

ACTES DE
COLLOQUE

Rennes
26-29 mai 1998
Cemagref France



Ramiran 98 *posters presentations*

8th International Conference on Management
Strategies for Organic Waste Use in Agriculture

8^e conférence internationale sur les stratégies
de gestion des déchets organiques en agriculture

Edited by José Martinez and Marie-Noëlle Maudet



Cemagref
EDITIONS

European System of Cooperative
Research Networks in Agriculture
(ESCORENA)

**Proceedings of the 8th International Conference
on the FAO ESCORENA Network
on Recycling of Agricultural,
Municipal and Industrial Residues in Agriculture
(Formerly Animal Waste Management).
Rennes, France, 26-29 May 1998**

RAMIRAN 98

*Actes de la 8ème Conférence du Réseau FAO
ESCORENA sur le Recyclage des Déchets Agricoles,
Municipaux et Industriels en Agriculture.
Rennes, France, 26-29 mai 1998.*

*Edited by:
José Martinez and Marie-Noëlle Maudet*

Proceedings of the Posters Presentations



The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of the frontiers or boundaries.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying or otherwise, without the prior permission of the copyright owner. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to :

- the Director, Information Division, Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00100 Rome, Italy.
- the Chef du service de l'IST, Cemagref, DSIC BP 44 92163 Antony Cedex, France

© FAO and Cemagref 1999

RAMIRAN 98. Actes de la 8^e conférence internationale sur les Stratégies de gestion des déchets organiques en agriculture. Rennes 26 – 29 mai 1998. **Volume 2 consacré aux présentations dites « posters ».** Coordination de l'édition : José Martinez et Marie-Noëlle Maudet. Impression et façonnage : imprimerie Cemagref, Antony, France. Vente par correspondance : Publi-Trans, BP 22, 91167 Longjumeau Cedex 9 - France, tél. 01 69 10 85 85. Diffusion aux libraires : Tec & Doc Lavoisier, 14, rue de Provigny, 94236 Cachan cedex – France
© FAO et Cemagref 1999, ISBN 2-85362-531-1. Dépôt légal : 2^e semestre 1999. Prix : 250 F TTC (38,11 € TTC).

Ramiran 98

8th International Conference on Management Strategies for Organic Waste Use in Agriculture.

8ème Conférence Internationale sur les Stratégies de Gestion des Déchets Organiques en Agriculture.

Edited by José Martinez and Marie-Noëlle Maudet

Advisory and Programme Committee :

J. Martinez - Cemagref France, Local Organizer.
J.E. Hall - WRC, Network Co-ordinator, UK.
J.C. Fardeau – INRA, France.
B.F. Pain - IGER North Wyke, UK.
G. Guiraud – CEA, France.
F. Béline – Cemagref, France.
C.H. Burton - Silsoe Research Institute, UK.
D. Chadwick - IGER North Wyke, UK.
A. de Guardia - Cemagref France.

Organizing Committee :

J. Martinez, Conference Organizer.
M.N. Maudet, Conference Secretary.
F. Béline.
P. Peu.
F. Guiziou.
D. Rogeau.
A. de Guardia
G. Le Bozec.

Avec la participation de :

F. Roche - Cemagref Rennes, Directeur.
R. Krell – FAO, Rome.
I. Alvarez – FAO, Rome.
R. Pochat – Cemagref, Antony.
J. Clément – Cemagref, DSIC, Antony.
C. Cédra – Cemagref, DSIC, Antony.
M. Boudot-Lamotte – Cemagref, Antony
V. Lucas - Hôtel Mercure, Rennes.
F. Egido – Cemagref, Rennes.
K. Morel – Hôtesse d'accueil, Rennes.

Résumé

Ce volume complète les actes de la 8^{ème} Conférence Internationale d'un Réseau FAO sur le Recyclage des Déchets Agricoles, Municipaux et Industriels en Agriculture (réseau RAMIRAN), qui s'est tenue à Rennes du 26 au 29 mai 1998. Il rassemble notamment une sélection de 39 articles présentés sous forme de « poster » ainsi que deux synthèses issues des groupes de travail.

