



# ONE HEALTH CASES

June 2024

## One Health Initiative of Centre for Applied One Health Research and Policy Advice (OHRP): Implementation on Enhancing Poultry Health and Production, Food Safety and Quality of Chicken Meat in Hong Kong SAR

The case study presents an interdisciplinary research program that has had a positive impact on poultry health and production in Hong Kong SAR. The program aims particularly to establish the first “Hong Kong Chicken Quality” brand and implement a sustainable culture of prudent use of antimicrobials.

Authors: Chen Xin<sup>1,2</sup>, Tu Tu Zaw Win<sup>1,3</sup>, Omid Nekouei<sup>1,2</sup>, Surya Paudel<sup>1,2</sup>, Denis Yau<sup>1</sup>, Lam Chun Ting<sup>1</sup>, Dirk U. Pfeiffer<sup>1,2</sup>, and Anne Conan<sup>1,3,4</sup>

Affiliations: <sup>1</sup>Centre for Applied One Health Research and Policy Advice (OHRP), City University of Hong Kong, Hong Kong, SAR, China

<sup>2</sup>Department of Infectious Diseases and Public Health, Jockey Club College of Veterinary Medicine and Life Sciences, City University of Hong Kong, Hong Kong, SAR, China

<sup>3</sup>Animals, Health, Territories, Risks and Ecosystems (ASTRE), University of Montpellier, CIRAD, INRAE, Montpellier, France

<sup>4</sup>French Agricultural Research Centre for International Development (CIRAD), UMR ASTRE, Harare, Zimbabwe

© 2024 Centre for Applied One Health Research and Policy Advice (OHRP), City University of Hong Kong, All Rights Reserved. Open Access. This article is licensed under a Creative Commons Attribution 4.0 International License.

## Table of Contents

Abstract .....	2
What is the Incremental Value That Makes This a One Health Case?.....	3
Learning Outcomes.....	3
Background and Context .....	3
Interdisciplinary Process .....	4
Program Impact .....	7
Program Outlook.....	8
Conclusions .....	8
Group Discussion Questions .....	8
Further Readings.....	9
References .....	9

## Abstract

In 2019, the Centre for One Health Applied Research and Policy Advice (OHRP) launched an interdisciplinary research program so far consisting of two independently funded projects that aimed to improve poultry health and production in Hong Kong SAR. The program focuses on applied field research and advanced health management practices through two independent projects fully funded by the Sustainable Agricultural Development Fund of the Hong Kong Agriculture, Fisheries and Conservation Department: The Poultry Health Assurance Project (PHAP) and the Poultry Health and Production Management Project (PHPM). Specifically, this work established collaborations between academic partners, the Hong Kong Agriculture, Fisheries and Conservation Department (AFCD), the Chicken Breeders Association, and the Veterinary Diagnostic Laboratory of City University of Hong Kong (CityU VDL), with the overarching objective of providing veterinary services to 29 chicken farms in Hong Kong SAR.

In this OHRP-launched program, there are two projects (Project I and Project II): the first one, named Poultry Health Assurance Project (PHAP), was conducted from 2019 to 2022, and the second one, named Poultry Health and Production Management Project from 2022 to 2024. Numerous innovative and sustainable studies and activities, such as implementing intelligent farming practices, have already been conducted. For instance, a mobile application called “Broiler Record APP” has been developed to facilitate data collection data and monitor farm production. Environmental data sensors have been installed in poultry farms to efficiently track and maintain stable temperature and humidity. Moreover, OHRP has introduced free-to-use newsletters and continuing education seminars called the Poultry News-Technology Promotion

Information Plan, which aims to introduce farmers to the latest technology, address the need for ongoing education for farm staff, and offer training courses for individuals interested in pursuing a career in the poultry industry. In addition, value chain mapping activities are also conducted to assess the impact of COVID-19 on the poultry value chain in collaboration between researchers from OHRP, City University of Hong Kong (CityU), and the Royal Veterinary College (RVC), United Kingdom. With the ambition of establishing a “Hong Kong Chicken Quality” brand through the prudent use of antibiotics, both projects also encompass veterinary clinical activities conducted by HK-registered veterinarians, such as veterinarian prescriptions and veterinary care.

