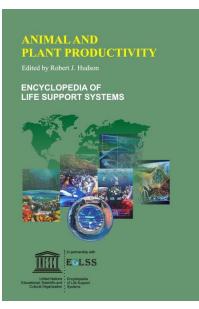
CONTENTS

ANIMAL AND PLANT PRODUCTIVITY



Animal and Plant Productivity - Volume 1 No. of Pages: 466 ISBN: 978-1-84826-317-8 (eBook) ISBN: 978-1-84826-767-1 (Print Volume)

For more information of e-book and Print Volume(s) order, please **click here**

Or contact : eolssunesco@gmail.com

CONTENTS

Productivity, Efficiency And Resilience Of Crop And Livestock Production

Gerald Singh, University of Alberta, Canada Robert J. Hudson, University of Alberta, Canada Noble T. Donkor, Canadian University College, Canada

- 1. Introduction
- 2. Science of Sustainability
 - 2.1. Sustainability Goals
 - 2.2. Definitions of Sustainability
- 3. Central Problem
 - 3.1. Human Population Dimensions
 - 3.2. Major Patterns of Food Production
 - 3.3. Climate Change and Agricultural Production
- 4. Food Production
- 5. Efficiency
- 6. Resilience
 - 6.1. Concerns
 - 6.2. Potential Achievements
- 7. Social Needs for Sustainable Crop and Livestock Production
 - 7.1. Other Agents Consumers
 - 7.2. General Strategies for Sustainable Production
- 8. Conclusions

Sustainable Animal Production

24

Ermias Kebreab, Faculty of Agricultural and Food Sciences, University of Manitoba, Canada Kim Ominski, Faculty of Agricultural and Food Sciences, University of Manitoba, Canada Karin Wittenberg, Faculty of Agricultural and Food Sciences, University of Manitoba, Canada

1. Introduction

- 2. Scope and Scale Species Distribution
- 3. The Purpose of Animal Production
 - 3.1. Commodity
 - 3.1.1. Food and Health
 - 3.1.2. Clothing
 - 3.1.3. Energy/power
 - 3.2. Non-Commodity
 - 3.2.1. Agritourism
 - 3.2.2. Companionship and Other Benefits
- 4. Types of Livestock Production Systems
 - 4.1. Extensive/Rangeland
 - 4.2. Intensive
- 5. Environmental Health and Sustainable Animal Agriculture
 - 5.1. Water
 - 5.2. Manure Storage and Management and Pathogens
 - 5.3. Greenhouse Gas Emissions
- 6. Economic Impact of Animal Agriculture
- 7. Societal Impacts of Animal Agriculture
 - 7.1. Global Consumption Patterns of Food from Animal Agriculture
 - 7.2. Food Safety and Security
 - 7.3. Animal Health and Well-being
- 8. Advancing Sustainable Animal Agriculture
- 9. Conclusion

x 1

Animal Production in the Tropics

C. Devendra, Consultant Tropical Animal Production Specialist, Kuala Lumpur, Malaysia.

- 1. Introduction
- 2. Rationale for accelerating animal production
- 3. Role and functions of animals
- 4. Demand for animal foods
- 5. Diversity and Animal Genetic Resources
 - 5.1. Diversity
 - 5.2. Species description
 - 5.2.1. Buffaloes
 - 5.2.2. Cattle
 - 5.2.3. Goats
 - 5.2.4. Sheep
 - 5.2.5. Pigs
 - 5.2.6. Chickens and Ducks
- 6. Animal production systems
 - 6.1. Types
 - 6.2. Landless systems
 - 6.2.1. Urban and peri-urban industrial landless systems
 - 6.2.2 Rural landless livestock production
 - 6.3. Crop-based systems
 - 6.3.1. Categories
 - 6.3.2. Relevance
 - 6.3.3. Genesis
 - 6.3.4. Diversification and integration
 - 6.3.5 Trends
 - 6.4. Agro-pastoralism
 - 6.5. Rangeland-based systems
- 7. Opportunities for productivity enhancement
 - 7.1. Emphasis on rainfed areas
 - 7.2. Significance of crop-animal interactions
 - 7.3 Production systems integrated with annual and perennial crops
 - 7.4. Strategy for improved feed utilization
 - 7.5. Animal manure, nutrient flows and dynamics
 - 7.6. Integration with aquaculture
 - 7.7. Improved Marketing
 - 7.8. Policy issues
 - 7.9 Interdisciplinary research and investments
- 8. Evolving scenarios and emerging issues in the future
- 9. Conclusions

