

HANDBOOK OF ANIMAL HUSBANDRY

Livestock sector has created a significant impact on equity in terms of employment and poverty alleviation. After staple crops, livestock sector is the second most important contributor to the agricultural economy. The producer prices of meat, eggs and milk, in India appear to be highly competitive as the domestic producer prices of these products are quite low compared to the ex-farm gate prices of major exporters in the world markets. A knowledge resource is essential to harness the potential of animal production. The Indian Council of Agricultural Research brought out first edition of *Handbook of Animal Husbandry* in 1962 for serving the end-users ranging from livestock owners to academicians. This is the Fourth revised and enlarged edition of *Handbook of Animal Husbandry* which includes 48 chapters under nine sections, such as Animal Genetics and Breeding; Animal Nutrition and Feed Technologies; Animal Management; Animal Reproduction; Animal Health Management; Animal Biotechnology; Animal Products, Technology and Machineries; Economics and Trade of Livestock and Poultry Enterprise; and Social Sciences. It has 19 new chapters like Impact of Biotechnology, Nanotechnology: Applications in Animal Sciences; Carbon trading: Mechanisms and Opportunities In Livestock Sector; Intellectual Property Rights Regime; Indigenous Technical Knowledge etc.; and old chapters were revised holistically. The fourth revised and enlarged edition of *Handbook of Animal Husbandry* will prove useful to the students, teachers, livestock/poultry farmers, and to especially those who visualize the economic growth of country with the support of livestock sector.



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Indian Council of Agricultural Research
New Delhi

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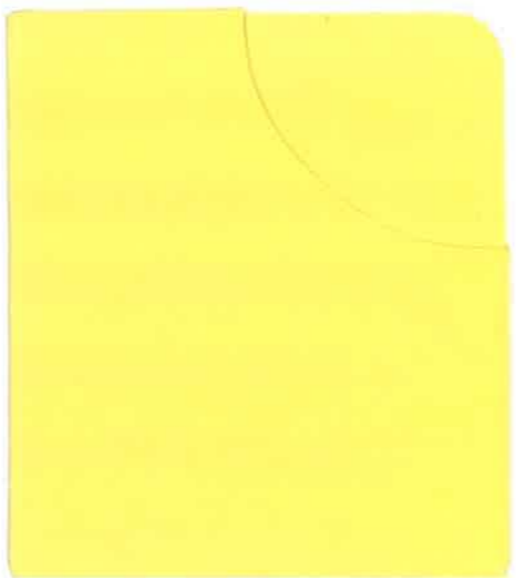
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Handbook of
Animal Husbandry



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Preface to the Fourth Revised and Enlarged Edition

The agrarian economy of India greatly depends on contributions from livestock sector. Besides providing draught and traction-power for agriculture and rural transport, it provides raw materials in the form of wool, hair, hides, skins etc., for the manufacturing sector. Even more importantly, it is a source of quality nutrient in the form of milk and milk products, meat and eggs. The share of livestock in the agricultural GDP improved consistently from 15 per cent in 1981-82 to 26 per cent in 2010-11 thus cushioning overall sustainable growth in agriculture.

Crop and animal husbandry are the twin endeavors which are highly interrelated and inseparable. The animal husbandry sector engages about 22.4 million people, which constitutes about 5.5 per cent of the total work force in the country. Gender equity and economic empowerment of women is more pronounced in livestock sector, as women participation is 71 per cent of the labour force, while it is only 33 per cent in crop farming.

As per the Livestock Census 2007, total livestock population is 529.7 million and poultry birds 648.8 million. In 2011-12, the production of milk was estimated at 127.9 million tonnes, eggs 66.45 billions, wool 44.73 million kg, and meat 5.51 million tonnes. Per capita availability of milk has also increased from 176 g/day in 1990-91 to 290 g/day in 2011-12. Per capita availability of eggs was about 55/year in 2011-12. Global demand for livestock products is increasing rapidly due to unprecedented rise in people's income. This change is more pronounced in the developing countries. Increasing global demand for livestock products is an opportunity for India to enhance production and increase its exports.