## What is the Incremental Value That Makes This a One Health Case?

This case study utilizes an interdisciplinary approach that involves both the academic and non-academic sectors in the fields of animal health, human health (food safety, AMR), and environmental health (pollution) in Hong Kong SAR. HK-registered veterinarians and researchers from OHRP and the City University of HK, government decision makers from AFCD, laboratory technicians, poultry farmers, and poultry experts from the Chicken Breeders Association collaborated closely through either research projects, workshops, training, and policy advice.

## Learning Outcomes

- Understand the importance of articulating an interdisciplinary approach, involving various stakeholders, such as government, academia, and farmers, and its role in improving practices related to poultry farm management, disease control, and food safety in Hong Kong SAR.
- Describe how interdisciplinary research can help with identifying the risk of occupational hazards, providing more continuous farm education, and reducing environmental pollution.
- Understand how the farm-to-fork strategies can integrate the promotion of poultry farming good practices, such as the prudent use of antibiotics and biosecurity, and the promotion of public awareness to develop cost-effective and low-risk farming practices.

## Background and Context

For the past two decades, global poultry production has doubled in size due to factors such as population growth and urbanization (Thornton, 2010). In contrast, the poultry industry in Hong Kong SAR has had a significant decline since the H5N1 avian influenza outbreak in 1997 (Ching, 2018). The poultry industry in Hong Kong SAR also faces challenges in livestock production development due to the limited availability of land. Currently, there is a total of 7 square kilometers of actively farmed land for both plantation and livestock production in Hong Kong SAR (Agriculture, Fisheries and Conservation Department (AFCD), 2022b).

Until 2015, live poultry in the Hong Kong SAR were supplied by local and registered farms from Mainland China. Since 2016, however, no live chickens have been imported from Mainland China, and the market demand relies instead on local farm supplies (Ko and Cheung, 2017). By the end of December 2022, there were a total of 29 licensed poultry farms. These local poultry farms are distributed across the New Territories, with a notable concentration in Yuen Long (Fig. 1) (Chan and Hon, 2020). Presently, there are a total of 28 operating chicken farms in Hong Kong SAR that cater to 100% of the local live chicken market demand, with one farm being inactive (Yau *et al.*, 2022). These 28 operating farms provide an approximate daily average of 10,000–12,000 chickens. Local poultry farms solely produce yellow chickens (Fig. 2) (Wu *et al.*, 2017).

Poultry is a widely consumed type of meat in Hong Kong SAR. According to AFCD, the daily consumption of fresh poultry meat in Hong Kong SAR in 2016 amounted to 22 metric tons, which consisted of 2.3% of the total poultry consumption in Hong Kong at the time (Ma, 2022). Live poultry retail outlets (e.g., wet markets) are an essential part of the supply chain of live poultry in Hong Kong SAR.

Hong Kong's poultry industry is vulnerable to the seasonal period of heightened risk for avian influenza (AI), which occurs during the winter and spring months (Agriculture, Fisheries and Conservation Department (AFCD), 2022a). The first recorded outbreak of human infection with highly pathogenic avian influenza (HPAI) H5N1 occurred in Hong Kong SAR in 1997, resulting in 18 individuals contracting the disease, six of whom died due to the disease (Health, Welfare and Food Bureau (FHB), 2004). Up to now, a recent human

