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Poultry breed improvement attempts in Vietnam and future direction: A review of literature

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ABSTRACT

Vietnam's poultry industry has experienced rapid growth in both quantity and quality, with the total poultry herd reaching 559.4 million in 2023. Approximately 60% of the national chicken population comprises indigenous colored-feathered breeds, valued for their resistance to environmental stress and flavorful meat. While these native breeds typically exhibit slower growth rates and lower egg production, they serve as a key genetic resource for breeding programs aimed at improving productivity. Recent initiatives have focused on the selection of Vietnamese local breeds, the development of hybrid breeds combining domestic and imported high-performance strains, enhancing both meat and egg yield. The National Institute of Animal Science (NIAS), in collaboration with the International Livestock Research Institute (ILRI), has initiated the Asian Chicken Genetic Gain (AsCGG) project to develop chicken strains better adapted to Vietnam's tropical climate. This partnership seeks to increase productivity and sustainability by providing smallholder farmers with improved breeds that are resilient to heat and disease. However, challenges remain in scaling these improved breeds and ensuring their sustainable distribution. Future efforts must focus on selective breeding programs for locally adapted chicken ecotypes to reduce dependency on imported genetics. Despite these challenges, growth opportunities exist through public-private partnerships, technological advancements, and international collaboration, which could bolster the resilience and productivity of Vietnam's poultry sector, ensuring food security and sustainable development.

Keywords: *ACGG, NIAS, Poultry breeding, Vietnam*

Introduction

The world's population is experiencing rapid growth, and projections indicate that it will continue to increase by approximately 1% per year over the coming decades (United Nations, 2019). This population surge places significant pressure on global food systems, particularly in terms of providing sufficient and nutritious food for an expanding population. Among the most affected sectors is animal-based food production, which is expected to face increased demand, driven by the growing population and rising incomes, especially in developing countries. The demand for eggs, one of the most affordable and nutritionally rich animal products, is a case in point. According to the Food and Agriculture Organization (FAO), global egg consumption is expected to rise considerably in the next decade. In developing countries, egg consumption is forecast to increase from 6.5 kg per person per year in 2000 to 8.9 kg (approximately 148 eggs) per person per year by 2030 (FAO, 2018). In industrialized nations, the increase will be more modest but still significant, from 13.5 kg (about 225 eggs) per person per year in 2020 to 14.8 kg (about 247 eggs) per person per year by 2030 (OECD-

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FAO, 2020). These figures reflect a growing global trend of increased protein consumption, particularly in countries undergoing economic development where animal products like eggs are becoming more accessible and affordable. Notably, Asia plays a dominant role in global egg consumption. Over 67% of the world's eggs are consumed in Asian countries (FAO, 2018). In China, the world's largest consumer of eggs, per capita consumption is particularly high. It is expected to rise from 15 kg (about 250 eggs) per person per year in 2000 to 20 kg (approximately 333 eggs) per person per year by 2030 (Yang *et al.*, 2020). This increase is partly driven by China's growing middle class, which is fueling higher demand for animal-based proteins like eggs, and by changing dietary patterns in urban areas where eggs are a staple in everyday meals. To meet this rapidly increasing demand, significant advancements in science, technology, and management practices will be necessary in poultry farming. One of the key areas requiring innovation is breeding. The development of more productive, disease-resistant, and environmentally sustainable poultry strains will be essential to meeting the growing demand for eggs without compromising quality or increasing production costs (Pym, 2018). This requires ongoing research in genetic selection, reproductive technologies, and the implementation of best practices in animal husbandry. In addition to breeding, improvements in poultry care, nutrition, and veterinary practices will be crucial. As demand grows, poultry farming will need to adopt more efficient practices to ensure the health and well-being of the birds, thereby optimizing egg production. This includes providing the right feed, managing housing conditions, preventing diseases, and ensuring animal welfare (Haugh, 2021). Veterinary advancements in disease control and prevention, particularly in large-scale commercial poultry production systems, will also play a critical role in maintaining productivity and reducing losses due to disease outbreaks (FAO, 2021). Moreover, innovations in precision agriculture and technology, such as automation, data analytics, and artificial intelligence, can contribute to more efficient management of poultry farms. These technologies can optimize feed use, monitor bird health in real-time, and ensure better management of environmental impacts, all of which are vital for boosting productivity in an increasingly resource-constrained world (Chadwick *et al.*, 2020). Addressing the challenge of meeting the growing demand for eggs and other animal-based foods requires a multi-faceted approach. Advancements in poultry breeding, care, and veterinary science, coupled with technological innovation, will be essential to ensure that global egg production can keep pace with the rising demand while promoting sustainability and animal welfare.