Physiology of Growth and Reproduction in Livestock

R.J. Christopherson, Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada

1. Growth

- 1.1 Early Embryonic Growth
- 1.2 Embryonic Origin of Various Organ Systems
- 1.3 Description of Tissue Types
 - 1.3.1 Epithelial tissues
 - 1.3.2 Connective tissues
 - 1.3.3 Muscle tissue
 - 1.3.3.1 Smooth muscles
 - 1.3.3.2 Cardiac muscle
 - 1.3.3.4 Skeletal muscles
 - 1.3.4 Nervous and Endocrine Tissue

69

- 1.4 Growth in Meat Producing Animals
- 1.5 Regulation of Growth
 - 1.5.1 Embryonic Growth
 - 1.5.2 Postnatal Growth
- 1.6. Adipose Tissue Growth
- 1.7 Factors that Reduce Growth
- 2. Reproductive Physiology
 - 2.1 Male Reproductive System
 - 2.2 Hormonal control of Spermatogenesis and Male Reproduction
 - 2.3 Female Reproduction
 - 2.3.1 Ovarian Function
 - 2.3.2 Female Steroid Hormones
 - 2.4 Mating and Fertilization
 - 2.5 Estrous Cycle and Sexual Receptivity
 - 2.6 Pregnancy
 - 2.7 Parturition
- 3. Conclusions

Evolution of Livestock Improvement

88

Michael K. Dyck, Department of Agricultural, Food and Nutritional Science, University of Alberta, Canada

- 1. Introduction
- 2. Livestock improvement techniques
 - 2.1 Quantitative Genetics
 - 2.2 Reproductive Technologies
 - 2.3 Molecular Biology
- 3. Transgenics
 - 3.1 Methods of Transgenesis
 - 3.1.1. Pronuclear Injection of Fertilised Oocytes
 - 3.1.2 Retroviral Infection
 - 3.1.3 Spermatozoa Mediated Gene Transfer
 - 3.1.4 Spermatogonial Transfer
 - 3.1.5 Embryonic Stem Cells
 - 3.1.6 Nuclear Transfer

3.2 Transgenic Livestock

- 3.2.1 Biomedical Applications of Transgenic Livestock
- 3.2.2 Agricultural Applications of Transgenic Livestock
 - 3.2.2.1 Milk Production
 - 3.2.2.2 Animal Growth and Meat Production
 - 3.2.2.3 Disease Resistance
 - 3.2.2.4 Reproductive Performance
 - 3.2.2.5 Summary of Transgenic Applications in Animal Agriculture
- 4. Livestock genomics
- 5. Conclusions

Monogastric Nutrition

S. Novak, Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada

S. Moehn, Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada

M. Yegani, Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada

D. Korver, Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada

1. General Introduction

2. Pigs

- 2.1 Nutrient Requirements of Pigs
 - 2.1.1. Essential Nutrients
 - 2.1.2. Estimates of Nutritional Requirements
 - 2.1.3. Amino Acid Requirements
 - 2.1.4. Energy Requirements
 - 2.1.5. Mineral and Vitamin Requirements
- 2.2 Feed Intake of Pigs
 - 2.2.1. Feeding Piglets
 - 2.2.2. Growing-Finishing Pigs
 - 2.2.3. Gestating Sows
 - 2.2.4. Lactating Sows
- 2.3 Feedstuffs for Pigs
 - 2.3.1. Cereal Grains
 - 2.3.2. Legume Seeds
 - 2.3.3. Feedstuffs from Animal Origin
 - 2.3.4. Other Feedstuffs
 - 2.3.5. Free Amino Acids and Feed Additives
- 2.4 Conclusion: Pigs
- 3. Poultry
 - 3.1. Characteristics of the Poultry GI Tract
 - 3.2. Nutritional Requirements of Poultry
 - 3.2.1. Energy
 - 3.2.2. Proteins
 - 3.2.3. Vitamins
 - 3.2.4. Minerals
 - 3.3. Feedstuffs for Poultry
 - 3.3.1. Energy Sources
 - 3.3.2. Protein Sources
 - 3.4 Feeding Management of Poultry
 - 3.4.1. Broilers
 - 3.4.2. Broiler Breeders
 - 3.4.3. Laying Hens
 - 3.4.4. Turkeys
 - 3.5 Conclusion: Poultry
- 4. Horses
 - 4.1 Digestive Physiology of Horses
 - 4.2 Nutrients Required by the Horse
 - 4.2.1. Water
 - 4.2.2. Energy
 - 4.2.3. Carbohydrates
 - 4.2.4. Fats
 - 4.2.5. Protein
 - 4.2.6. Minerals for Horses
 - 4.2.7. Trace Minerals
 - 4.2.8. Vitamins for Horses
 - 4.3 Feedstuffs for Horses
 - 4.3.1. Forages
 - 4.3.2. Types of Forage
 - 4.3.3. Selecting Concentrates for Horses
 - 4.4 Feeding Management of Horses
 - 4.4.1. Feeding the Mature, Idle horse: Maintenance
 - 4.4.2. Feeding the Broodmare
 - 4.4.3. Feeding Management of the Stallion
 - 4.4.4. Feeding Management of the Growing Horse
 - 4.4.5. Feeding Management of the Performance or Working Horse
 - 4.5 Conclusion: Horses

