

# **National Livestock, Poultry and Aquaculture Waste Management**

**Proceedings of the  
National Workshop**

**29-31 July 1991  
Westin Crown Center Hotel  
Kansas, Missouri**

**Sponsored by  
USDA Extension Service  
Water Quality National Initiative Team**



**American Society of Agricultural Engineers**

ASAE Publication 03-92

# ***National Livestock, Poultry and Aquaculture Waste Management***

**Proceedings of the  
National Workshop**

**29-31 July 1991**

**Westin Crown Center Hotel  
Kansas City, Missouri**

Published by  
**American Society of Agricultural Engineers**  
**2950 Niles Rd., St. Joseph, Michigan 49085-9659 USA**

**Copyright © 1992 by  
American Society of Agricultural Engineers  
All rights reserved**

**Library of Congress Card Number (LCCN) 92-81342  
International Standard Book Number (ISBN) 0-929355-27-X**

**The American Society of Agricultural Engineers is not responsible for statements and opinions advanced in its meetings or printed in its publications. They represent the views of the individual to whom they are credited and are not binding on the Society as a whole.**

**NATIONAL LIVESTOCK, POULTRY AND AQUACULTURE  
WASTE MANAGEMENT WORKSHOP**

**DATE:**

July 29-31, 1991

**LOCATION:**

Westin Crown Center Hotel  
Kansas City, Missouri

**SPONSORED BY:**

USDA Extension Service Water Quality National Initiative Team

**Cosponsored By:**

USDA Agricultural Research Service; USDA Soil Conservation Service; US  
Environmental Protection Agency; Tennessee Valley Authority; Michigan State  
University, Department of Animal Science

**COOPERATOR:**

USDA Cooperative State Research Service

## PREFACE

This workshop was a cooperative effort of USDA-Extension Service, universities, state and national organizations, related agribusinesses, and allied industries. The workshop was organized to discuss issues relating to water quality and animal waste management. A cornerstone was laid to attempt to define problems and solutions that will ensure the soundness of our national resources. Growth and concentration of the livestock, poultry, and aquaculture industries has resulted in large volumes of waste that must be utilized in an environmentally sound manner. Increased concern for these matters is evident within the animal industries, by the public, and regulatory agencies.

The intent of this workshop was to enhance the understanding of issues underlying water quality initiatives supported by Federal programs relative to the environmentally sound utilization of wastes generated by livestock, poultry and aquaculture activities. In an attempt to provide a broad overview of issues as perceived by various government agencies and industry participants, discussion and networking were stimulated. Although this workshop was conceived as a one-time event, continued dialogue between industries, the public and governmental agencies may provide a need for follow-up workshops.

## EDITORIAL

The manuscripts presented for this workshop were reviewed and subjected to minor revision, as necessary, by the editors. The manuscripts were not evaluated by a peer review process. We want to thank all authors for their diligence and timeliness in preparation of their manuscripts. The editors are indebted to Patricia Owen for her technical assistance and dedicated efforts in ensuring the quality of this proceedings.

Unless otherwise stated, mention of trade names in this proceedings does not imply endorsement by the editors or workshop sponsors.

John Blake  
James Donald  
William Magette

Editors

## ACKNOWLEDGEMENTS

The organization and administration of a successful workshop requires diligence and cooperation of many individuals and organizations. This workshop was no exception. The cooperation among the committees and the dedication and perseverance by the committee chairs is greatly appreciated. A thank you is deserving of those who were involved in the planning and execution of this workshop.

It is impossible to list all those that made significant contributions to this workshop. Certainly the planning committees, session chairs who coordinated their program portion, and speakers deserve a lion's share of the credit for the success of this workshop. The success of this workshop will result in far-reaching effects for the scope of animal agriculture and aquaculture.

Jon Hiler and Judy Brown of the American Society of Agricultural Engineers should be recognized for their coordination of local arrangements.

We gratefully acknowledge the financial contribution of Farmer Automatic of America, Inc.