In order to harness the maximum potential of animal production, there has always been a need of some knowledge resource available at hand. The Indian Council of Agricultural Research (ICAR) has viewed publication of handbooks as an important activity and resource for serving the end users ranging from academicians to agri-business managers and progressive livestock owners of the country and abroad. Besides sharing and dissemination of knowledge and technologies, capacity building is one important objectives for which handbooks serve as crucial resource. The first edition of *Handbook of Animal Husbandry* was published in 1962 by the ICAR for students, teachers, scientists, and entrepreneurs. The handbook was revised in 1977, 1990, and 2002. This is the Fourth revised and enlarged edition of *Handbook of Animal Husbandry* which includes 48 chapters under nine sections, viz. Animal Genetics and Breeding; Animal Nutrition and Feed Technologies; Animal Management; Animal Reproduction; Animal Health Management; Animal Biotechnology; Animal Products, Technology and Machineries; Economics and Trade of Livestock and Poultry Enterprise; and Social Sciences. It has 19 new chapters like Impact of Biotechnology, Nanotechnology;

Applications in Animal Sciences; Carbon Trading: Mechanisms and Opportunities in Livestock Sector; Intellectual Property Rights Regime; Indigenous Technical Knowledge etc. Many chapters in previous edition were revised holistically. In view of the ICAR's new focus on Knowledge Management, the latest revised edition of Handbook encompasses all relevant information and database concerning livestock health and production.

While appreciating the efforts of team of contributing experts and worthy editors it gives me great satisfaction to present this enlarged edition to the people of India and abroad, especially to those who visualize the economic growth of country with the support of livestock sector.

K M L Pathak

Deputy Director General
Division of Animal Sciences,
Indian Council of Agricultural Research
Krishi Bhavan, New Delhi 110 001

New Delhi
June 2013

Preface to the Third Revised Edition

The livestock sector in India is experiencing fast growth. Livestock resources across regions and species have therefore to be utilized optimally to achieve the goals of efficiency, equity, nutritional security and sustainability. Consumption of livestock products has been increasing over the last 20 years. Sustained economic growth and attendant increase in per capita income are expected to further boost demand of livestock products substantially. Demand for milk and meat is estimated to be 147 and 14 million tonnes, respectively in 2020. Changing consumption pattern and increasing needs of livestock products would demand use of new scientific technologies to achieve goal of increased animal production efficiency. The new revised and enlarged edition of *Handbook of Animal Husbandry* deals with nearly all aspects of animal husbandry under a single cover.

The Indian Council of Agricultural Research brought out the First Edition of *Handbook of Animal Husbandry* in 1962, which benefited the students, and enlightened the farmers and the persons interested in livestock. In 1977 and 1990 its revised editions were printed. This third revised edition includes seventeen updated and revised chapters and fourteen new chapters. Chapters on the camel, equines, rabbitry, small laboratory animals and economics of livestock keeping have been included considering the requirements of young entrepreneurs. Chapters on avian diseases, reproductive disorders, and biotechnology in animal health and production have also been included due to their direct effect on poultry and livestock production economics. Veterinary public health has always been important but recent bioterrorism threats have highlighted its relevance in the modern times. In post-GATT era, the world has shrunk where country's legislation knowledge is must for further trade interactions. Taking this into view a new chapter—Legislations in Veterinary and Animal Sciences, has been included. Another new chapter—Informatics in Animal Husbandry, deals with role of information in animal husbandry. Keywords, websites and bioinformatics have also been included in this chapter.

I hope this new revised edition will serve as animal husbandry compendium for all those interested in the study of animal sciences including students, young entrepreneurs, policy planners and farmers.

New Delhi
22 September 2002

V K Taneja
Deputy Director-General
(Animal Sciences)
Indian Council of Agricultural Research

Preface to the Second Revised Edition

Livestock have been playing an important role in our economy. Their contribution to GNP is Rs 227 billion, constituting 25% of the total GNP of Rs 1,087 billion from agriculture in 1987-1988. This however does not include their contribution to the draught power, which is rather large. Animal husbandry and dairying have been mainly rural-based, generating employment among the rural people and providing income to them.

Our livestock are generally poor producers, because of poor feed and management, and tropical heat, and diseases. However as a result of research work conducted by the scientists of the ICAR institutes, state agricultural universities, the government and non-government research organizations, etc, much is now known about the genetic resources, their production potential, nutritional requirements, problems impeding fuller expression of genetic potential especially due to disease, nutritional and environmental stresses. Improvement strategies have been developed and their application is now the basis of our livestock development programmes. Adoption of these strategies during the last 20 years has resulted in 2.5-fold increase in milk production, 3-fold increase in meat production and 20-fold increase in egg production. It has now become possible to start commercial ventures in dairy production, poultry production, meat production, wool and other animal fibre production, both in rural and peri-urban areas.

To benefit the students, enlightened farmers and persons interested in livestock with the latest findings in animal husbandry and dairying, the Indian Council of Agricultural Research brought out the first edition of the *Handbook of Animal Husbandry* in 1962. Since then, it has been in great demand. It was reprinted in 1967. In 1977 a revised edition of the Handbook was brought out with additional 3 new chapters, viz. Pigs, Meat and Fisheries. This revised edition was reprinted in 1985. Simultaneously the Council undertook a programme for revising all the chapters of Handbook and publish it in a more convenient format. This edition printed in a new format provides the latest information on all aspects of animal husbandry, viz. breeding, nutrition, health, dairying and management. Some of the areas in which significant additions have been made are embryo transfer technology, breeding, health cover, feed formulations and animal products technology. Various chapters have been written by eminent experts in the respective fields.

