds. 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 are ready for slaughtering between 42 and 45 days (at six weeks) with an average weight of 2,200–2,400 g. The egg productivity of layers is higher than for the layers in the semi-intensive system. Based on the breed, a hen can produce 270–280 eggs per year. According to Desvaux et al. (2008), the intensive production system is better developed in the Red River Delta region of the country than in 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 18.34% of the total livestock meat supplied in the country, while pig production contributed 46.88%. There has been a significant increase in the supply of poultry meat in the past two decades (Figure 2). Average annual poultry meat production grew by 8.84% from 2000 to 2020. This shows the significant contribution of the sector to meeting the 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 (2021a), cattle meat import significantly increased from 479 t in 2014 to 2,338 t in 2019. This shows an increase in consumption of cattle meat in these 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 to expand the industry due to weather, land and infrastructure-related issues.

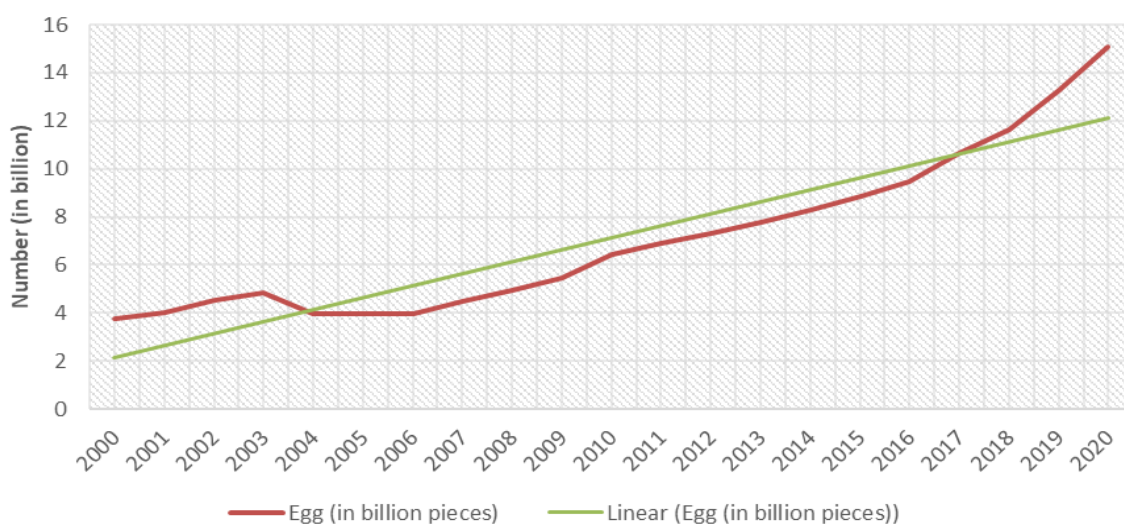
Figure 2: Total meat produced in Vietnam by major livestock types.



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

There was a surge in the volume of eggs produced in the previous two decades (Figure 3). Between 2000 and 2020, on average, the total egg production grew by 7.46% per year. In 2020 the country produced 15.1 billion eggs. The total egg production in 2020 was four times higher than the total egg production 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, as with the volume of meat produced, there was negative growth from 2003 to 2006 related to the HPAI outbreak in the country (Desvaux et al. 2008).

Figure 3: Trend in the volume of egg production in Vietnam.



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

3.5 Poultry products import and producer prices

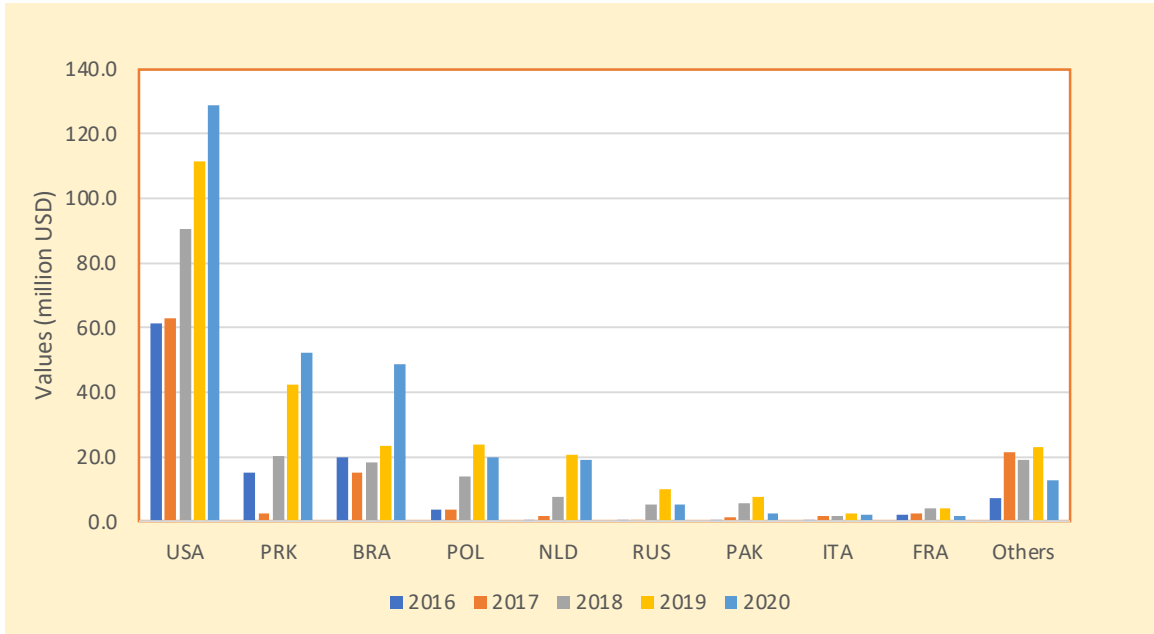
Despite an increasing trend in poultry meat production, Vietnam remains a net importer of poultry meat. In 2020, the country imported a volume of poultry meat worth USD 293.2 million (Figure 4). The value and amount of imports have shown significant growth since 2016. For example, the total value of imports in 2020 was 2.1 times the value of imports in 2016. The country imported poultry products from different countries in 2020, with 92% imported from the United States, the Republic of Korea, Brazil, Poland and the Netherlands (ITC 2021). In the same year, imports from the United States took the largest share (44%). The increasing trend in imports could be associated 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 and FAO (2020) forecasts, Asia will account for 53% of global meat imports by 2029. This forecast shows the highest increase in meat import will be observed in the Philippines and Vietnam.