Current situation

Vietnam's poultry industry in recent years has undergone many changes and developed rapidly in both quantity and quality. In terms of quantity, the total poultry herd in the country in 2023 is 559.40 million heads, In the structure of the national chicken herd, about 60% are colored feathered chickens with indigenous genes. The colored feathered chicken breeds that currently dominate the Vietnamese market are mainly derived from native chicken breeds. Although Vietnam's native chicken breeds are poorly laid, the growth rate is slow and long-lasting, but in return, they have good resistance and adaptation to the weather, and delicious meat suits the taste of Vietnamese people. Therefore, to maximize the advantages of indigenous chicken breeds, scientists have used these chicken breeds as an important genetic source in breeding work.

Chicken Breed Improvement Program attempts

Research and selection of imported chicken breeds and new lines created in Vietnam

Recent efforts in the research and development of indigenous chicken breeds in Vietnam have been complemented by the importation of high-yield meat and egg-oriented breeds to meet the growing food demand. These imported breeds and new hybrid lines have been selected for improved productivity, focusing on either high meat volume or egg yield. Phung Duc Tien *et al.* (2009) reported that two lines, HA1 and HA2, were developed by crossing Egyptian and Hyline chickens which led to significant results. The developed lines at 19 weeks, the chickens reached 1,428.67 - 1,480.90 g (females), and egg yield was 229.48 - 234.73 eggs per hen over 72 weeks. Pham Cong Thieu *et al.* (2009) bred three imported chicken breeds (HW, RID, PGI) that showed stabilized performance over four generations. The body weight of HW chickens reaching 1,480 - 1,500 g for roosters and 1,210 - 1,230 g for hens at 19 weeks. Egg production has been improved, HW from 191.71 to 259.44 eggs, RID from 155.79 to 211.18 eggs, and PGI from 140.34 to 207.48 eggs. Three lines of feathered chicken were developed (VP3, VP4, and VP5), the egg yields of these lines up to 38 weeks showed stable improvements over generations: VP3 ranged from 53.39 to 54.36 eggs, VP4 from 55.71 to 54.78 eggs, and VP5 from 55.12 to 56.58 eggs. Nguyen Quy Khiem *et al.* (2017) developed the TN1 and TN2 lines that the crossbreds body weight showed a huge improvement. TN1 roosters' body weight increased from 2,262.38 g to 2,830.67 g over four generations, with stable egg production around 150 eggs at 64 weeks. The TN2 line showed a modest increase in egg yield from 175.10 to 178.05 eggs at 64 weeks. Phung Duc Tien *et al.* (2017) selected three lines of colored chickens (TP4, TP1, and TP2) from generation 4 to generation 8. TP4 chickens were bred for larger body mass, with egg yield stable around 166-167 eggs at 68 weeks. TP1 and TP2, selected for high egg productivity, saw increases in egg yield: TP1 from 181.43 to 182.88 eggs, and TP2 from 177.58 to 179.78 eggs. Le Thi Nga *et al.* (2017) focused on four lines of high-quality meat chickens (RTP1 to RTP4) over four generations. The results showed significant increases in body mass, with RTP4 roosters growing from 952.50 g to 1,149.50 g at 4 weeks. RTP4 also showed a notable increase in egg yield from 150.09 to 167.85 eggs at 40 weeks. Ho Xuan Tung *et al.* (2017) improved two lines of Ri chickens (VP2) over five generations. At 8 weeks, male body weights ranged from 1,215.14 g to 1,295.0 g, and egg yield at 68 weeks increased from 139.83 eggs to 143.23 eggs. Nguyen Quy Khiem (2021) selected two lines of chickens (LV1, LV7 and LV2, LV8) through four generations. The 8-week body weight of roosters in the LV1 line increased from 1,823.26 g to 1,830.80 g, and hens from 1,447.56 g to 1,456.52 g. Egg yield at 68 weeks for LV1 and LV2 lines improved by 4.16 - 5.21 eggs. Egyptian chicken lines (AC1 and AC2) were also improved, with AC1 yielding 205.96 - 206.45 eggs at 72 weeks and AC2 yielding 195.18 - 195.76 eggs at 72 weeks. These breeding programs demonstrate ongoing efforts to enhance the productivity of chickens, focusing both on meat quality and egg yield through careful selection over multiple generations. While the attempts in this regard look promising, the ability to maintain the lines and distributing them to the end users at scale remains a challenge.