I am confident that this Handbook will be of immense help to all the users, especially the students.

New Delhi
21 June 1990

R M Acharya
Deputy Director-General
(Animal Sciences)
Indian Council of Agricultural Research

Preface to the First Revised Edition

The first editions of the *Handbook of Animal Husbandry* was brought out in 1962 primarily to meet the requirements of students and extension workers. It was a useful compendium of authentic information on various aspects of animal husbandry. There was a great demand for this publication which led to its reprinting in 1967.

Several important developments have taken place since 1962 in different branches of animal sciences. Intensive crossbreeding programmes in cattle have led to the evolution of high-yielding milch animals. Buffalo improvement work has also received greater attention. New sheep breeds with quality wool have been produced. Great strides have been made in poultry research and development programmes. Several sera and vaccines have been evolved for the control and prevention of important livestock diseases. New aquaculture techniques have opened up revolutionary possibilities in inland and coastal aquaculture. There is practically no field of animal sciences in which research has not made significant progress. It was, therefore, decided to update the Handbook in the light of research conducted over the last 15 years. The revised Handbook has, in addition, new chapters on Pigs, Meat and Fisheries which did not find place in the last edition.

I hope that the revised and enlarged edition of the Handbook will be found useful and serve as a reference book for all those interested in the study of animal sciences, livestock farmers and those associated with the implementation of animal husbandry programmes in the country. Since mixed farming involving crop-livestock-fish integration could increase income and employment in rural areas, besides leading to efficient energy conservation and utilization, this Handbook is a timely addition to the sources of information available to all involved in mixed farming.

New Delhi
22 August 1977

M S Swaminathan
Director-General
Indian Council of Agricultural Research

Preface to the First Edition

The preparation of the *Handbook of Animal Husbandry* was taken up by the Indian Council of Agricultural Research on the recommendation of the Planning Commission in 1954. This Handbook is companion volume to the *Handbook of Agriculture* published by the Council in June 1961.

After a careful assessment of the needs of the livestock farmers and the student community in India, it was decided that the *Handbook of Animal Husbandry* should contain chapters on the breeding of cattle, buffaloes, sheep, goats and poultry; animal nutrition, management, housing and hygiene; disease caused by viruses, bacteria and fungi and miscellaneous pathological conditions and diseases; artificial insemination; dairying; and beekeeping. These chapters have been written by specialists who have devoted a life-time to the study of their subjects and the entire material has been edited by Dr S K Sen, Retired Head of the Division of Parasitology, Indian Veterinary Research Institute, Izatnagar. Shri Prem Nath and Shri D Raghavan have assisted in the production of this publication.

In this Handbook the theory and practice of animal husbandry has been set out in simple language but in clear and precise terms. It represents the fruit of four years of labour and gives a broad panoramic picture of the many problems facing the animal husbandry workers today.

I hope that this useful compendium of authentic information on a subject of national importance will meet the urgent and practical requirements of students, progressive farmers and extension workers.

New Delhi
25 September 1962

A D Pandit
Vice-President
Indian Council of Agricultural Research

Contents

<i>Preface to the Fourth Revised and Enlarged Edition</i>	iii
<i>Preface to the Third Revised Edition</i>	v
<i>Preface to the Second Revised Edition</i>	vi
<i>Preface to the First Revised Edition</i>	vii
<i>Preface to the First Edition</i>	viii
1. Livestock Sector in India: Challenges and Opportunities	1
Part 1: Animal Genetics and Breeding	
2. Livestock and Poultry Genetic Resources	19
3. Conservation of Animal Genetic Resources	41
4. Animal Genetics and Breeding	56
Part 2: Animal Nutrition and Feed Technologies	
5. Principles of Animal Nutrition	105
6. Feed and Fodder Resources	166
7. Agro-Industrial By-products, Unconventional Feed and Antinutritional Factors	198
8. Feed and Fodder Technology	246
9. Advances in Mineral and Vitamin Nutrition of Livestock	278
10. Poultry Nutrition	302
Part 3: Animal Management	
11. Livestock Management	316
12. Animal Shelter, Climate Change and Coping Strategies	346
13. Organic Animal Husbandry	365
14. Laboratory Animals for Research and Biological Production	383
Part 4: Animal Reproduction	
15. Basics of Animal Reproduction	410
16. Semenbiology and Artificial Insemination	446
17. Reproductive Disorders	506
18. Reproductive Endocrinology	519
Part 5: Animal Health Management	
19. Bacterial and Mycotic Diseases	536
20. Diseases caused by Viruses	588
21. Chlamydia and Mycoplasmosis	629
22. Parasites and Parasitic Diseases	637
23. Deficiency Diseases and Metabolic Disorders	728
24. Zoonotic Diseases	760