## WORKSHOP COMMITTEES

Coordinator	Richard Reynnells USDA-Extension Service Washington, DC
Program Co-Chairpersons	Lewis Carr University of Maryland Richard Reynnells USDA-Extension Service
Poster Session and Exhibits	Glenn Carpenter West Virginia University
On-site Media and Facilities	Cal Flegal Michigan State University
Promotion and Public Relations	Maynard Hogberg Michigan State University
Proceedings Co-Editors	John Blake, Chair Auburn University James Donald Auburn University William Magette University of Maryland at College Park
Local Coordinators	Jon Hiler, ASAE Judy Brown, ASAE

## GENERAL PROGRAM PLANNING COMMITTEE\*

Lewis Carr	University of Maryland at College Park
Richard Reynnells	USDA Extension Service
Steve Pretanik	National Broiler Council
Kathleen Hartnett	National Cattleman's Association
Mike Smith	National Cattleman's Association
John Adams	National Milk Producers Federation
Chris Novak	National Pork Producers Council
Joe Pocius	National Turkey Federation
Joe Zublena	North Carolina State University
Ken Lippen	United Egg Producers
Lewis Smith	USDA Agricultural Research Service
Gary Jensen	USDA Extension Service
Harvey Mack	USDA Soil Conservation Service
Catherine Long	US Environmental Protection Agency
Anne Weinberg	US Environmental Protection Agency
Fred Wheaton	University of Maryland at College Park
Larry Stewart	University of Maryland at College Park
William Magette	University of Maryland at College Park
Mitch Woodard	University of Maryland at College Park

*\*As stated in the acknowledgements, many more people contributed to the final program.*

## COMMODITY PLANNING COMMITTEES

### Agronomy and Economics

Joseph Zublena, Co-Chair	North Carolina State University
Lee Christensen, Co-Chair	USDA, Economic Research Service
Tammy Daniels	University of Arkansas
Ken Foster	Purdue University
Bob Steward	USDA/ARS, Bushland, TX
Stan Wilkenson	USDA, Watkinsville, GA

### Aquaculture

Gary Jensen, Co-Chair	USDA-Extension Service, Washington, DC
Jerry Shireman, Co-Chair	University of Florida
Bob Bastian	US Environmental Protection Agency
Les Behrends	Tennessee Valley Authority
Ernie Bannon	University of Idaho
Meryl Broussard	USDA/CSRS, Washington, DC
John Ewart	University of Delaware
Jeff Hinshaw	North Carolina State University
Kevan Main	The Oceanic Institute
Joe McCraren	National Aquaculture Association
Lona Minne	Minnesota Aqua Farms

John Nickum  
Brad Powers

LaDon Swann  
Craig Tucker  
Harry Westers

### Beef

James Clawson, Co-Chair  
Bill Boyd, Co-Chair  
Will Blackburn  
Chuck Clanton  
Edward Prigge  
John Sweeten  
Andy Tucker  
Ross Wilson

### Dairy

Dean Falk, Co-Chair  
Anne Weinberg, Co-Chair  
Eldridge Collins, Jr.  
Basil Eastwood  
Bill Lazarus  
Catherine Long  
Bill Ritter  
Mary Leigh Wolf

### Poultry

John Schwartz, Co-Chair  
Harvey Mack, Co-Chair  
John Blake  
Glenn Carpenter  
Lewis Carr  
Lee Christensen  
Donald Conner  
Don Dalton  
James Donald  
Cal Flegal  
Ken Holleman  
Ken Klippen  
William Merka  
Dennis Murphy  
Cliff Oilor  
Joe Pocius

### Swine

Leslie Christianson, Chair  
Dwayne Bundy  
Don Day  
Jerry King  
Mac Safley

US Fish & Wildlife Service  
National Association State  
Aquaculture Coordinators  
Purdue University  
Mississippi State University  
Michigan Department of Natural Resources

University of California  
USDA/SCS, Lincoln, NE  
USDA/ARS, Boise, ID  
University of Minnesota  
West Virginia University  
Texas A & M University  
NCA Water Quality Subcommittee  
Texas Cattle Feeders

University of Idaho  
US Environmental Protection Agency  
Virginia Tech  
USDA-Extension Service, Washington, DC  
University of Minnesota  
US Environmental Protection Agency  
University of Delaware  
Texas A & M University