A higher volume of meat imports that could be substituted domestically shows a lack of competitiveness in the poultry sector, which can be examined using different indicators, such as producer prices. According to FAO (2021a), 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 producer prices of poultry meat in the last two decades in Vietnam. For instance, in 2019, the annual average producer price for chicken meat was USD 4,259/t, while the price in 2000 was USD 1,487/t (FAO 2021a). This shows that the price in 2019 was 2.86 times the price in 2000. Figure 5 presents the 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

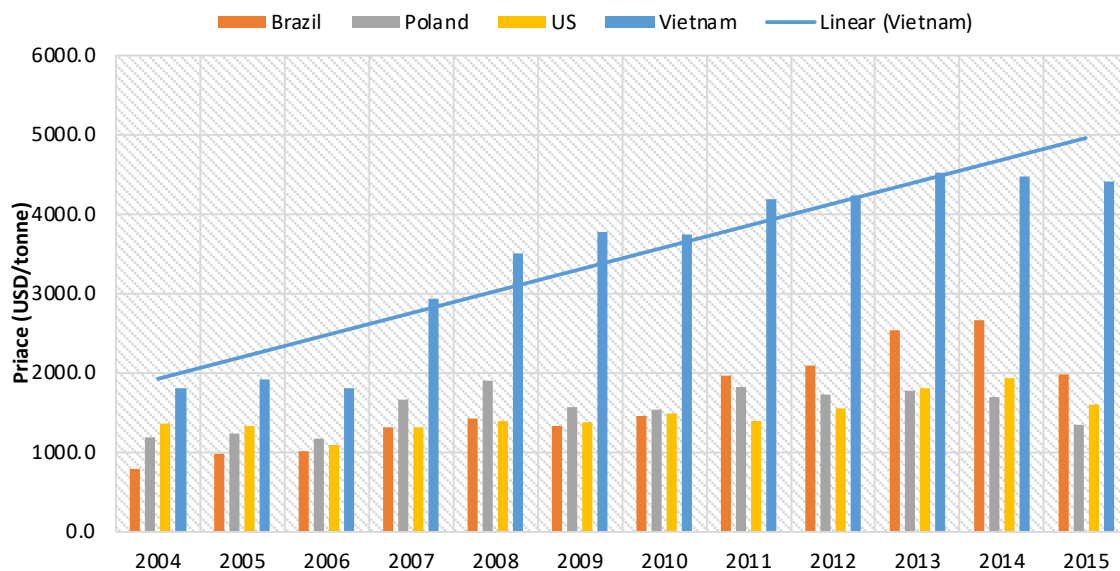
producer prices in the exporting countries. For example, in 2015, the average annual producer price in Vietnam was 2.2, 2.76 and 3.28 times the average annual producer prices in Brazil, the United States, and Poland. This reflects, internationally, that Vietnamese poultry meat production is highly uncompetitive in the current production and cost structure.

Figure 4: Value of poultry meat imported into Vietnam by source country.



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

Figure 5: Producer price of chicken meat in Vietnam and exporting countries.



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

As in the global market, a lack of competitiveness is also 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 in the neighbouring countries, there was an increasing trend in chicken meat producer prices in Vietnam. A steady increase in producer price in Vietnam may suggest the need to enhance the sector’s production and productivity through policies and strategies on production, marketing, and pricing of poultry products.

