

A. Jalaludeen · R. Richard Churchil · Elisabeth Baéza *Editors*

Duck Production and Management Strategies

This book provides comprehensive insights into the field of duck production and management. It presents a complete overview of different aspects of duck production with particular emphasis on rearing systems. The book reviews current knowledge on the anatomy, physiology, genetics, breeding, nutrition, incubation, and hatching practices of ducks. It further discusses the common diseases of duck, their treatment regime, and prevention strategies. The book additionally examines all aspects of the global duck industry, the constraints, and the recommendations. It also explores nutrient requirements and feed evaluation for duck and evaluates nutrition's influence on the gut microbiome. Towards the end, the book presents the latest genomic applications, including high throughput sequencing and various bioinformatics tools in duck production. This book serves as an essential resource for duck industry practitioners, researchers, and students.

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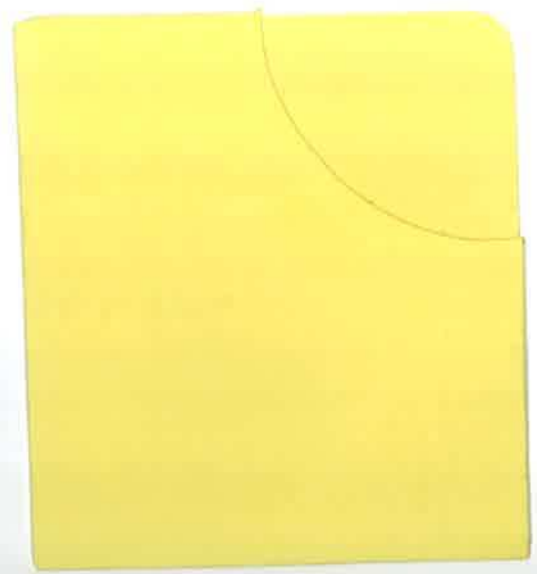
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Elisabeth Baéza
Editors

Duck Production and Management Strategies

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Dr. Bhagabat Panda
(1929 to 2016)



Dr. Bhagabat Panda obtained his Bachelor of Veterinary Science degree from Bombay Veterinary College (1953) and MS (1960) and PhD (1963) degrees from the University of Maryland College Park. Following a brief assignment in Venezuela, he joined as Scientific Officer at CFTRI, Mysore, India (1963), and later became the head of the Division of Poultry Research of IVRI (1969). He transformed the Division into a 'Center of Excellence' and later as Central Avian Research Institute and served as Founder Director (1979–1990). He was the first Project Coordinator of All India Coordinated

Research Projects on poultry breeding in India. He founded the Indian Poultry Science Association (IPSA) and led it as President (1981–1997). He was the recipient of UNDP fellowship (1972), National Productivity Award from the President of India (1988), IPSA lifetime achievement award (1990), International Poultry Hall of Fame and Lifetime Achievement Award from WPSA (2001), and honorary degree of Doctor from Orissa University of Agriculture and Technology (2009). He has visited poultry science research and educational institutions in France, USSR, UK, USA, Canada, Japan, Scotland and Australia. He published 320 research papers and six textbooks. He served as the editor-in-chief of the Indian Journal of Poultry Science and a member of the Editorial Board of the World's Poultry Science Journal. Dr. Panda is popularly known as the 'Father of Poultry Education' in India.

***Dr. A. Ramakrishnan
(1936 to 2006)***



Dr. A. Ramakrishnan was a graduate of Madras Veterinary College. After a brief stint

as Veterinary Surgeon, he did postgraduation and doctorate from agricultural universities of Gujarat and Andhra Pradesh states respectively and postgraduate diploma in Poultry Nutrition from the University of Calcutta. He was one among the early faculty to join the College of Veterinary and Animal Sciences (CoVAS), Thrissur, Kerala, where he made poultry science education to receive adequate focus in the veterinary curriculum. He assumed the head of Department of Poultry Science in 1972. He has done pioneering research in pastoral duck farming system of Kerala. Under his stewardship, the Department of Poultry Science started research as early from 1974 on different aspects of Kuttanad duck production like incubation and embryonic development, management and housing systems, evaluation of production performances and quality assessment of duck products and economics of duck farming. An AICRP on Poultry Breeding Centre was established at Mannuthy in 1976. He was instrumental in the establishment of Centre for Advanced Studies in Poultry Science in 1985, first of its kind in India. He was the founder Director of the Centre and continued till his retirement from service. Dr. A. Ramakrishnan memorial award has been instituted by the Kerala Chapter of Indian Poultry Science Association to recognize eminent scientists for their contribution in the field of poultry production.