Pennsylvania State University  
USDA/SCS, Washington, DC  
Auburn University  
West Virginia University  
University of Maryland  
USDA/ERS, Washington, DC  
Auburn University  
Southeastern Poultry & Egg Assoc.  
Auburn University  
Michigan State University  
Oregon State University  
United Egg Producers  
University of Georgia  
University of Maryland  
Pacific Egg & Poultry Association  
National Turkey Federation

University of Illinois  
Iowa State University  
University of Illinois  
National Park Producers Council  
North Carolina State University



Mac Safley  
Art Muehling  
Alan Sutton  
M. E. Tumbleson  
Steve Pretanik  
Richard Reynnells  
William Ritter  
Jerry Truitt  
Lee Tsai

Food Processing

William Merka, Co-Chair  
Ray Carawan, Co-Chair  
Ellis Brunton  
Lewis Carr

North Carolina State University  
University of Illinois  
Purdue University  
University of Illinois  
National Broiler Council  
USDA-Extension Service, Washington, DC  
University of Delaware  
Delmarva Poultry Industry  
USDA/ARS, Albany, CA

University of Georgia  
North Carolina State University  
Tyson Foods  
University of Maryland

# Table of Contents

Sponsoring Organizations .....	viii
Preface .....	ix
Acknowledgements .....	x
<b>INTRODUCTION</b>	
R. D. Reynnells .....	1
<b>WELCOME</b>	
T. R. Yonke .....	3
<b>NATIONAL OVERVIEW</b>	
Livestock and Poultry Waste Management: A National Overview .....	4
J. M. Sweeten	
<b>FUTURE OF ANIMAL WASTE MANAGEMENT</b>	
Future of Animal Waste Management: Research Perspective .....	16
L. W. Smith and W. D. Kemper	
Animal Waste Management: An Industry Perspective .....	23
E. W. Brunton	
<b>LEGISLATIVE OUTLOOK</b>	
Self-Regulation vs. Legislative Regulation--It's Your Choice .....	27
G. L. Bullard	
Perspective of a State Water Commission Regarding Animal Waste Management .....	30
J. D. Bush	
Managing Animal Waste in Missouri .....	35
D. Whiteside	
<b>COMPOSTING</b>	
National Overview of Composting .....	38
R. M. Kashmanian	
<b>IMPACTS OF ANIMAL WASTE MANAGEMENT ON WATER QUALITY</b>	
The Impact of Livestock Waste on Water Resources in the United States .....	48
C. M. Long and W. Painter	
Impacts of Animal Wastes on Water Quality: A Perspective from USDA .....	52
J. Fedkiw	
Do Your Best Management Practices Really Work? Assessing Effectiveness of Manure Management Practices Through Biological Monitoring .....	63
K. Firehock	
Status of Florida Regulations of Dairy Farm Waste Management .....	67
W. A. Darling	
Impact of Animal Waste Management on Water Quality .....	71
L. N. Mielke	
Corps of Engineers Regulatory Program and Agriculture .....	77
J. F. Studt	

<b>UTILIZATION OF ANIMAL WASTES</b>	
Innovative Utilization of Animal Waste.....	82
J. N. Krider	
<b>IMPLICATIONS OF ENERGY RECOVERY TECHNOLOGIES</b>	
Profitable Alternatives for Regulatory Impacts on Livestock Waste	
Management .....	89
K. F. Roos	
<b>CASE STUDY: CHESAPEAKE BAY PROGRAM</b>	
The Chesapeake Bay Experience.....	100
L. R. Shuyler	
<b>NUTRIENT MANAGEMENT</b>	
Nutrient Management Plans and Related Programs Using Livestock and	
Poultry Waste.....	106
R. A. Wiese	
Nutrient Management in Livestock Waste Systems.....	110
C. Fulhage	
Permits, Process and Variations.....	116
R. W. Summers	
<b>RESPONSIBILITY AND ANIMAL WASTE MANAGEMENT</b>	
Our Responsibility in Animal Waste Management.....	121
J. J. Smith	
<b>GOVERNMENT AGENCIES</b>	
EPA Programs Addressing Animal Waste Management.....	128
A. C. Weinberg	
The Role of Extension in Implementing Animal Waste Management	
Priority Programs .....	134
V. M. Jennings	
ASCS Water Quality Initiatives.....	137
J. R. McMullen	
Government Agency-Tennessee Valley Authority.....	140
V. C. Bice	
Government Agency-SCS .....	146
G. D. Seinwill	
<b>COMMODITY PRESENTATIONS</b>	
<b>AGRONOMY AND ECONOMICS</b>	
Effect of Animal Manure on Soil Physical and Chemical Properties.....	149
B. A. Stewart	
Effect of Soil Test Phosphorus on the Quality of the Runoff Water:	
Research Needs .....	155
T. C. Daniel, A. N. Sharpley, and T. J. Logan	
An Economic Overview of Livestock Waste Management Concerns.....	161
K. A. Foster	
Nitrogen Carryover from Broiler Litter Applied to Coastal Bermudagrass.....	166
S. R. Wilkinson	