Le thème de la Conférence était les stratégies de gestion des déchets organiques utilisés en agriculture et cette session poster était organisée en 4 parties :

- Stratégies de gestion des déchets organiques utilisés en agriculture.
- Valeur agronomique des déchets organiques.
- Mesure, modélisation et maîtrise des émissions gazeuses.
- Traitement et gestion des déchets.

Dix articles sont présentés dans la première partie sur le thème des stratégies de gestion allant de la variabilité dans l'épandage de fumiers et lisiers aux systèmes de réglementation en vigueur dans la région Lombarde en Italie.

La deuxième partie comprend une série de dix articles sur la valeur agronomique, articulés autour de la caractérisation des déchets à recycler, le risque de contamination bactérienne lié à leur utilisation ainsi que la détermination de la dose optimale pour une meilleure efficacité azotée.

La troisième partie traite de la pollution de l'air provoquée par l'activité agricole et notamment les émissions d'ammoniac, de protoxyde d'azote, de méthane et d'odeurs. Les résultats présentés identifient les principales sources (bâtiment, stockage, épandage) et les principaux produits organiques étudiés : lisiers, fumiers, composts, boues, et témoignent de nombreuses interactions entre ces différents composés gazeux.

La quatrième partie décrit différents procédés de traitement et de gestion des déchets, notamment des lisiers, à travers des techniques telles que l'aération, la construction de zones humides ou le traitement chimique par ajout d'additifs.

Enfin deux articles issus des groupes de travail sur les déchets solides et sur les éléments traces métalliques sont présentés.

General Abstract

This volume extends the Proceedings of the 8th International Conference of the FAO ESCORENA Recycling of Agricultural, Municipal and Industrial Residues in Agriculture Network (RAMIRAN), held in Rennes, France from 26 to 29 May 1998. It contains a selection of poster presentations plus two surveys coming from the expert groups.

The theme of the Conference was Management Strategies for Organic Waste Use in Agriculture and this poster session was divided into four parts :

- Management strategies for organic waste use in agriculture.
- Agronomic value of organic wastes.
- Measurement, modelling and control of gaseous emissions.
- Processing and handling of wastes.

There were ten poster papers presented in the first part, covering a wide range of topics, from the variability in the distribution of manure from slurry or solid manure spreaders to the regulatory system for manure management in the Lombard region of Italy.

The organic wastes can be a source of nutrients for plant nutrition. Through the ten papers presented on the theme Agronomic values the wastes have been considered as that source of nutrients but also their contamination potential for soils and waters has been taken into account.

The third part offered a comprehensive overview on the ongoing research work in the field of gaseous emissions from handling and utilisation of organic residues in agriculture. The authors mainly focused on ammonia, but also on methane, nitrous oxide and odour emissions. It became clear that a lot of interactions occur between emissions of various gases.

Part four covered the different aspects of processing wastes, with a special attention on livestock slurries through biological processes (aeration, constructed wetland) and chemical approaches.

Finally two survey papers produced from the expert groups on solid manure and on trace elements are published in this volume.