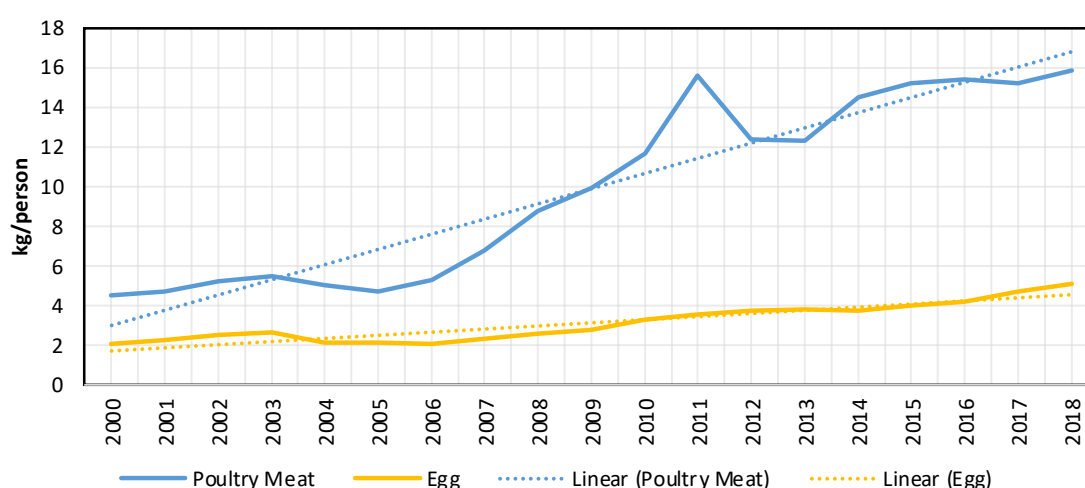
Table 2: Producer price of chicken meat and eggs in Vietnam and neighbouring countries.

Year	Meat producer price (USD/tonne)				Egg producer price (USD/tonne)			
	China	Malaysia	Thailand	Vietnam	China	Malaysia	Thailand	Vietnam
2010	2,484.5	2,204.2	1,687.7	3,735.4				
2011	2,910.2	2,222.2	1,919.0	4,186.4	1,345.2	1,688.5	1,579.4	2,623.5
2012	2,839.9	2,347.2	1,690.2	4,230.6	1,259.9	1,618.8	1,317.8	2,543.3
2013	3,041.0	2,412.0	1,759.5	4,515.7	1,359.1	1,745.5	1,593.4	2,762.9
2014	1,902.7	2,337.4	1,641.4	4,465.9	1,090.8	1,797.2	1,522.2	2,700.3
2015	1,894.1	2,022.8	1,399.4	4,413.4	911.1	1,493.6	1,256.7	2,703.1
2016	2,009.3	2,049.0	1,322.4	4,093.1	985.6	1,325.8	1,337.2	1,473.0
2017	1,681.4	2,011.4	1,373.0	3,852.8	1,105.5	1,240.1	1,248.8	2,908.2
Avg.	2,345.4	2,200.8	1,599.1	4,186.7	1,151.0	1,558.5	1,407.9	2,530.6
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 egg and meat per capita supply in recent years (Figure 6). According to FAO, in 2018, the average supplies of eggs and poultry meat were 15.89 and 5.13 kg/person, respectively. The estimated average meat supply in 2018 was higher than the global (15.55 kg/person), regional (10.08 kg/person) and sub-regional (13.57 kg/person) averages. 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 in 2018 was significantly lower than the global (9.68 kg/person), regional (10.08 kg/person) and sub-regional (7.06 kg/person per year) averages. 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 a lower volume of egg imports. 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.

Figure 6: Trend in annual poultry product supply in Vietnam.



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

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 incomes, population growth and urbanization. However, changes in development processes and their associated economic and social dynamics have also made 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, and 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

Like other countries, chicken breeds in Vietnam can be categorized as indigenous/local, hybrids and exotic breeds. Vietnam is considered the area of 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 types of indigenous or local breeds in the country. According to NIAH (2003), there are more than 18 indigenous breeds in Vietnam, including Ri, Ho, Mia, Dong Tao, Tau Vang, 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, including Ri, Te, Tau Vang, Ac, Oke, H'Mong, Tre, Choi, Phu Luu Te, To, Dan Khao, Mia, Ho and Dong Tao. Despite the variability in the reported number and type of breeds, these sources show the availability of diverse indigenous chicken breeds in the country.

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 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 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 3–4 times higher than other chicken breeds. Historical evidence shows that these chickens were offered to the King as gifts on 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), as of 2003, there were about 24 hybrid and exotic chicken breeds in the country. These include Kabir, Tam Hoang, Luong Phuong, Thai Hoa, 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. These include Tam Hoang, Luong Phuong,

Kabir (Israel) and Sasso and ISA colour breeds. These breeds are used for meat, egg or both meat and egg production under smallholder semi-intensive production systems. Research has 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 have variously been increases, decreases and average utilization levels after their introduction.