## AQUACULTURE

Fish Farm Effluent Quality . . . . .	171
E. L. Brannon	
Quality of Potential Effluents from Channel Catfish Culture Ponds . . . . .	177
C. S. Tucker	
Economic Implications of Water Quality Management for a Commercial Trout Farm . . . . .	185
R. MacMillan	
The Aquaculture Pond Effluent Problem - Past, Present, and Future . . . . .	191
C. E. Boyd	
The Use of Trout Manure as a Fertilizer for Idaho Crops . . . . .	198
G. L. Olson	
Water Quality from Florida Catfish and Fingerling Culture Ponds . . . . .	206
J. V. Shireman and C. E. Cichra	
Status of Waste Management Practices in Marine Net-Pen Systems in Washington State . . . . .	211
D. P. Weston	
Working with State Agencies and Policy Makers on Aquaculture Regulatory Issues . . . . .	216
L. Minne	
Overview of Federal Regulations Pertaining to Aquaculture Waste Management and Effluents . . . . .	220
R. K. Bastian	
Aquaculture Effluent Regulation: State Regulatory Perspective. . . . .	227
D. Joyner	

## BEEF

### Confinement Feeding

Environmental Management for Commercial Cattle Feedlots in Moisture Deficit Locations . . . . .	232
J. M. Sweeten	
Beef Cattle Waste Management Systems for the Farmer-Feeder in Humid Climates . . . . .	247
C. J. Clanton	

### Riparian and Pasture

Western Rangeland Riparian Waste Management Issues . . . . .	253
W. H. Blackburn and M. K. Wood	
Recycling and Potential Problems of Excreta from Beef Cattle on Pasture in the East . . . . .	258
E. C. Prigge and W. B. Bryan	
Water Quality Concerns of Beef Producers . . . . .	263
A. Tucker and M. T. Smith	

## DAIRY

Dairy Manure Management - An Industry Perspective . . . . .	267
D. Grusenmeyer	
Regulations Bolster Voluntary Programs for Clean Up of Agricultural Nonpoint "Bad Actors" in Wisconsin . . . . .	273
E. Odgers	

<b>POULTRY</b>	
Poultry Waste Issues of Concern on Delmarva . . . . .	278
L. E. Carr	
The Poultry Waste Management Situation in Oregon. . . . .	280
K. A. Holleman	
Poultry Waste Management in Alabama . . . . .	282
J. O. Donald and J. P. Blake	
<b>SWINE</b>	
Producer Priorities and Perspective . . . . .	285
J. King	
Odor Issues with Wastes . . . . .	288
D. S. Bundy	
Swine Manure as a Crop Nutrient Resource . . . . .	293
A. L. Sutton	
Evaluation of Swine Waste Management - Facilities and Methods . . . . .	298
L. M. Safley, Jr.	
Swine Commodity Group - Regulations. . . . .	301
A. J. Muchling	
<b>COMMODITY RECOMMENDATIONS</b>	
Agronomy and Economics . . . . .	304
J. Zublena	
Aquaculture . . . . .	307
G. L. Jensen	
Beef . . . . .	309
W. J. Clawson	
Dairy . . . . .	314
D. E. Falk	
Poultry . . . . .	317
J. Schwartz	
Swine . . . . .	320
L. L. Christianson, D. L. Day, and M. E. Tumbleson	
Food Processing. . . . .	324
R. E. Carawan and W. Merka	
<b>GENERAL RECOMMENDATIONS</b>	
Animal Agriculture: Priority Nominations. . . . .	327
R. Reynnells	
<b>POSTER PRESENTATIONS</b>	
Chemical Test Kits for Aquaculture Effluent Monitoring: Selection and Application . . . . .	336
D. E. Terlizzi	
Use of Recirculation and Biofiltration in Maintaining Water Quality in Aquaculture Ponds . . . . .	340
W. J. Lorio and P. W. Perschbacher	
Extending the Value of Aquaculture Effluents Through Sustainable Agriculture Practices. . . . .	344
K. M. Fitzsimmons	