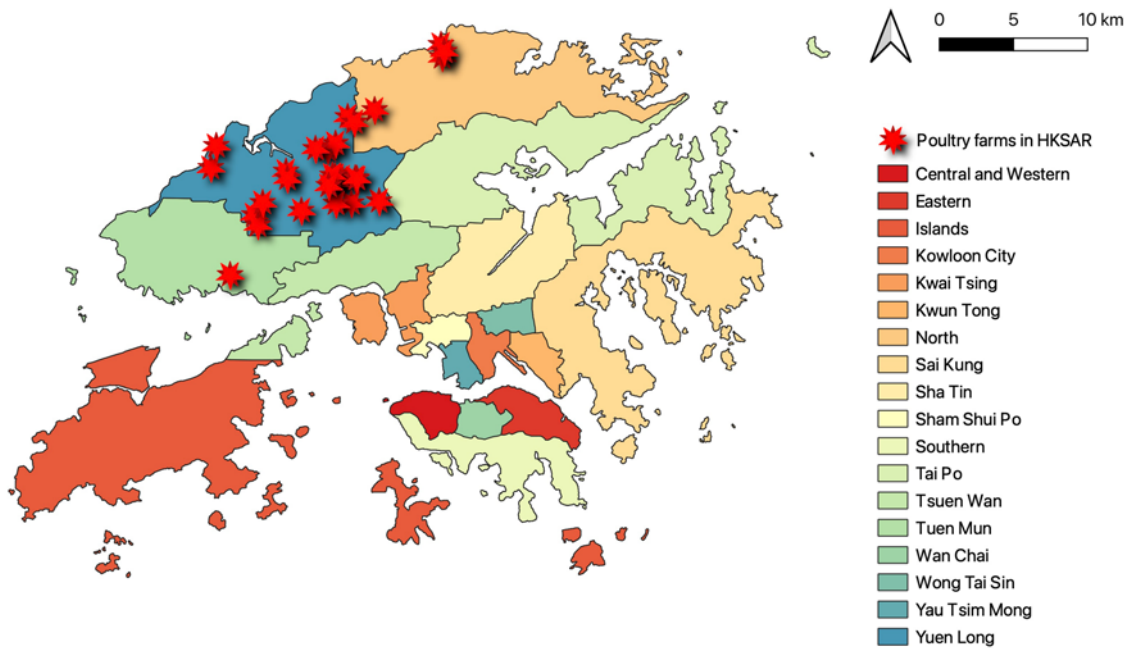


Fig. 1. Map of poultry farms in Hong Kong SAR.

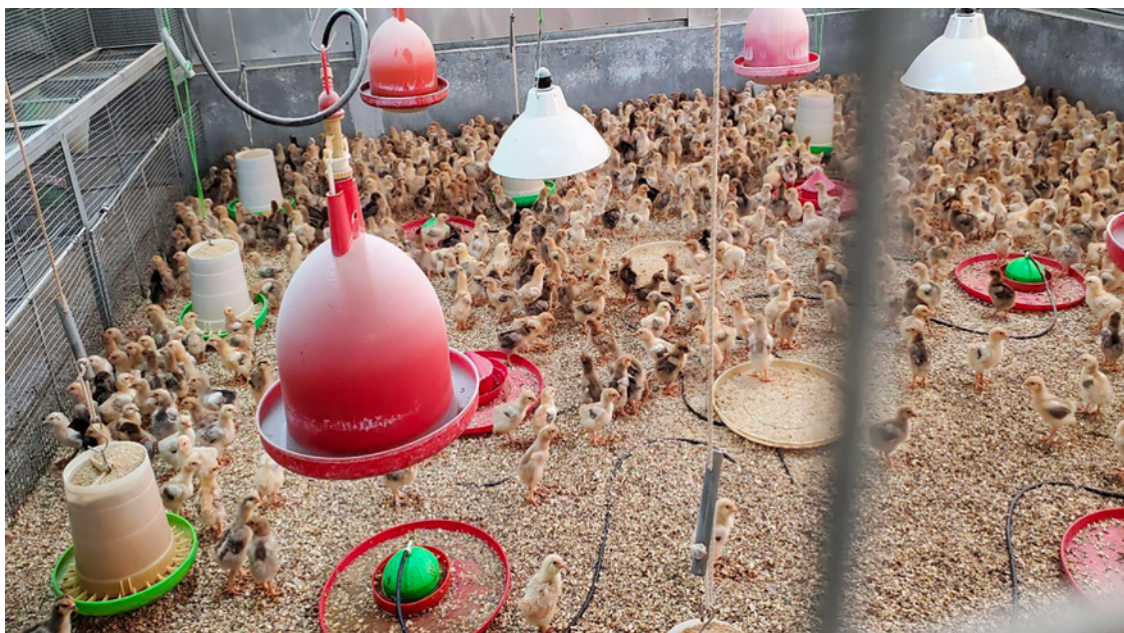


Fig. 2. Starter broiler farm in Hong Kong SAR.

case of avian influenza A (H5N6) was also confirmed in neighboring Guangdong Province on February 28, 2023 (Centre for Health Protection (CHP), 2023).