Research on the selection of native chicken breeds

Several studies were conducted in Vietnam focusing on the selective breeding of domestic chicken breeds to enhance both body mass and egg productivity, with significant improvements observed over multiple generations. Nguyen Huy Dat *et al.* (2005) selected Ri chickens over 4 generations. The body mass of 9-week-old hens increased from 642 g to 686 g, and roosters from 785 g to 863 g. At 19 weeks, hens weighed 1,241 - 1,256 g, and roosters 1,735 - 1,747 g. Egg yield at 68 weeks increased by 4.5 eggs (3.6%), from 124.5 to 129.01 eggs. Feed consumption remained stable, and the hatchability rate was high (76.69 - 77.86%). Pham Cong Thieu *et al.* (2009) selected H'Mong chickens for 4 generations, improving body mass at 9 weeks from 8836.70 g to 860.50 g for roosters and 676.00 g to 684.50 g for hens. By 20 weeks, roosters increased from 1,710.40 g to 1,785.90 g and hens from 1,227.5 g to 1,276.9 g. Egg yield at 72 weeks increased from 104.40 to 114.32 eggs. Ngo Thi Kim Cuc *et al.* (2014) worked on Ri Hoa Mo chickens over 3 generations, achieving an 8.5% increase in the percentage of plumage feathers. Body mass at 8 weeks increased from 668.04 g to 690.44 g for roosters, and from 627.15 g to 663.35 g for hens. Egg yield at 68 weeks increased from 126.21 to 129.28 eggs. Le Thi Thu Hien *et al.* (2016) selected Northern and Southern Bamboo chickens. For Northern Bamboo chickens, roosters' weight at 8 weeks increased from 395.18 g to 420.87 g, and hens from 302.82 g to 325.58 g. Southern Bamboo chickens saw similar improvements, with roosters growing from 437.3 g to 452.1 g and hens from 365.7 g to 376.2 g. Egg yield remained stable across generations, with high hatchability rates (89 - 90%). Le Thi Thu Hien *et al.* (2015b) selected fighting chickens over 4 generations. By 8 weeks, roosters increased from 661.67 g to 696.00 g, and hens from 1,611.28 g to 1,678.54 g by 20 weeks. Egg yield remained steady at 26.83 - 27.14 eggs at 68 weeks. Hatchability was high (89.40% - 90.47%). Ngo Thi Kim Cuc *et al.* (2016, 2016a) worked on Mia chickens over 4 generations. Roosters' body mass increased from 637.90 g to 674.06 g at 8 weeks, and hens from 556.19 g to 591.08 g. Egg yield remained stable at 72 - 72.85% hatchability, with commercial Mia chickens weighing 1,357.33 g - 1,391.67 g at 15 weeks. Vu Dinh Ton (2015) selected Ho chickens for 3 generations, increasing egg yield from 43.58 to 52.40 eggs per hen per year. Vu Ngoc Son *et al.* (2015) selected Lac Thuy chickens for 2 generations. At 20 weeks, roosters weighed 1,852.15 g - 1,890.10 g and hens 1,580.15 g - 1,600.00 g. Egg yield at 68 weeks increased from 97.96 to 89.48 eggs. Vu Cong Quy (2017) selected Lien Minh chickens over 4 generations, improving body mass from 726.89g to 805.09 g (roosters) and from 608.92 g to 674.37 g (hens) at 8 weeks. Egg yield at 68 weeks remained stable at 90.59 - 90.84 eggs. Nguyen Thi Muoi (2021) worked on Lac Thuy and Kien chickens over 4 generations. At 20 weeks, Lac Thuy roosters reached 1,942.45 g - 1,999.75 g and hens 1,495.0 g - 1,545.60 g, while Kien roosters reached 1,556.83 g - 1,631.67 g and hens 1,298.50 g - 1,383.45 g. Egg yield for Lac Thuy chickens increased from 94.56 to 104 eggs, and Kien chickens from 63.89 to 68.71 eggs per hen per year. Ngo Thi Kim Cuc (2021) selected Nhieu ngon (Multi-fingered) and Lac Son chickens over 4 generations. At 8 weeks, Nhieu ngon roosters increased from 473.50 g to 574.03 g and hens from 426.37 g to 483.71 g, while Lac Son roosters increased from 658.79 g to 694.67 g and hens from 544.19 g to 583.57 g. By 20 weeks, Nhieu ngon roosters reached 1,501.25 g - 1,628.63 g and hens 1,126.40 g - 1,216.68 g, while Lac Son roosters reached 1,607.88 g - 1,703.38 g and hens 1,358.40 g - 1,420.78 g. Nguyen Quy Khiem (2021) worked on Mia and Ri chickens over 5 generations. Mia rooster body mass at 8 weeks increased from 875.84 g to 920.25 g, and hen mass from 681.22 g to 725.45 g. Mia egg yield increased from 56.18 eggs to 60.38 eggs per hen at 38 weeks. For Ri chickens, rooster body mass increased from 845.55 g to 1,000.60 g, and hens from 653.37 g to 795.78 g. Egg yield remained stable at 51.34 - 52.95 eggs for Ri hens. These studies highlight the potential for improving the productivity and body mass of indigenous chicken breeds through selective breeding. Although native breeds often have slower growth rates and lower egg production compared to commercial breeds, they offer excellent resistance to harsh environmental conditions and are highly valued for their flavorful meat. These breeds are key to sustainable production and contribute to food security, especially as consumer demand for quality and safe food products grows.