Feasibility of Using Vegetable Hydroponics to Treat Aquaculture Effluents . . . . .	347
J. E. Rakocy	
Waste Management of Sediment Laden Effluent Streams Generated by Intensive Recirculating Aquaculture Systems . . . . .	351
R. F. Malone, D. E. Coffin, and S. Chen	
Cost and Economic Feasibility of Dairy Waste Management: Central Texas Representative Dairies . . . . .	355
G. Allen, A. Lovell, B. Schwart, R. Lacewell, J. Schmucker, D. Leatham, and J. Richardson	
Comparative Protocol for Evaluating Water Quality and Effluent Discharge from Intensive Aquaculture Production Systems . . . . .	360
T. S. Handwerker	
Utilization of Composted Poultry Carcasses: A Preliminary Field Evaluation. . . .	365
T. S. Handwerker, T. Sims, and D. Murphy	
Integrated Aquaculture Based on Spirulina, Livestock Wastes, Brine and Power Plant Byproducts . . . . .	369
N. C. Parker, M. C. Bates, C. B. Fedler	
Managing Aquaculture Wastes--Nutritional Aspects. . . . .	373
P. B. Brown	
Aquaculture Production Using Water Reuse Technologies to Reduce Waste Water. . . . .	377
D. E. Owsley	
Processing Fish and Seafood Waste into Animal Feed . . . . .	382
A. H. Stephenson, T. A. McCaskey, and B. G. Ruffin	
Managing Broiler Litter as a Feed Resource . . . . .	387
T. A. McCaskey, A. H. Stephenson, B. G. Ruffin, and R. C. Strickland	
An Extension Program for Poultry Waste Management . . . . .	393
J. P. Blake and J. O. Donald	
Fish Composting in Michigan . . . . .	398
W. J. Hoagman	
<b>LIST OF ATTENDEES . . . . .</b>	<b>401</b>

## INTRODUCTION

Richard D. Reynnells  
NPL-Poultry Science  
USDA Extension Service  
Room 3334 South Agriculture Building  
Washington, DC 20250-0900

With teamwork between government agencies and the industries, and acceptance of individual responsibilities, we have a chance of solving or ameliorating waste management and water quality problems. Waiting to be regulated into compliance with water quality standards solves few problems because there is a perceived or actual lack of concern for our environment. More importantly, there is a lack of commitment to our responsibilities for maintaining ground and surface water quality. Without a commitment, real progress is an illusion and a creator of jobs at the local, state and Federal levels.

By actively seeking ways to minimize our negative impacts on the environment, we may actually boost the profit potential of individual farms. For example, waste management plans integrate knowledge of nutrient availability, crop needs and the nutrient level of inputs. Using a holistic approach, least cost or optimal production of crops is possible. In some cases, manures may be composted and applied to the land or sold. Marketing systems need to be established for the by-products of production in order to achieve sustained profits and to utilize what has been considered waste.

Who knows better the challenges faced by farmers and others on the firing line than persons in that position? Advisory councils, meetings such as this, and independent communication with government personnel strengthens the regulations we require, and which are also certain to exist. Regulations are necessary to control the small minority that apparently have little or no concern for the environment, and possibly a primary concern for their convenience or profit. Regulations are strengthened by being reasonable, by setting realistic goals and standards that may be modified over time, and by earning the trust and/or cooperation of persons being regulated. Regulation without assistance and appropriate patience is neither effective nor in the best interest of stated goals of protecting our environment. Government personnel have a responsibility to first educate and to provide financial and/or research assistance, then use other measures as necessary to protect the quality of our water supplies. The reauthorization of Clean Water Act, which is currently underway, and the Coastal Zone Management Act, have components that undoubtedly will significantly affect all of animal agriculture. Farmers who actually do not have a problem with waste management or water quality should not be penalized for those that do. This would not appear to be the traditional answer to water quality concerns.