Rumen Microbiology

161

M. Qi, Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, Alberta, Canada K. D. Jakober, Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, Alberta, Canada

T. A. McAllister, Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, Alberta, Canada

- 1. Introduction
- 2. Rumen Ecosystem
- 3. Microbial Species
 - 3.1. Bacteria
 - 3.2. Protozoa
 - 3.3. Fungi
 - 3.4. Bacteriophage
 - 3.5. Mycoplasmas
 - 3.6. Methanogens
- 4. Feed Degradation in the Rumen
 - 4.1. Fiber Degradation
 - 4.2 Starch Degradation
 - 4.3. Protein Degradation
 - 4.4. Lipid Degradation
- 5. Microbial Attachment and Biofilms
 - 5.1. Biofilm Formation on Forages and Grains
 - 5.2. Biofilms on Gut Tissues
- 6. Manipulation of Rumen Fermentation
 - 6.1. Propionate Enhancers
 - 6.2. Methane Inhibitors
 - 6.3. Defaunation
- 7. Conclusion and Future Directions

Meat Science

Mick Price, University of Alberta, Edmonton, Alberta, Canada

- 1. Introduction
 - 1.1 Definitions
 - 1.2. Meat industry by-products
- 2. Harvesting
 - 2.1. Transportation
 - 2.2. Stunning, Slaughter and Dressing
 - 2.3 Packaging, Processing and Storage
 - 2.3.1. Vacuum Packaging
 - 2.3.2. Modified Atmosphere Packaging
 - 2.3.3. Oxygen Permeable
 - 2.3.4. Freezing
- 3. Conversion of muscle to meat
 - 3.1. Anatomy and Physiology of Living Muscle
 - 3.2. Muscle Contraction
 - 3.3. Muscle Fiber-types
 - 3.4. Myoglobin
 - 3.5. Post-mortem Glycolysis
 - 3.6. Ageing or Conditioning
- 4. Carcass Quality
 - 4.1. Dressing Percentage
 - 4.2. Cutability
 - 4.3. Appearance
 - 4.4. Grading and Classification
- 5. Meat quality

- 5.1. Appearance
- 5.2. Eating Quality (Palatability)
 - 5.2.1. Tenderness
 - 5.2.1.1. Ante mortem factors affecting tenderness
 - 5.2.1.2. Post mortem factors affecting tenderness
- 5.3. Juiciness
 - 5.3.1. Ante Mortem Factors Affecting Juiciness
 - 5.3.2. Post Mortem Factors Affecting Juiciness
- 5.4. Flavor
 - 5.4.1. Ante Mortem Factors Affecting Flavor
- 5.4.2. Post Mortem Factors Affecting Flavor
- 6. Measuring meat quality
 - 6.1. Instrument-based Measurements
 - 6.2. Human-based Measurements
- 7. Effects of cooking on meat
- 8. Conclusion

Agroecology: Environmentally Sound And Socially Just Alternatives To The Industrial Farming Model 211

Miguel A. Altieri, University of California, Berkeley, USA

1. Introduction

- 2. Agroecology and Sustainable Agriculture for Small Farmers in the Developing World
 - 2.1. Extent of Peasant Agriculture
 - 2.2. Agroecological Features of Traditional Farming Systems
 - 2.3. Examples of Traditional Agriculture Around the World
 - 2.3.1. Latin America
 - 2.3.2. Asia
 - 2.3.3. African Traditional Agriculture
 - 2.4. Biodiversity and its Ecological Function in Traditional Agriculture
 - 2.4.1. Indigenous Farming Systems as Design Models
 - 2.4.2. Applying Agroecology to Improve the Productivity of Small Farming Systems
 - 2.4.3. Current Limitations to the Widespread Use of Agroecology
 - 2.4.4. Scaling up of Agroecological Innovations
- Outlook and Prospects
 Organic Agriculture in the Industrial World
 - Organic Agriculture in the Indi
 - 3.1. Global Extent
 - 3.2. Differences between Organic and Conventional Agriculture
 - 3.3. Comparison of Productivity between Conventional and Organic Systems
 - 3.4. Organic Agriculture and Biodiversity
 - 3.5. Agroecological Features of Organic Farming Systems
 - 3.6. Agronomic and Ecological Performance during Transition to Organic Management
 - 3.7. Comparisons between Organic and Conventional Systems
 - 3.8. Healthy Soils-Healthy Plants
 - 3.9. Cuba: A National Experiment on the Conversion to Organic Agriculture
 - 3.10. Transitioning Organic Agriculture beyond Input Substitution
 - 3.11. Enhancing Biodiversity on Organic Farms
- 4. Moving Ahead
- 5. Conclusions