25. Emerging, Exotic and Transboundary Animal Diseases	809
26. Avian Infectious Diseases	820
27. Livestock Disease Surveillance and Forecasting in India	860
28. Advances in Veterinary Medicine	886
29. Indigenous Technical Knowledge in Animal Husbandry and Ethnoveterinary Medicine	953
30. Postmortem Examination and Disease Diagnosis	980
Part 6: Animal Biotechnology	
31. Transgenic Animals	1026
32. Embryo Transfer Technology in Farm Animals	1042
33. Impact of Biotechnology on Animal Production and health in India	1067
34. Nanotechnology: Applications in Animal Sciences	1094
Part 7: Animal Products, Technology and Machineries	
35. Indigenous Dairy Products and Equipments	1117
36. Meat Products	1147
37. Wool Fibre: Production, Properties and Processing	1163
38. Animal Waste Management	1219
39. Good Manufacturing Practice and Quality Parameters	1226
Part 8: Economics and Trade of Livestock and Poultry Enterprise	
40. Economics of Livestock and Poultry Enterprise	1248
41. Trade in Livestock Products	1268
42. Carbon Trading: Mechanisms and Opportunities in Livestock Sector	1300
43. Draught Animal Power in Agriculture	1312
Part 9: Social Sciences	
44. Livestock Extension and Education	1323
45. Veterinary and Animal Science Education for Livestock Development	1366
46. Veterinary Jurisprudence	1383
47. Intellectual Property Rights Regime	1445
48. ICT in Animal Husbandry	1452
<i>Index</i>	1490
<i>Contributors</i>	1540
<i>Annexure I.</i> List of bulletins/leaflets on livestock and poultry breeds published by the National Bureau of Animal Genetic Resources, Karnal	1550

1. Livestock Sector in India: Challenges and Opportunities

One of the globally recognized 12 mega-biodiversity countries, India is bestowed with rich diversity of livestock germplasm as well. This includes the uniquely distinguished breeds of buffalo (Murrah, Nili Ravi, Jaffarabadi), cattle (Sahiwal, Hariana, Tharparkar, Ongole, Gir, Vechur), goat (Pashmina, Sirohi, Ibex), sheep (Garole, Dumba, Gaddi), pig (Ghungroo), horse (Marwari, Kathiawari), as well as the poultry (Aseel, Kadaknath, Vanaraja) (<http://dad.fao.org/>). Livestock sector plays a multidimensional role in agricultural development of the country and has contributed immensely to the national GDP. During 2010-11, estimated total milk production was 121.8 million tonnes, while meat production was estimated at 4.83 million tonnes, 61.45 billion eggs and 43.13 million kg wool. Over the last 10 years, the contribution of livestock sector to total national GDP has hovered between 3.5 and 4%, while its contribution to the GDP from agriculture has witnessed steady increase from almost 25% to over 30% during the same period. In 2007-08, contribution of milk alone to GDP was ₹162,136 crore, being the highest from any single agricultural commodity, apart from ₹8,656 crore worth of total exports from the livestock sector.

Livestock sector has created a significant impact on equity in terms of employment and poverty alleviation. In low-income agrarian economies including that of India, livestock form an integral part of predominantly small-holder diversified crop-livestock farming systems. After staple crops, livestock sector is the second most important contributor to the agricultural economy. The productivity and income growth in the livestock sector has witnessed strong income multiplier and poverty reduction impacts, thereby justifying a strategy to stimulate simultaneous growth in both livestock and staple crops sectors.

Of the total households in the rural India, about 73% own livestock. More importantly, small and marginal farmers account for three quarters of these households. Thereby, livestock sector provides self-employment to 22.45 million people, either part-time or full-time, both to educated and uneducated youths. The smaller units will primarily provide employment for the family members, while products may not necessarily enter the processing chain. On the other hand, big livestock enterprises provide much more employment at different stages starting from livestock management, production, processing and finally marketing. In addition, animal husbandry promotes gender equity as over three-fourths of the labour in livestock production comprises women.

Enterprises like dairy farming and layer poultry farming are the sources of regular income due to daily production of sellable products like milk and eggs. Income from livestock production accounts for 15-40% of the farm households' income in different states. It is a conceded fact that the farmers involved in animal husbandry rarely