Therefore, given all the potential health risks associated with live chicken production in Hong Kong, it is crucial to take a One Health approach to prevent diseases and decrease AMR. The aim of this collaborative work is to support all the stakeholders along the live poultry value chain in order to provide sufficient, safe, high-quality, and nutritious chicken meat for Hong Kong residents.

## Interdisciplinary Process

Since 2019, the OHRP has been collaborating with the AFCD, CityU VDL, and the Chicken Breeder Association on this interdisciplinary program. With the aim of providing veterinary services to local chicken

farms in Hong Kong SAR and improving chicken meat quality and food safety, this program encompasses numerous different activities (Table 1). The first project, the Poultry Health Assurance Project (PHAP), established the foundation for activities, focusing on gathering health and production data to provide recommendations for enhancing poultry production, product safety, and quality. This was followed by a second Poultry Health and Production Management Project that was built based on the results of the first project and represents more specific activities dedicated to developing and testing innovative tools for the 29 poultry farms involved. In more detail, the day-to-day activities of the OHRP ambulatory veterinary team include conducting on-farm visits, providing clinical services, assessing biosecurity measures, and collecting samples from water, broilers, and breeders for pathogen and AMR surveillance purposes. All collected samples are tested by CityU VDL and then stored in biobanks. They are subsequently entered into a project database, which is accessible to CityU researchers upon request. Research findings are communicated to both the AFCD and farmers, facilitating discussions on potential actions beneficial to the entire poultry industry and the public health of Hong Kong.

**Table 1.** Detailed arrangement of two projects.

Activity	Project I	Project II
Value chain mapping	Conduct interviews of different poultry stakeholders in Hong Kong. Draft the map of live chicken value chain to identify main stakeholders.	Conduct interviews of the stakeholders identified in project I and identify changes in the value chain. Assess the impact of COVID-19 on the chicken value chain by interviewing poultry stakeholders.
Animal Husbandry Management		Produce environmental data sensors and monitor various environmental parameters like temperature and humidity. Develop and test a production follow-up phone application: Broiler Record APP (MBApp).
Farmer Education	Create newsletter for the poultry professionals with inputs from the OHRP and the Department of Public Health and Infectious Diseases CityU. Organize seminar with AFCD and farmers.	Establish a continuing education scheme for existing poultry workers. Provide a workshop for the local newcomers who wish to work in the poultry industry.

The OHRP ambulatory veterinary team, in their farm visits, maintains close communication and dedicated efforts to understand farmers' insights, real-time status updates, concerns, and challenges. This engagement is crucial for the poultry team to identify the farmers' needs and challenges, leading to more effective solutions. For instance, the team noticed that physical broiler management forms for farmers in a previous project had low engagement rates for various reasons, such as a lack of staffing to input data manually or a willingness to share actual farm data anonymously. Therefore, a functional Broiler Record APP (MBApp) has been proposed to offer convenience and highlight the significance of making regular data updates, which targets to record significant poultry farm basic data (vaccination, pest control, and feed formulation) and batch information (daily depletion, broiler growth, and medication history). Through this app, the OHRP team creates a farm profile account for each target farm using the currently available data. Farmers can then log into their accounts to edit their farm background information for profile updates or routinely update data, such as daily depletion rate, medication records, and other information. As an effective communication tool, online consultations are also available at any time and anywhere to provide timely services or feedback for farmers, which help to overcome physical barriers and late responses in communication between local farmers and the OHRP poultry teams. However, the poultry team noticed that data updates were inconsistent and often incomplete during the tested period. To address this, a new design feature is being added that will send push notifications to remind farmers to enter data regularly. As a result, more real-time analytics and statistical summaries will be available through MBApp, including body weight curves, daily depletion curves, mortality curves, certain disease records, and others. These insights can be used to monitor the performance of each batch, compare it with benchmarks, and implement advanced treatments for farmers to ensure healthy growth.