Recently, studies on selection through 4 generations of Dong Tao chicken, which is known for their large stature, distinctive features, and unique ankle rings showed that body weight at 8 old weeks of the male line is increased by 16,5% (1.189,00 g at generation 1 and 1.379,86 g at generation 4) for male and 32,32% (790,95 g at generation 1 and 1.046,62 g at generation 4) for female. The egg performance is sustainable from 67,06 - 67,80 eggs/year. For the Dong Tao female line, The egg performance increased from 67,11 eggs/year at generation 1 to 71,95 eggs/year at generation 4 but the body weight at 8 old weeks is sustainable from 989,13 at generation 1 to 1179,93 at generation 4 from male and from 799,59 g at generation 1 to 836,6 at generation 4 for female (Ngo Thi Kim Cuc *et al.*, 2022).

Selection through 4 generations of Mong chicken indicates that body weight at 8 old weeks of the male line is increased by 16,05% (806,56 g at generation 1 and 939,71 g at generation 4) for male and 15,28% (654,75 g at generation 1 and 754,80 g at generation 4) for female. The egg performance is sustainable from 86,01 - 86,48 eggs/year. For the Mong female line, The egg performance is increased from 86,14 eggs/year at generation 1 to 92,24 eggs/year at generation 4 but the body weight at 8 old weeks is sustainable from 746,07 at generation 1 to 767,73 at generation 4 for male and from 649,85 at generation 1 to 658,90 at generation 4 for male (Ngo Thi Kim Cuc, 2022).