In the past few decades, the country has imported high-producing chicken strains for the intensive and industrial production system. Some of these are Arbor Acres, Ross 208, Ross 308, Ross 508, Avian, Lohman, Cobb 707, Hubbard; and egg breeds such as Leghorn, Goldline 54, Miravia, Brown Nick, Hisex Brown, Hyline 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 in traditional/backyard production 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. Although the traditional/backyard production system is primarily based on scavenging feeds, smallholder producers that adopt this system also provide supplementary feeds from local sources. This may include broken rice, rice bran, dry potato, maize, aquatic plants, dry cassava or kitchen waste (FAO 2008; Moula et al. 2011). However, producers provide standardized feeds in the semi-intensive production system, either sourced from local markets or their 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 and bronchitis are the main poultry diseases 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 that may include lethargy, weariness, digestive symptoms (diarrhoea, flatulence and abnormal colour of faeces), lower respiratory tract symptoms (dyspnoea and amplified respiratory sounds), sudden death, swollen crop, paralysed 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 recurring high disease prevalence along the smallholder poultry value chain depends not only on addressing the biological and environmental aspects but also on 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 are associated with the type of production system adopted by farmers (Desvaux et al. 2008). In the traditional/backyard production system, chickens are mainly free-ranging 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 primarily 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 mainly keep young chickens and broilers indoors while layer-breeder chickens are held outdoors, either unconfined or in pens.

4.3 Chicken egg and meat productivity

4.3.1 Productivity performance of local chickens

The primary goals of 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 chickens can be measured using different indicators such as days to sexual maturity, growth rate, egg production, egg hatchability, chick survival rate and culling age. In Vietnam, an indigenous hen typically reaches egg-laying in 4–10 months, and hens and breeding males are kept from three to five years (Moula et al. 2011; Do et al. 2019). Using data from the FAO Domestic Animal Diversity Information System (DAD-IS), a summary of some indigenous chicken breeds' main performance indicators 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 Tau Vang. The live weight of Mia chicken is 800–900 g at 60 days of age, and 3,500–4,000 g and 2,500–3,000 g for cocks and hens, respectively, at 140–150 days. Mia hens lay 55–60 eggs per year (Lung and Long 1994). Dong Tao is another of the local chickens raised in Vietnam, known for its good meat. It reaches 700–800 g at 60 days, while at 140 days, the cocks weigh 3,200–4,000 g and the hens 2,300–3,000 g. Similar to 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, the live weight of males is 2,500 g, and the live weight of females is 1,750 g. At 8–11 weeks, it is 3,692 g for males and 2,235 g for females. The eggs from Ho chickens weigh an average of 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 per year is 5.23 (a minimum of 4 and a maximum of 7) and the average number of eggs per year is 66.8 (a minimum of 28 and maximum of 126).

The Choi breed is used for cockfighting, and farmers tend to keep more cocks for that purpose. In rural areas, cockfights are held during annual festivals. The cocks and hens have similar feather colours: black, grey, white and brownish; five-colour; apricot; or white and grey. The leg colour is typically black, white, ash-grey, yellow or slate; the skin is red; the ears are yellow, black, red, white or deep brown; and the comb is pea or chestnut. The shanks of Choi chickens are very strong. At birth, the body weight averages 32.2 g. At 16 weeks, males average 1,370 g and females 948.16 g. The survival rate is relatively high, at an average of 98.9%. Adult body weight averages 2,836.6 g for males and 2,445.2 g for females. The average age at the first egg for Choi is 211.08 days. Average egg production is 54.04 eggs/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, and the skin, legs, meat and bones are black (Thien et al. 1994).

The Ri chicken is among the most popular native breeds found in northern Vietnam. The growth performance of this breed is documented in multiple studies. Moula et al. (2011) conducted a study showing that day-old chicks weigh 25.71–30.31 g; at 12 weeks, males weigh 919.65–1,174.63 g, and females weigh 745.38–929.96 g. At week 19, males reach 1,705.62–1,971.2 g and females reach 1,140.4–1,431.0 g. The productive and reproductive performance of the H'Mong breed is also well documented in the literature (Cuc et al. 2006; Phuong et al. 2017). The H'mong chicken originated in

Northern Vietnam but is kept in other regions of Vietnam as well. According to Phuong et al. (2017), the breed's average age at first laying is 151.67 days, and at this age, hens achieve a body weight of 1,318.23–1,329.84 g. The average egg productivity is 12–13 eggs/clutch, with an average egg weight of 41.9 g (Cuc et al. 2006), and by 42 weeks of age, the average hen produces 24.12 eggs 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 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 programmes or by introducing more productive yet locally adapted breeds that suit the preferences 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 Luong Phuong weigh 1,850, 1,810 and 1,986 g, respectively. The hens of these breeds produce 144 (TH 882), 158 (Jiangcun) and 171 (Luong Phuong) eggs per year. Similarly, Kabir and Sasso hens produce 187 and 197 eggs per year, respectively. The weight and survival rate of crossbreds obtained from exotic and Vietnamese chickens have also been documented by FAO (2008). According to this study, at 12 weeks of age, Kabir × Jiangcun and Ri × Kabir strains weigh 2,230 and 1,683 g, respectively. At the same age, these breeds have a survival rate of 93.3% (Kabir × Jiangcun) and 93.5% (Ri × Kabir). A cross between the ISA Brown industrial strain and Vietnamese Ri breed (ISARI) 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 2,100–2,500 g at 49–56 days.