Farmers now have access to innovative technologies to improve their farming practices, which were been introduced by veterinary teams during farm visits. They can keep the chicken coop at a stable and suitable temperature and humidity for broiler growth through the fogger-circulation fan, which is equipped with real-time data loggers and a control panel for auto-adjustment. The data logger automatically measures the temperature-humidity index (THI) inside the chicken house every 15 min. If the THI goes beyond the comfortable range for chickens, the ventilation fans and foggers are turned on to reduce the temperature

and support the chickens' heat dissipation. However, during our test period, it became evident that some poultry workers relied on routine rather than the system's data-driven recommendations. For instance, the circulation fan was left on continuously throughout the summer, regardless of the actual temperature, and the fogger operated for a fixed 12 h daily without considering real-time humidity levels.

Moreover, OHRP has created and distributed technical, promotional newsletters (Fig. 3) for poultry farmers to spread basic information on common infectious diseases in poultry and strategies for the prevention

OHRP推2020-I

CityU 健康一元化及政策應用研究中心  
香港城市大學  
City University of Hong Kong

## 抗藥性細菌是如何形成

● 無抗藥性細菌 ● 具抗藥性細菌

用藥不當

具抗藥性細菌會在藥物治療後仍然存活，大量繁殖後會造成難以治療的感染

### 預防形成抗菌素耐藥性(AMR) 四大法則

- 防範於未然，落實生物安全各項措施
- 做好農場管理及紀錄減少動物生病的機會
- 要得到正確診斷以判斷用藥，避免用藥不當
- 依照正確劑量和停藥期用藥

**Fig. 3.** Poultry newsletter in antimicrobial resistance (AMR): Treatment solutions accompanied by antimicrobial overuse and misuse in poultry contribute to the growing concern about antimicrobial resistance (AMR). Some suggestions can be used to decrease the need for antimicrobial usage and minimize the overuse of antimicrobials: biosecurity, better farm management practices, and evidence-based and up-to-date guidance on antimicrobial prescribing.

and control of poultry diseases. A continuing education scheme was introduced for existing poultry workers interested in pursuing a career in the industry, such as training on the use of poultry vaccines, biosecurity, antimicrobial use, and so on (Fig. 4). Additionally, workshops were established for newcomers who wish to work in poultry farming.



**Fig. 4.** Biosecurity workshop for local poultry farmers on December 11, 2019 (Centre for Applied One Health Research and Policy Advice (OHRP), 2019).

## Program Impact

To facilitate communication between OHRP, the ambulatory veterinary team, and farmers, the collected data was utilized to create a farmer's newsletter, known as "Poultry News-Technology Promotion Information," which was distributed offline to the farms on a monthly basis. This newsletter offered informative content and guidance for farming practices, providing continuous education to farmers and farm staff. Meanwhile, several peer-reviewed research publications have emerged from the program, including "Quality Assessment of Day-Old Chickens on the Broiler Farms of Hong Kong" by Nekouei *et al.* (2022), which evaluated the quality of newly hatched broiler chicks. Another publication, "Serological Survey of Avian Metapneumovirus in Vaccinated and Unvaccinated Broiler Chickens in Hong Kong" by Conan *et al.* (2023) examined the status of avian metapneumovirus (aMPV) in poultry farms in Hong Kong SAR. Moreover, the research conducted by Yau *et al.* (2022) on bacterial contamination of nipple-watering systems in vacant broiler houses led to a presentation at the 26th World's Poultry Congress in 2022. This study assessed the bacterial burden within these watering systems both during the presence of birds and following cage washing prior to the introduction of a new flock. The result of this study prompted the recommendation for farmers in Hong Kong SAR to adopt various husbandry practices, such as overnight acid soaking, disinfection with omnicide, and switching from well water to tap water to mitigate contamination of the nipple-watering systems.

As part of Project II of the OHRP-launched program, a customized poultry health and production management service called the Broiler Record APP (MBApp) is being developed for poultry farms in Hong Kong SAR. This APP aims to encourage local poultry farmers to utilize effective data management systems through electronic record-keeping tools and effectively communicate with the veterinary team for online consultations to overcome any physical barriers in daily life. Through the MBApp, the farmer can allow early detection of health or potential production issues through this real-time daily depletion monitoring data, which records the number of dead and culled chickens within a batch. After that, farmers can make decisions to intervene or seek real-time veterinary consultation from OHRP through texts, images, video, and even voice calls to OHRP poultry veterinarians. Additionally, the ambulatory veterinary team and OHRP provide short-term and long-term interventions tailored to each farm to manage relevant constraints to health and production.