Development of hybrid chicken out of meat and egg lines

Research on hybrid combinations between domestic and native chicken breeds has achieved significant success, with several studies focusing on improving both meat and egg production. Phung Duc Tien *et al.* (2011) compared two hybrid lines: Dominant Sussex D-304 (TM1) and Dominant Blie D-107 (TM2). Results showed that both lines exhibited high feed conversion efficiency and good body weights at 18 weeks of age. TM1 chickens had a hen weight of 1433.33 g and a rooster weight of 1937.00 g, with an egg yield of 137.73 eggs per hen over 52 weeks. TM2 chickens had a similar body mass, with hens weighing 1456.33 g and roosters 1956.33 g, and a slightly higher egg yield of 142.88 eggs per hen. Both lines had high fertility and hatching rates, between 81.74% and 93.25%. Nguyen Duc Trong *et al.* (2013) tested Dominant egg-oriented chickens, observing rearing rates of 91.8% for broodstock chickens and 93.5% for commercial chickens by 18 weeks. Egg yields were similar, with both groups producing approximately 235 eggs per hen over 48 weeks. The feed conversion ratio was around 2.2 kg of feed per 10 eggs. Additionally, the egg mass ranged from 58.64 to 71.57 g, with a yolk ratio of 28.27 - 29.41%. Nguyen Quy Khiem (2021) investigated 8 hybrid combinations for both meat and egg production. For example, Hybrid Combination 1 (♂TN1 × ♀R2TN3) reached 3151.61 g in males and 2122.33 g in females by 20 weeks, with an egg yield of 170.26 eggs per hen and a high fertility rate of 96.14%. Other hybrid combinations also showed strong growth, feed conversion efficiency, and egg productivity, with some achieving up to 275.80 eggs per hen over 72 weeks. Genetic studies using microsatellite techniques have further contributed to understanding the genetic structure and diversity of native Vietnamese chicken populations. Cuc *et al.* (2006) assessed H'mong chickens, finding no inbreeding within the populations, which were in Hardy-Weinberg equilibrium. The genetic distance between the chicken groups correlated with their geographical locations. In a similar study, Berthouly *et al.* (2009) found significant genetic differentiation between Ha Giang chickens and wild Asian chickens, suggesting a flow of genes from wild chickens into the local populations. Le Thi Thuy *et al.* (2009) studied genetic diversity among five indigenous chicken breeds (Bamboo, Ac, H'mong, Fighting, and Ho chickens), identifying three distinct genetic groups. Meanwhile, Ngo Thi Kim Cuc, 2018) used 29 microsatellites to study nine native chicken breeds and found that Vietnamese breeds were genetically distinct from Chinese breeds, with genetic differences corresponding to their geographical regions. Further studies by Nguyen Van Ba (2013) and Nguyen Khac Khanh (2015) highlighted the genetic variability and low inbreeding risks in breeds such as the multi-fingered chicken, which showed higher genetic diversity compared to breeds like Dong Tao, Sugarcane, and Yellow Chinese chickens. Studies on Lac Son chickens (Ngo Thi Kim Cuc and Nguyen Van Ba, 2019) revealed moderate genetic diversity and low inbreeding, with Lac Son chickens being genetically distinct from other breeds in the region. Finally, Nguyen Thi Muoi (2021) found that Lac Thuy chickens had relatively high genetic diversity and a distinct genetic structure compared to other Vietnamese breeds. These studies emphasize the importance of maintaining genetic diversity and the potential for improving native chicken breeds through careful breeding and hybridization.

Recent collaboration with international partners

Since mid-2021, the National Institute of Animal Sciences (NIAS) of Vietnam has partnered with the International Livestock Research Institute (ILRI) to conduct research on tropically adapted and high-performance chicken strains under both on-station and on-farm conditions in Vietnam. This collaboration is part of a larger initiative known as the Asian Chicken Genetic Gain (AsCGG) project, which is funded by the Australian Centre for International Agricultural Research (ACIAR) and is still ongoing. The project's overarching goal is to provide smallholder poultry producers in Vietnam with improved chicken breeds that are better adapted to the tropical climate, thereby increasing their productivity and sustainability. By doing so, the project also creates an opportunity for private sector companies to participate in the dissemination of these more productive chicken strains on a larger scale. The Asian Chicken Genetic Gain (AsCGG) project focuses on sourcing and testing genetically improved poultry breeds that can thrive under the specific environmental conditions of Vietnam. This includes testing for resilience against tropical diseases, tolerance to heat stress, and the ability to produce high-quality eggs and meat in smallholder farming systems. The project is aimed at filling a critical gap in Vietnam's poultry sector by offering alternative chicken breeds that are better suited to local conditions, in contrast to traditional breeds or imported strains that may not perform well in the tropical environment (Robinson *et al.*, 2020). The study's findings have shown that such an initiative can be both successful and promising. One of the key takeaways from the project is the importance of fostering Public-Private Partnerships (PPP) to facilitate the wide-scale dissemination of these improved poultry breeds. The involvement of private poultry companies, especially those engaged in breeding and distribution, is essential to the sustainability and scaling of the initiative. These companies can help extend the reach of high-performing chicken strains to smallholder farmers across the country, offering them a reliable source of genetically improved poultry that can enhance productivity and livelihoods (Nguyen *et al.*, 2022). However, despite these successes, the project also highlighted some ongoing challenges. One of the key issues identified was the need for a selective breeding program that focuses on locally adapted chicken ecotypes. While introducing improved chicken breeds from international sources is a positive step, it is critical for Vietnam to establish its own sustainable breeding programs. This would help avoid long-term dependency on imported breeds and ensure that future poultry production in Vietnam remains independent and resilient. Selective breeding of locally adapted poultry ecotypes would also ensure that the resulting chicken strains are not only productive but also better suited to local environmental, social, and economic conditions (Tran *et al.*, 2021; Liao *et al.*, 2019).