4.4 Breed selection and trait preferences

Smallholder producers keep chickens 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 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). Research shows that most smallholder producers prefer indigenous breeds due to their adaptation, resilience, brooding behaviour, low cost of production, scavenging ability, premium output prices, 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 or conservation-related motives. The primary uses, 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; Delabouglise 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 made up of indigenous breeds that are characterized by low egg and meat production and are susceptible to various diseases. Research shows 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 input prices (Akter et al. 2004). HPAI outbreaks seem to be 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 household heads participated in poultry-related courses in the study areas.

5. Poultry product marketing

5.1 Overview of the poultry market

Marketing of poultry products is the main activity in all poultry production systems. Like the medium- and large-scale commercial producers, smallholder producers, also have significant participation in the marketing of poultry products (Tung and Costales 2007). There are distinctions 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 consumption and to generate additional income. Therefore, they sell a limited number of live birds and eggs in 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 product 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).

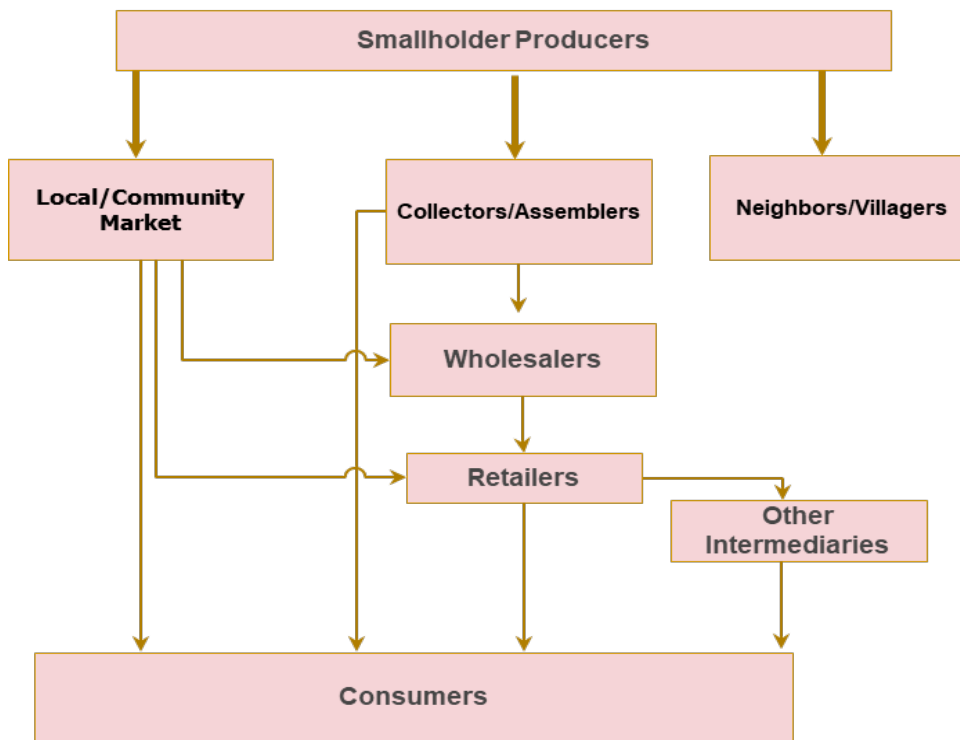
Empirical evidence also shows the association between poultry product marketing and agro-ecology or locations of the producers. Producers in the highland areas have a lower volume of production and market participation than producers in the midland and lowland areas (Tung and Costales 2007). The price 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. Lastly, farmers will sell poultry products to other farmers in their area, either for reproduction or consumption purposes. Sometimes poultry products may pass through multiple traders and actors that have mixed roles.

Figure 7: Smallholder marketing channels.



Source: Adopted from Tung and Costales (2007).

The live bird market can be a retail, wholesale or mixed market where both retailing and wholesaling activities are conducted (Fournie et al. 2012). Based on the volume of birds traded, the market can be further 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. For intermediate live bird markets, Chickens 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 source of chickens in large markets. All of the above markets can be open every day or periodically on certain days of the month.

5.3 Pricing of poultry products

The price of poultry products is associated with different quality attributes such as breed type, 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 fetch a higher price than exotic chicken breed 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 supermarkets. Research shows 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 marketing opportunities. Unlike smallholder producers, medium- and large-scale commercial producers have better bargaining power, and they usually receive a better price than smallholder producers (Tung and Costales 2007). There are also seasonal differences in the prices of poultry products. For instance, the Tet and Chinese New Year (late January or early February) periods are usually associated with higher poultry market prices and up to 100% increases in the volume of sale (Delabouglise et al. 2017). Poultry production and trading activity significantly increase in the festival season 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, the major market constraints include inadequate market infrastructure; limited institutional support; unstable markets and price fluctuations; the dominance of traders and lower bargaining power of smallholder producers; disease transmission; and inadequate standards and grading systems (Hanh et al. 2007; Tung and Costales 2007; Thang et al. 2010b; Sealy et al. 2019). Research has 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, 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 product consumption

6.1 Nutritional status of Southeast 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 children under five 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 2021a). 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 two regions. Child undernutrition can 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. These have multi-factorial causes involving complex interactions with nutrition and severe consequences for maternal and child survival and health, healthy pregnancies, cognitive development and work productivity (Balaram et al. 2011). The prevalence of anaemia in Southeast Asian countries is among the highest in the world (WHO 2015; Sunuwar et al. 2020). For instance, according to WHO (2008a), the prevalence of anaemia in southeast Asia was 65.5% among pre-school-age children, 48.2% among pregnant women and 45.7% among non-pregnant women. The prevalence is higher than the global average and represents the second-highest regional average in the world after Africa.