## Program Outlook

The second project of the OHRP-launched program is currently underway and is scheduled to continue until April 29, 2024. We are grateful for the intensive collaboration involving all stakeholders over the past 4–5 years. The wealth of local knowledge accumulated, including databases, baselines, and research findings, will be beneficial for various future applications, such as academic research and policy formulation by HK AFCD decision makers. Meanwhile, the precious knowledge contributed by numerous stakeholders will further support research into advanced production management strategies to ensure a consistent supply of chicken meat.

During this project, the ambulatory poultry veterinary team will continue to offer veterinary clinical services and diagnostic prescriptions to poultry farmers in Hong Kong SAR. These services encompass necropsy, laboratory testing, preliminary clinical diagnosis, bacterial isolation, and drug sensitivity tests. In addition, the team will facilitate the development of a safe pharmacy, which aims to generate more effective prescriptions for farmers at the cost price of the prescribed antibiotic medication. Overall, this research program aims to deliver sustainable veterinarian services to local poultry farmers and continue to conduct independent research to enhance the health and productivity of poultry farms in Hong Kong SAR.

## Conclusions

The program described here not only helps the government of Hong Kong regulate the use of antibiotics on poultry farms but also supports farmers in preventing respiratory and intestinal problems in poultry farms. This initiative also ensures food safety for the public and provides high-quality chicken meat at affordable prices. The interdisciplinary collaborative research conducted in this program has had positive impacts on both poultry health and production services in the entire poultry industry of Hong Kong SAR.

## Group Discussion Questions

1. This work established collaborations with many people from different areas. Thus, who would be the main stakeholders involved in an interdisciplinary approach? Meanwhile, what would be the roles and responsibilities of each stakeholder?
2. In our program, we are facing challenges such as some pathogenic organisms in poultry farm environments and antimicrobial-resistant bacteria carriage in poultry. Therefore, what would be the major challenges encountered during the interdisciplinary approach of the program?
3. What would you suggest to overcome the challenges of an interdisciplinary approach in this program and maintain the sustainability of the program outcomes?

## Conflict of interest

The authors have no conflicts of interest to declare.

## Acknowledgment

We gratefully acknowledge the research funding provided by the Agriculture, Fisheries and Conservation Department (AFCD) of the Hong Kong Special Administrative Region (SAR), through the Sustainable Agricultural Development Fund (SADF). We further extend our acknowledgment to the collaborations of many colleagues. Their collective contributions have been significant to our research endeavor.

## Disclaimer

Any opinions, findings, conclusions, or recommendations expressed in this material/event (or by members of the project team) do not reflect the views of the Government of the Hong Kong Special Administrative Region, Agriculture, Fisheries and Conservation Department or the Sustainable Agricultural Development Fund Advisory Committee.



## Funding statement

SADF-0010 and SADF-0042 Sustainable Agricultural Development Fund poultry project.

## Further Readings

Akidarju, M.S., Onyemaechi, E.G. and Dauda, M.G. (2010) An assessment of some poultry management practices and disease recognition by poultry farmers in Maiduguri arid zone, Nigeria. *World's Poultry Science Journal* 66(2), 285–296. DOI: 10.1017/S0043933910000334.

Ali, A., Ponnampalam, E.N., Pushpakumara, G., Cottrell, J.J., Suleria, H.A.R. and Dunshea, F.R. (2021) Cinnamon: A natural feed additive for poultry health and production—A review. *Animals* 11(7), 2026. DOI: 10.3390/ani11072026.

Gyles, C.L. (2008) Antimicrobial resistance in selected bacteria from poultry. *Animal Health Research Reviews* 9(2), 149–158. DOI: 10.1017/S1466252308001552.

Hedman, H.D., Vasco, K.A. and Zhang, L. (2020) A review of antimicrobial resistance in poultry farming within low-resource settings. *Animals* 10(8), 1264.