The setting up of a national poultry breeding program that Integrates selective breeding techniques, local ecotype management, and private sector involvement could provide a model for sustainable poultry development in Vietnam and other tropical regions. This approach could help secure food sovereignty, reduce costs associated with importing poultry genetics, and improve the overall resilience of smallholder poultry production systems (FAO, 2020). In conclusion, while the AsCCG project has demonstrated that introducing improved chicken breeds through collaborative efforts can be successful, it also underscores the need for a long-term strategy involving local breeding programs. By establishing a sustainable, self-sufficient poultry industry based on selective breeding of locally adapted chickens, Vietnam can mitigate its reliance on external genetic resources, ensuring a more resilient and productive poultry sector for the future.

Challenges and opportunities of chicken breed development in Vietnam

The studies conducted in Vietnam aimed at improving poultry production have yielded impressive results, but the crucial question remains: How are these programs performing in real-world settings, and to what extent have the benefits been translated into tangible genetic improvements in poultry breeds? To answer this question, a thorough impact study must be carried out at the grassroots level, directly assessing the outcomes of these interventions in terms of genetic progress and practical benefits for farmers (Bui *et al.*, 2018). Such studies are vital in understanding how genetic advancements are benefiting the productivity, resilience, and disease resistance of poultry in local farms. The development of poultry breeds in Vietnam presents a unique set of both challenges and opportunities. On one hand, the country's poultry sector faces several hurdles, such as ensuring the genetic improvement of local breeds, managing disease resistance, and improving overall productivity while maintaining sustainable practices. On the other hand, these challenges also present exciting opportunities for innovation, particularly through collaborative efforts between researchers, policymakers, and farmers. By leveraging technological advancements, modern breeding techniques, and external expertise, Vietnam could significantly enhance the sustainability and productivity of its poultry industry (Nguyen *et al.*, 2020; Lee *et al.*, 2019). To address these challenges effectively, there may be a need to strengthen the existing infrastructure and capacity in the poultry breeding sector. Specifically, Vietnam's ability to respond to the growing demand for improved, locally adapted chicken strains might require enhanced training, resources, and support for both public and private breeding programs (FAO, 2017). The country's existing expertise in modernizing its breeding programs should be further developed, with an emphasis on building a more robust research framework that can adapt to evolving needs in poultry genetics (Nguyen *et al.*, 2021). Collaboration with other countries that have faced similar challenges can also be invaluable. Learning from the experiences of countries with more advanced poultry breeding programs could provide valuable insights into best practices and innovative solutions. This could help streamline the development of improved poultry breeds that are better suited to local conditions in Vietnam, including factors such as climate, disease resistance, and consumer preferences (Gueye, 2009; Khan *et al.*, 2020). International partnerships, particularly with countries in Southeast Asia, could help Vietnam overcome technical challenges while benefiting from shared knowledge and resources. Ultimately, the success of these poultry development programs will depend on the ability to address the technical, logistical, and socio-economic challenges through coordinated efforts. By fostering a supportive environment for local farmers and integrating cutting-edge technology, Vietnam has the potential to build a more resilient and efficient poultry sector, ensuring both increased productivity and long-term sustainability (FAO, 2020).

Conclusion

Looking ahead, a key priority for Vietnam's poultry sector will be to focus on the selective breeding of locally adapted chicken ecotypes. This approach would help reduce the country's reliance on imported genetics and promote the development of a more sustainable and self-sufficient poultry industry. To fully realize this potential, it is essential to strengthen the capacity of local breeding programs, improve infrastructure, and foster public-private partnerships to ensure that innovations are translated into practical solutions on the ground. While challenges persist, Vietnam has substantial opportunities to enhance the resilience and productivity of its poultry sector through strategic investments in breeding, research, and international collaboration. By leveraging modern breeding technologies and fostering greater collaboration between the public and private sectors, Vietnam can build a more sustainable and prosperous poultry industry, which will not only meet the country's growing demand for poultry products but also contribute to broader goals of food security and agricultural development.

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