Nutrition is an important factor for healthy growth and development in children, and dietary guidelines recommend a well-balanced diet including all major food groups for sufficient intake of necessary macro- and micronutrients (Bao et al. 2018). Research shows that a large proportion of children in Southeast Asia do not meet their daily recommended intake of many nutrients such as calcium, iron, vitamin C and vitamin D (Bao Khanh et al. 2016).

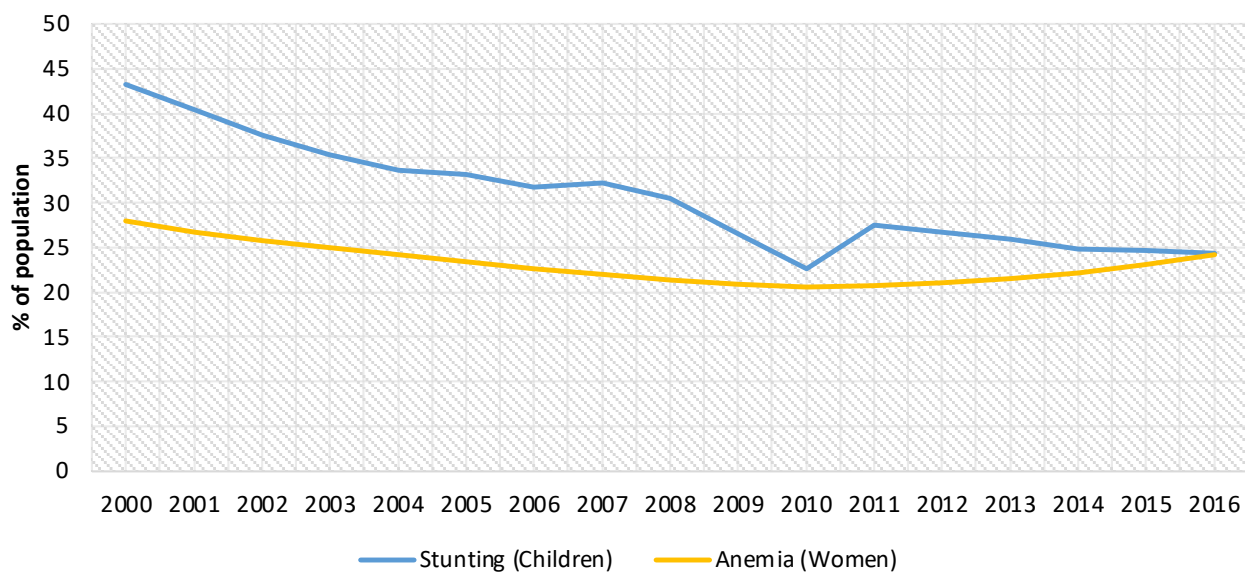
6.2 Nutritional status of children and women in Vietnam

In Vietnam, about 1.9 million children under five 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 in 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 (2020c), 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' heads, and households with different socio-economic statuses. Resource-poor households in rural areas are the most 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 shows higher stunting prevalence in rural areas than urban areas and 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 Central Coastal and Red River Delta regions.

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 µg/litre in 2008, which is below the adequate level established by the World Health Organization. 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 (2021a), there has been little progress in reducing these numbers among children and women in recent years (Figure 8). Moreover, this report shows that anaemia prevalence among women and children is highest in the Northern Midlands and Mountainous region.

Figure 8: Prevalence of stunting among children and anaemia among women in Vietnam.



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

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), which dropped from 27.9% in 2000 to 20.6% in 2010 before rising again to 24.2% in 2016. The prevalence decreased during 2000–2010 and has started increasing since 2011. The average annual reduction was only 0.84%.