Pius, L.O., Strausz, P. and Kusza, S. (2021) Overview of poultry management as a key factor for solving food and nutritional security with a special focus on chicken breeding in east African countries. *Biology* 10(8), 810. DOI: 10.3390/biology10080810.

## References

Agriculture, Fisheries and Conservation Department (AFCD) (2022a) Avian Influenza Health Advice. Available at: [https://www.afcd.gov.hk/english/quarantine/qua\\_vetlab/qua\\_vetlab\\_ndr/h5n1\\_health\\_advice.html](https://www.afcd.gov.hk/english/quarantine/qua_vetlab/qua_vetlab_ndr/h5n1_health_advice.html) (accessed 12 May 2023).

Agriculture, Fisheries and Conservation Department (AFCD) (2022b) Hong Kong: The Facts of Agriculture and Fisheries. Available at: <https://www.gov.hk/en/about/abouthk/factsheets/docs/agriculture.pdf> (accessed 23 April 2023).

Centre for Applied One Health Research and Policy Advice (OHRP) (2019) Improving Poultry Health and Production in Hong Kong (completed). Available at: <https://www.cityu.edu.hk/ohrp/ambulatory-veterinary-services/improving-poultry-health-and-production-hong-kong-completed> (accessed 16 April 2024).

Centre for Health Protection (CHP) (2023) Avian Influenza Report. Centre for Health Protection (CHP), p. 13. Available at: [https://www.chp.gov.hk/files/pdf/2023\\_avian\\_influenza\\_report\\_vol19\\_wk15.pdf](https://www.chp.gov.hk/files/pdf/2023_avian_influenza_report_vol19_wk15.pdf) (accessed 21 April 2023).

Chan, S. and Hon, S. (2020) LCQ9: Live Poultry Trade. Available at: <https://www.info.gov.hk/gia/general/202004/22/P2020042200277.htm> (accessed 21 April 2023).

Ching, F. (2018) Bird flu, SARS and beyond. In: Ching, F. (ed.) *130 Years of Medicine in Hong Kong*. Springer, Singapore, pp. 381–434. DOI: 10.1007/978-981-10-6316-9\_14.

Conan, A. *et al.* (2023) Serological survey of avian metapneumovirus in vaccinated and unvaccinated broiler chickens in Hong Kong. *Tropical Animal Health and Production* 55(3), 179. DOI: 10.1007/s11250-023-03592-6.

Health, Welfare and Food Bureau (FHB) (2004) *Prevention of Avian Influenza: Consultation on Long Term Direction to Minimize the Risk of Human Infection*. Hong Kong SAR, p. 35. Available at: <https://www.legco.gov.hk/yr03-04/english/panels/fseh/papers/fseh0402-avian-e-scan.pdf> (accessed 12 May 2023).

Ko, W. and Cheung, T. (2017) Hong Kong Government Lifts Ban on Live Poultry Sales. Available at: <https://www.info.gov.hk/gia/general/201706/07/P2017060700751.htm> (accessed 21 April 2023).

Ma, Y. (2022) Average Daily Consumption of Live Poultry in Hong Kong from 2015 to 2021. Available at: <https://www.statista.com/statistics/995196/hong-kong-average-daily-live-poultry-consumption/> (accessed 21 April 2023).

Nekouei, O. *et al.* (2022) Quality assessment of day-old chickens on the broiler farms of Hong Kong. *Animals* 12(12), 1520. DOI: 10.3390/ani12121520.

Thornton, P.K. (2010) Livestock production: recent trends, future prospects. *Philosophical Transactions of the Royal Society B: Biological Sciences* 365(1554), 2853–2867. DOI: 10.1098/rstb.2010.0134.

Wu, T., Suen, N. and Su, S. (2017) *Study on the Way Forward of Live Poultry Trade in Hong Kong*, p. 37. Available at: <https://www.legco.gov.hk/yr16-17/english/panels/fseh/papers/fseh20170411-crpt20170403-e.pdf> (accessed 21 April 2023).

Yau, D., Tsang, L.S. and Lam, T.S. (2022) 29 Poultry Farms in HK 2022.