The attitude of cooperation between industry and government is supported by the buy-in via financial and personnel support for this program by several USDA agencies, the Environmental Protection Agency, and commodity organizations. It is each of our responsibility to facilitate this team effort at all levels of government and the industries. We also need to encourage laggards within these categories to adopt a proactive attitude and not totally rely on regulations, or the equally ineffective hands-off approach to addressing water quality issues. Encouragement must be provided industry personnel to make required changes and actively seek alternatives that improve waste management and water quality.

We are here today to attempt to define problems and solutions so that voluntary programs will achieve the water quality goals necessary to sustain both the animal industries and the environment. Without networking, and input by the industries regarding local, state and federal legislation and regulations, we lose the ability to create a teamwork approach to solving our problems. This absence also eliminates the possibility of viable educational programs, and hinders technical assistance and research programs. Networking also allows persons in the affected industries, and other citizens, the opportunity to know how their tax dollars are being spent by persons in positions of trust.

The purpose of the workshop is to provide a national forum to develop a broad consensus on the scope, dimensions and implications of the impacts of animal waste on water quality. The prioritized recommendations from commodity workgroups will represent educational, research, and technical assistance requirements, solutions and opportunities, and an identification of potential barriers and constraints in dealing with the water quality issues related to animal waste management.

Presentations are intended to enhance the understanding of the issues surrounding water quality and waste management. By providing a broad overview of these issues as perceived by the various government agencies and industry representatives, we hope to stimulate honest discussion and networking, and to set the stage for the establishment of meaningful recommendations. Even though this fact-finding workshop is a one-time event, the intent is to make an important contribution to the continued dialogue between the affected industries, citizens, and government agencies.



## **WELCOME**

**Thomas R. Yonke**  
**AFNR Program Director/Assistant Dean**  
**Agricultural Extension, 2-70 Agriculture Building**  
**University of Missouri Columbia, Columbia, MO 65211**

**Good Morning! It is a special pleasure to welcome you to Kansas City for the National Livestock, Poultry and Aquaculture Waste Management Workshop.**

**Kansas City is an appropriate setting for this workshop because of its place in the history of development and growth of the livestock industry and because of its current leadership in agribusiness.**

**Missouri is a very diverse state with over five million people located predominantly in three metropolitan areas and with about 106,000 farms.**

**Missouri ranks second in the nation in cow-calf numbers which are on over 80,000 farms. These numbers reflect the nature of Missouri as a forage based livestock state. We are also taking steps to regain our national standing in the swine industry and Missouri has a rapidly growing poultry industry, both in turkeys and broilers. These enterprises have special implications to Missouri's natural resources and will be the subject of many discussions over the next couple of days.**

**In recognition of some of the water quality and other environmental concerns, University Extension and the State Department of Natural Resources led an effort in 1989 to establish a State Water Quality Coordinating Committee composed of state and federal agencies and other interested parties relating to these issues. The group has served to identify, discuss, set priorities and initiate plans to deal with water quality issues. The Committee has served well the interests of both agriculture and natural resources. The University of Missouri is a full partner in this process.**

**Also, in 1989 University Extension established a special programming initiative in water quality. This has evolved into a current major initiative, Environmental Quality and Stewardship which addresses water quality, natural resource management and solid waste. Extension is involved in the Missouri Goodwater Creek Project, one of the national MSEA projects, focusing on crop production management systems. We are a part of the operating team, along with SCS and ASCS, on the Niangua River Hydrologic Unit addressing best management practices on dairy farms. In addition, Extension has been a key player in developing educational materials relating to water quality and the expanding poultry industry. The latter efforts have been supported by MDNR and EPA Region VII.**

**In Missouri, all of the payers have enjoyed a full partnership in dealing with these critical issues for the future of agriculture and our natural resources. In like manner, I encourage you to share your perspectives, expertise and talents as we plan both to better serve our animal industry and to insure a lasting quality environment for all citizens.**

**Again, Welcome to Missouri and Kansas City!**