6.3 Household dietary diversity and poultry product consumption

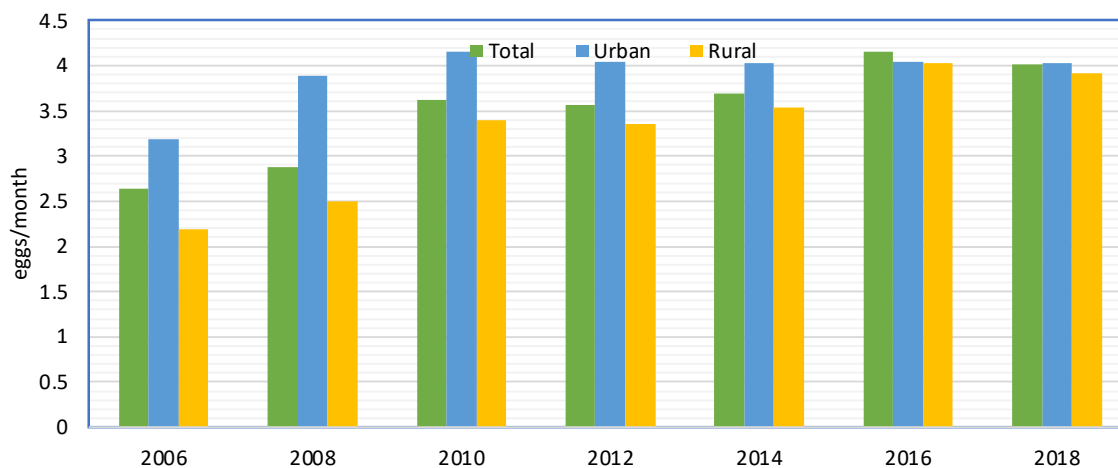
Research shows that Vietnam is in a nutrition transition, and there is a positive change in nutrition outcomes (Harris et al. 2020). The supply of different food groups has increased significantly in the previous decade, and there has been a change in household dietary diversity. Household preference 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 groups consumed, the average maternal and child dietary diversity were 4.6 and 4.4, respectively. According to WHO (2008b), child dietary diversity was above the minimum cutoff point, indicating a good dietary diversity of household consumption status. However, research evidence shows that poor households have not experienced significant increases in food consumption, calorie intake or 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 women'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 improve household food security in the region (Iannotti et al. 2014).

There is an increasing trend in the monthly consumption of poultry products in Vietnam. According to household survey results (GSO 2019), the average number of eggs consumed monthly increased from 2.64 per person in 2006 to 4.01 per person in 2018 (Figure 9). Average egg consumption in urban areas has been higher than consumption in rural areas, but here there is a decreasing trend. Despite the observed increasing trend overall, the average consumption reported looks small. Moreover, when average consumption in 2016 is disaggregated into income quintile groups, households in the poorest quintile consumed 2.9 eggs/person while those in the richest quintile consumed 4.9 eggs/person per month (GSO 2020c). This shows an existing difference in the consumption of poultry products among different population groups.

Poultry meat is the main type of meat consumed by rural and urban households. Like egg consumption, as indicated above, there has been 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. Pork accounts for another 52.68% of this budget, while beef makes up 9.13% and other meat 7.78%. Although the data is not disaggregated by animal type, in 2018, the average household meat consumption was 2.18 kg/person per month (GSO 2019). The average urban and rural consumption in the same year was 2.24 and 2.15 kg/person per month, respectively. This shows the presence of a slight difference between urban and rural areas.

Figure 9: Egg consumption per capita in urban and rural households in Vietnam.



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

The data on poultry meat consumption and the share of poultry in 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 demand for poultry products will increase in the future. Poultry meat will account for the largest proportion (44%) of global meat consumption in the coming decades (OECD and 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 of and access to nutrient-rich foods to enhance household dietary diversity (Harris et al. 2020). This may include consuming poultry meat, which is rich in protein and low in fat and consuming eggs, which are rich in vitamins, minerals, and various key nutrients. Enhancing smallholder poultry production can contribute to 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 promote maternal and child dietary diversity and encourage mothers to feed young children (Nguyen et al. 2013).

To improve children's and women's nutrition in Vietnam, approaches should focus on the continued improvement of infant and young child feeding practices, particularly early breastfeeding initiation, exclusive breastfeeding, timely introduction of complementary food, and appropriate 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 production need a vital nutrition promotion component for effective behaviour change in feeding practices. Environmentally safe poultry production is also essential to maximize the benefits of increased egg and chicken meat production (Omer 2020).

Despite the overall positive progress in household nutritional status, the progress made among poor rural and some ethnic minority households have been inadequate (Thang and Popkin 2004; Mishra and Ray 2009). To remedy this will require scaling out 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 makes a multidimensional contribution. 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 eggs and meat (Epprecht et al. 2007; Moula et al. 2011). Poultry production has a crucial role in poverty reduction, employment creation, inequality reduction and women's 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% 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 their household income, smallholder producers in the traditional/backyard production system generate about 8% of their household income. The lower level of income contribution in the traditional/backyard system could be associated with its lower production and productivity.

Most smallholder producers who keep indigenous breeds generate income to support other livelihood activities (Bett et al. 2014). The income from their 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 breeds of chickens have different social and cultural values in Vietnam. Some breeds are used for religious purposes, gifts, entertainment (cockfighting), medicine, or pets (FAO 2008). For instance, the 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 studies (Mack et al. 2005; Wong et al. 2017). Similarly, the contribution of poultry production to poverty reduction has also been explored by empirical research 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. More 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, in particular, 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 have 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 about the quality and sustainability of agricultural growth and patterns of development due to the low profitability of smallholder farmers, low agricultural worker productivity, low or mixed product quality and low-value addition (World Bank 2016). For instance, smallholder rice producers are being pushed out of rice farming and prevented from engaging in alternative production strategies. As a result, researchers like Gorman (2019) have showed that focusing on monoculture-based production will further erode smallholder producers' livelihood and lead to agrarian crises.