Foreword

Feeding the world with animal protein and sustainability of production are the key issues for poultry production. The efficient production of poultry over the last 70 years has made poultry meat and eggs the most affordable high-quality animal protein. All achieved through the application of research-derived scientific principles of breeding, genetics, nutrition and management. In the same period many demographic changes have taken place and these changes continue. At this moment the world is inhabited by almost 7 billion people (9 billion by 2050), and this population will need animal protein for daily use. The changes include increases in absolute wealth of people in countries in Latin America, the Middle East and South-East Asia and are largely the result of economic factors. On a global scale this already has resulted in more people worldwide being raised from poverty than ever before.

The increase in animal protein consumption has its price, as sustainability of poultry production is affected by aspects of diseases, food safety, animal welfare, environmental impact, use of natural resources and loss of biodiversity. Worldwide, large areas of land and large volumes of water have to be used for necessary crop production and for keeping poultry and livestock. A balance has to be found as natural reserve is crucial to mankind. Global meat production therefore will grow at a moderate pace, due to these constraints resulting in higher input costs and competing demand for land and water from alternative crops. It is expected that poultry meat production will increase and that waterfowl, specially duck, production will take a positive role in relation to food security in several parts of the world.

Duck farming has a long history, but the modern duck industry is relative small in most parts of the world. However the duck industry is very dynamic and over the last couple of decades has been through a period of rapid expansion. In some parts of the world, duck production has started to challenge the consumption of other types of poultry. China produces more than 2/3 of all ducks produced worldwide and so it is inevitable that what happens or does not happen in China will have a profound impact on the world of duck production. The role of the duck industry on the development of rural areas is also important, not only in economic terms. For the further development of duck production, the presence of a strong feed industry and a well-working veterinary service is essential.

The World's Poultry Science Association (WPSA) acknowledges the importance of waterfowl production and the science beyond, not only by placing a related picture on the cover of each June issue of the *World's Poultry Science Journal*,

but also in supporting the working group Waterfowl, which operates under the umbrella of the Asian Pacific Poultry Federation of WPSA. As knowledge dissemination is our mission, successful World Waterfowl Conferences have been organized over the past years in China, India, Vietnam and Taiwan. The next conference is planned for Indonesia. During our World's Poultry Congresses there also are sessions specially for waterfowl production.

We are very thankful to the editors who initiated the production of this book and to the contributing authors. This book describing all aspects of duck production will be a standard of scientific knowledge for the years to come.

Roel Mulder
Dr R.W.A.W. Mulder
Secretary General
World's Poultry Science Association (WPSA)

Preface

Duck is one of the earliest domesticated species of poultry, which happened around 2000 years ago. Duck is the second important poultry species, next only to chicken in terms of eggs and meat production. Despite the global presence, economic importance and livelihood contribution, ducks failed to attract the attention of scientific book writers so far. Books on general subjects like 'Poultry Production' or 'Livestock Production' devote only a little portion to ducks.

Majority of ducks are reared in Asia (89.7%), followed by Europe (6.5%), Americas (2.3%), Africa (1.4%) and Oceania (0.1%). China alone had a duck population of 712.4 million, *i.e.*, nearly two-third of world's duck population. The scientific research on ducks is concentrated in mainland and provinces (like Taiwan) of China. Considerable research findings are being published in Mandarin (Chinese language) in China and Taiwan. The mule duck production is the major activity of Taiwanese duck industry, but its breeding and rearing methods and nutritive value of meat are not much known outside China/Taiwan. The information about classic Chinese and Taiwanese duck breeds, value addition especially down and feather, is not available in the public domain and is confined only in the domain of China and its provinces due to language barrier.

The core idea of writing a book on ducks was seeded by Dr. Bhagabat Panda. Dr. Bhagabat Panda desired to do this on his own, but could not accomplish due to his old age. He found a right choice in Dr. A. Jalaludeen, the senior editor of this book to do this. Dr. Panda expressed his desire in 2006 to Dr. A. Jalaludeen, who, at that time, was Director of the Centre for Advanced Studies in Poultry Science of College of Veterinary and Animal Sciences, Thrissur, Kerala. This Centre has a rich tradition and vast experience in duck production research since the 1970s; the efforts initiated by Dr. A. Ramakrishnan, the first Director of this Centre. This Centre has to its credit conducted the fourth World Waterfowl Conference in Thrissur in November 2009 in a grand manner. Although Dr. Jalaludeen narrated this to Dr. R. R. Churchil, his junior colleague in 2009, the thought process regained momentum only in October 2017. The visit of Dr. A. Jalaludeen to Taiwan to attend the 6th World Waterfowl conference in October 2017 had yet another agenda of identifying some potential chapter authors from Taiwan. The contribution of Dr. Jeng-Fang Huang, Director, Ilan Branch, Livestock Research Institute, Council of Agriculture, Taiwan, was immense in identifying a team of outstanding resource persons in Taiwan for this purpose and is highly appreciated. Dr. Elisabeth Baéza,