Range And Pasture Productivity

Edward W. Bork, University of Alberta, Canada

1. Introduction

2. Concepts, Terms and Measures 2.1. Vegetation Productivity

- 2.2. Animal Productivity
 - 2.2.1. Quantifying Animal Impacts: The Stocking Rate Concept
 - 2.2.2. Measures of Individual Animal Productivity
 - 2.2.3. Land-Based Measures of Animal Production
- 2.3. Carrying Capacity
- 3. Non-Disturbance Influences on Plant Production
 - 3.1. Intra-Specific Plant Controls
 - 3.2. Environmental Influences
 - 3.2.1. Climate
 - 3.2.2. Topography
 - 3.2.3. Soils
- 4. Range and Pasture Production Responses to Disturbance
 - 4.1. Plant Morpho-Physiological Changes Following Disturbance
 - 4.2. Plant Strategies to Deal with Defoliation
 - 4.2.1. Defoliation Avoidance
 - 4.2.2. Defoliation Tolerance
 - 4.3. Defoliation Impacts on Plant Growth
 - 4.3.1. Defoliation Severity, Timing and Frequency 4.3.2. Compensatory Plant Growth
 - 4.4. Plant Responses to Changes in Micro-Environment
 - 4.5. Range and Pasture Fire
- 5. Role of Plant Communities in Regulating Production
 - 5.1. Why Species Mixtures?
 - 5.2. Plant Community Dynamics under Disturbance
 - 5.2.1. Diagnostic Stages of Plant Community Change
 - 5.3. Community Resistance and Resilience
- 6. Management Considerations
 - 6.1. Identifying the Optimal Stocking Rate
 - 6.2. Sustainable Grazing Capacity
 - 6.2.1. Safe Use and Management Factor Adjustments
 - 6.2.2. Coping with Temporal Variation in Production
 - 6.3. Planned Management Strategies to Balance Plant and Animal Production
 - 6.3.1. Season-Long or Continuous Grazing
 - 6.3.2. Complementary or Seasonal Suitability Grazing
 - 6.3.3. Rest Rotational Grazing
 - 6.3.4. High Performance Grazing
 - 6.3.5. High Utilization Grazing
- 7. Conclusions

Sustainable Crop Production: Physiology, Biochemistry And Molecular Biology

294

Allen G. Good, Department of Biological Sciences, University of Alberta, Edmonton, AB, Canada Rowshon Begam, Department of Biological Sciences, University of Alberta, Edmonton, AB, Canada Ashok Shrawat, Department of Biological Sciences, University of Alberta, Edmonton, AB, Canada

- 1. Introduction.
- 2. What is Sustainable Crop Production?
- 3. Examples of Agriculturally Sustainable Systems.

4. Physiological and Biotechnological Approaches to Improvement Crop Sustainability. (Successes and Failures)

- 5. Are these Physiological/Molecular Technologies More Sustainable?
- 6. What are some of the New Developments That Will Need to be evaluated?
- 7. Regulatory Issues.
- 8. Lessons to be learned
- 9. How Can Transgenic Crops Contribute to Increased Food Productivity and Stability?
- 10. Funding and Organizational Issues: What Is Required for Success?
- 11. Developing Successful Research to Increase Yields (Target Areas)

Crop Improvement (The 'Gene' Revolution)

313

Nat N. V. Kav, Department of Agricultural, Food and Nutritional Science, University of Alberta, Canada William Yajima, Department of Agricultural, Food and Nutritional Science, University of Alberta, Canada

Nidhi Sharma, Department of Agricultural, Food and Nutritional Science, University of Alberta, Canada Sanjeeva Srivastava, Department of Agricultural, Food and Nutritional Science, University of Alberta, Canada

Sowmya Krishnaswamy, Department of Agricultural, Food and Nutritional Science, University of Alberta, Canada