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

In Vietnam, research and development efforts have supported growth in agricultural production (Yen et al. 2017). Research activities have been an integral part of the agricultural policy formulation and implementation process. There have been different reforms in 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 in the country, comprising 33 government agencies and 11 higher education institutes (Stads et al. 2020).

The research agencies have different focus areas, including plant and animal genetics, biotechnology, plant and animal breed selection and distribution, agronomy, forest science, water resource management, veterinary science, aquaculture, agricultural engineering and post-harvest technologies. 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 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 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 livestock sector's productivity, quality, efficiency, and competitiveness.

According to Stads et al. (2020), Vietnam has better research performance than other Southeast Asia countries. The research efforts have given better focus to the livestock sector than in other countries in the region. These researchers have also forecasted that Vietnam will create higher agricultural productivity growth from investing in livestock and fisheries 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 in recent years looks encouraging. Poultry research and development activities have taken the largest share of livestock research (Stads and Hai 2006). But most of the poultry research to date is inclined towards disease prevention and management activities. Attention to genetic improvement, access to services and markets, and other management issues seems inadequate.

In recent decades, the inadequate attention given to productivity improvement research can easily be observed in the steady and lower productivity growth of smallholder poultry production. As indicated above, chicken breeds' egg and meat productivity under the smallholder production system are significantly lower than 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 institution building (OECD 2015; World Bank 2016). Therefore, policy actions should focus on re-orienting agricultural research and extension services, improving farm management skills, improving the institutional design of agricultural research and development and enhancing smallholders' 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 these areas demand integrated interventions that have the active engagement of both public and private actors, widely known as a public-private partnership (PPP). Although it needs further research, the vital role of PPP to transform the agricultural sector has been documented in various studies (Hartwich et al. 2007; Ferroni and Castle 2011; Rankin et al. 2017). In poultry production, 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 feeds (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- and 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. It has multiple contributions to the livelihoods of rural and peri-urban households. It supplies cheap and nutrient-rich foods and generates income to support other livelihood activities. Smallholder poultry production makes an incredibly significant economic contribution to resource-poor households in rural and peri-urban areas. However, this production system retains 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 livelihoods of smallholder producers and suggests the need for pro-poor and inclusive interventions that can 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 the integration of producers with better input and output markets. Approaches to improve genetic potential may include building local capacity in breed selection and management and introducing high-yielding, farmer preferred 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 and sustained supply of locally available feeds, will make significant contributions.

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Appendix A: Performance indicators of Vietnamese domestic breeds

Common name	Weight (kg)		Eggs/year			Egg weight (g)	Birth weight (g)		Maturity age (month)		Age first parturition
	Male	Female	Mean	Min	Max		Male	Male Female	Female		
Ga Ac	1.0	0.8	93	91	95	30	20	20	4.0	3.5	4.0
Ga Choi	5.0	4.0	50			50	32	30	5.5	6.0	7.0
Ga Dong Tao	4.8	3.8	70			52	35	35	5.0	5.5	6.5
Ga Ho	4.5	3.5	55	50	60	51	33	31	7.5	8.0	10.0
Ga Mia	3.0	2.0	80	70	90	55	30	30	4.0	5.0	6.0
Ga Mong	3.5	2.5	85	75	90	45	300	00	4.7	4.7	5.0
Ga Ri	2.7	1.4	120	90	130	45	28	28	4.0	4.0	4.5
Ga Tau Vang	2.5	1.8	120	95	130	45	32	2	4.0	4.0	5.0
Ga To	5.0	3.0	130	120	140	50	320	300	4.0	4.0	5.0
Ga Tre	1.2	0.8	60	40	70	40	16	16	5.0	5.0	6.0
H'mong	2.4	1.8	60	40	75	50	29	29	4.0	4.0	4.5
Oke	2.5	1.5	83	60	90	45	30	30	3.0	4.0	5.0
Te	1.6	1.3	95	80	120	45	25	25	4.0	4.0	4.5
Tien Yen	1.5	2.5									
Vanphu	2.2	1.9				35	25	25	4.0	4.5	5.0

Source: Compiled by the author using data from FAO (2021b).

Appendix B: Main use, adaptability and some specific characteristics of indigenous breeds

Common name	Main uses	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 (nonbackyard)
Ga Tau Vang	Eggs, Meat	Adapted to Vietnam	-	Good meat	Extensive (nonbackyard)
Ga To			-	-	-
Ga Tre	Fancy, Meat	Well adapted to harsh conditions	-	-	Extensive (nonbackyard)
H'mong	Eggs, Meat	Well adapted to high cold mountain	-	Good meat	Extensive (nonbackyard)
Oke	Meat	Well adapted to harsh conditions	-	Good meat	Extensive (nonbackyard)
Te	Meat	Normal, not as good as others	-	-	Extensive (nonbackyard)
Tien Yen	Fancy, Meat	-	-	-	-
Vanphu	Meat	-	-	-	-

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

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