The French National Research Institute for Agriculture, Food and Environment, Nouzilly, France, who attended the conference also accepted to write a chapter, later joined as an editor of the book.

The book *Duck Production and Management Strategies* provides comprehensive insights into the field of Duck Production. This book presents a complete overview of different aspects of global duck production with emphasis on prospects, constraints and recommendations. It represents the complete integration of current knowledge on anatomy, physiology, genetics and breeding, nutrition, incubation and hatching practices of ducks. The information about classic Chinese and Taiwanese duck breeds, value addition especially down and feather and mule duck production confined only within the domain of China and its provinces have been brought out. The duck breeds have been entirely freshly illustrated. Exhaustive details on transhumant duck farming which is successfully practiced in different countries like India, Bangladesh, Viet Nam and Indonesia along with flock movement have been mapped. The advancements in different rearing and housing systems have been compiled. Our recent understanding of the nutritive value, processing and further processing of duck egg and meat has been scripted in different chapters. One chapter covers the important area of disease management including avian influenza. As there is tremendous increase in knowledge on biotechnology, a chapter has been devoted to provide insights on emerging trends in the subject pertaining to ducks.

The authors invited to contribute to the book have all been carefully chosen from the world community of scientists and scholars who are well qualified to do so. It is strongly believed that this book will serve as an encyclopaedia for academicians who teach life sciences, veterinary and animal sciences and allied subjects, a reference book for researchers and a textbook for students.

Finally, the efforts of publishers for their guidance and support in seamless production process of the book and the care they have taken in printing and reaching the end users are highly appreciated.

Wayanad, Kerala, India
Chennai, Tamil Nadu, India
Nouzilly, France
15 June 2021

A. Jalaludeen
R. Richard Churchil
Elisabeth Baéza

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About the Editors

A. Jalaludeen has served as Director of Academics and Research of Kerala Veterinary and Animal Sciences University, and Special Officer to the College of Avian Sciences and Management. He is known for his pioneering work in characterizing Kuttanad ducks. He was the plenary speaker of the 6th World Waterfowl Conference held at Taiwan in 2017. He has developed linkages with the State Institute of Rural Development, Assam, India, in the refinement of backyard duck farming, which resulted in socio-economic empowerment of rural women and was appreciated by Dr. A. P. J. Abdul Kalam, then President of India. He was invited by the University of Brawijaya, Malang, Indonesia, in 2019 as Visiting Professor. As a teacher with 36 years of experience to his credit, he has published many peer-reviewed research articles and has provided guidance to more than 45 postgraduate and doctoral students in poultry science and allied subjects. He has also authored three books and four book chapters. He has organized many seminars/symposia, including International Conference on Waterfowls in India.

R. Richard Churchil is working as Professor at the Directorate of Research, Tamil Nadu Veterinary and Animal Sciences University, Chennai. He was graduated from Madras Veterinary College and pursued his doctoral degree at Indian Veterinary Research Institute, Izatnagar. He received gold medals in postgraduation and the Jawaharlal Nehru Award of ICAR for his doctoral research on development of transgenic spermatozoa. He worked as poultry breeding scientist in Kerala Agricultural University, Thrissur, for a decade before joining Tamil Nadu Veterinary and Animal Sciences University, Chennai. He has published 77 peer-reviewed research articles in highly reputed journals and has written seven book chapters. He was trained on 'Transgenic animals' at the University of Nantes, France. He teaches Poultry Science to undergraduate students and Poultry Breeding and Biotechnology to postgraduate/doctoral students.

Elisabeth Baéza works as Professor at INRAE, Université de Tours. She has obtained a diploma of Engineer in Agronomy (ENSFA, Rennes, France), specialized in Animal Productions, and a Ph.D. in Animal Sciences from the University of Montpellier (France). She was recruited at INRAE Nouzilly Centre (France) in 1993 to work on waterfowl production and poultry meat quality. She has identified significant determinants of duck meat quality and the main factors influencing