1. Introduction

- 1.1. The Origin of Agriculture and Agricultural Revolutions
- 2. The green revolution
 - 2.1. Historical Perspectives
 - 2.2. The Generation of High Yielding Varieties (HYV)
 - 2.3. The Spread of the Green Revolution
 - 2.4. Success of the Green Revolution in India
- 3. Challenges for crop improvement and food production in the 21st century
 - 3.1. The Need for Another Revolution The Gene Revolution
 - 3.2. The Discovery of Genes and the Start of Genetic Engineering
 - 3.3. Gene Revolution in Plant Agriculture Genetic Engineering
 - 3.4. Potential Organizations Contributing to a Gene Revolution
- 4. Applications of genetic engineering in crop improvement: success stories
 - 4.1. Applications in Generating Disease-Tolerant Plants
 - 4.1.1. Available Techniques for the Generation of Disease Resistance
 - 4.1.2. Genetic Engineering for Increased Tolerance to Viral Phytopathogens
 - 4.1.3. Genetic Engineering for Increased Tolerance to Fungal Phytopathogens
 - 4.1.4. Genetic Engineering for Increased Tolerance to Bacterial Phytopathogens
 - 4.1.5. Genetic Engineering for Increased Tolerance to Nematode and Insect Phytopathogens
 - 4.2. Applications in Abiotic Stress
 - 4.2.1. Genetic Engineering of Plants for Abiotic Stress Tolerance: Some Examples

5. Conclusions

Ecological Economics

Brian Czech, Center for the Advancement of the Steady State Economy, 5101 South 11th Street., Arlington, Virginia 22204, USA

1. Historical Development of Ecological Economics

- 2. Approach and Philosophy of Ecological Economics
 - 2.1. Transdisciplinarity
 - 2.2. Ends, Means, and a Normative Stance
- 3. Themes and Emphases in Ecological Economics
 - 3.1. The Scale Issue
 - 3.2. Distribution of Wealth
 - 3.3. Allocation of Resources
- 4. Policy Implications of Ecological Economics
 - 4.1. Sustainable Scale
 - 4.2. Fair Distribution
 - 4.3. Efficient Allocation
- 5. Future Directions and Challenges for Ecological Economics
 - 5.1. Reinforcing the Primacy of Sustainable Scale
 - 5.2. Clarifying the Ecological Implications of Money Volumes and Flows
 - 5.3. Conceivable Need for De-Growth
- 6. Conclusion

Agricultural Economics

Ellen Goddard, Department of Rural Economy, University of Alberta, Canada Scott Jeffrey, Department of Rural Economy, University of Alberta, Canada Jim Unterschultz, Department of Rural Economy, University of Alberta, Canada Michele Veeman, Department of Rural Economy, University of Alberta, Canada Terrence Veeman, Department of Rural Economy, University of Alberta, Canada

1. Production Economics

- 1.1 The "Production Problem"
- 1.2. Traditional Production Economics
- 1.3 Production Economics Concepts
- 1.4 Contemporary Production Economics and Economic Issues
 - 1.4.1 Efficiency and Competitiveness
 - 1.4.2 Regulatory Reform and Production
 - 1.4.3 Agricultural/Environment Interaction
 - 1.4.4 Quantitative Production Economics Tools
- 2. Consumer Theory and Behavior
 - 2.1 Traditional Consumer Theory Applications in Agricultural Economics
 - 2.2 Contemporary Consumer Analysis in Agricultural Economics
 - 2.3 Methods Used in Determining Consumer Demands for Agricultural Products
- 3. Agricultural Marketing
 - 3.1 Market Structure Issues for Agriculture
 - 3.2 Marketing Programs and Policies
 - 3.3. Major current issues in agricultural marketing
- 4. Resource Economics
 - 4.1. Resource Conservation
 - 4.2. Economics of Land Use and Conservation
 - 4.3. Water Economics
- 5. Conclusion

Integrated Resource Management and Planning

Matthew Carlson, *ALCES Landscape Ecology Group, Canada* Brad Stelfox, *ALCES Landscape Ecology Group, Canada*

- 1. Introduction
- 2. Defining Integrated Resource Management
- 3. Elements of an Integrated Resource Management Approach
 - 3.1. Stakeholder Collaboration
 - 3.2. Explicit Goals and Indicators
 - 3.3. Tradeoff Analysis
 - 3.4. Adaptive Management
 - 3.5. Monitoring
 - 3.6. Development Thresholds
 - 3.7. Zoning
- 4. Integrated Resource Management in Practice
- 5. Conclusion

Index

About EOLSS

390

405