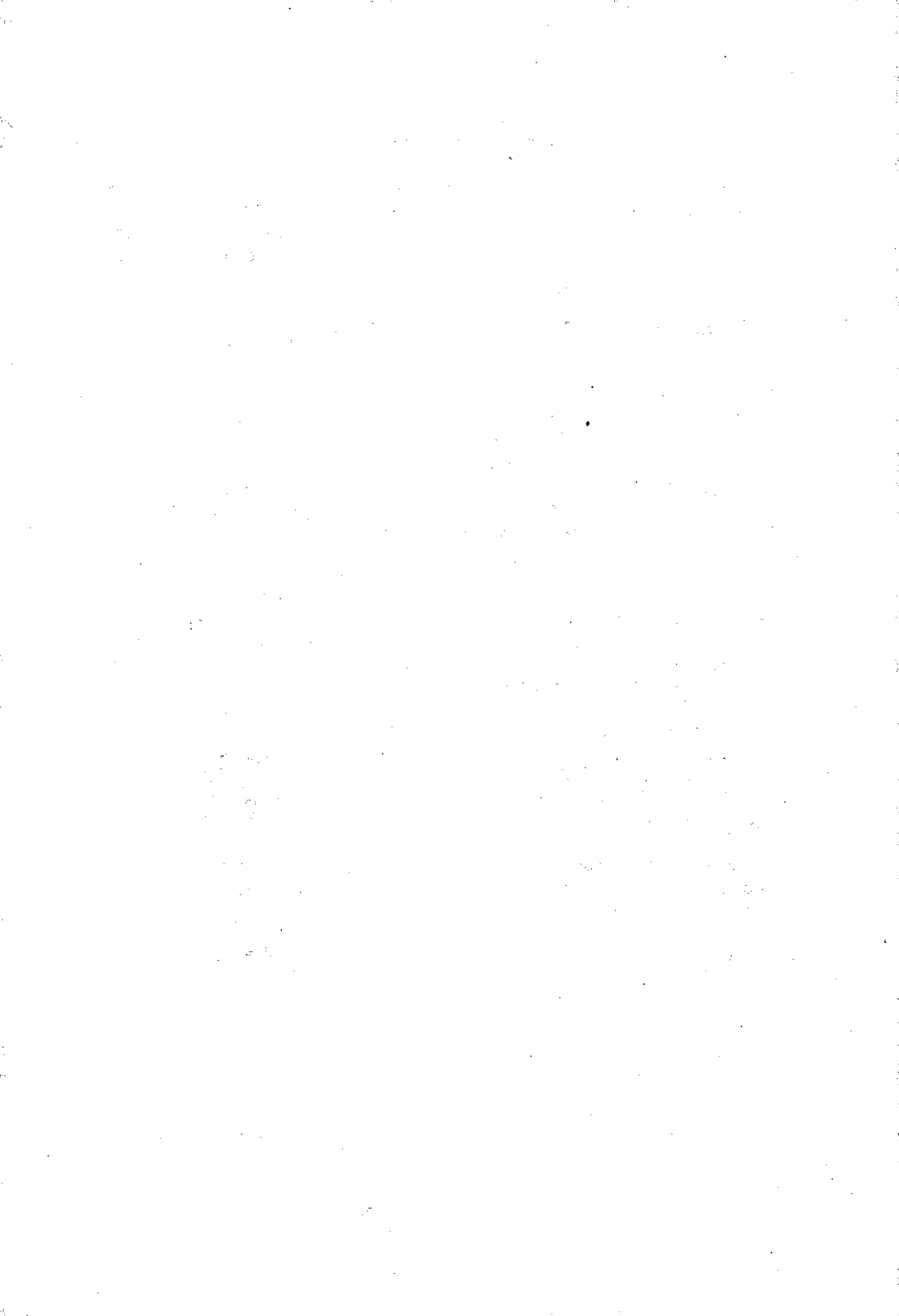


Table of Contents

Preface	11
<u>Part 1 bis : Management strategies for organic waste use in agriculture.</u> ..	13
Poultry housing and manure management systems : recent developments in Italy as regards ammonia emissions.....	15
<i>F. da Borso, R. Chiumenti (Italy)</i>	
Logistical considerations for spent mushroom compost utilisation.	23
<i>W. Magette, S. Smyth and V. Dodd (Ireland).</i>	
Environmental impacts of outdoor pig production.....	31
<i>H. Menzi, W. Stauffer, U. Zihlmann, P. Weisskopf (Switzerland).</i>	
Case studies of waste minimisation on farms.....	41
<i>R.J. Nicholson, D.J. Baldwin, J.P. Metcalfe, K.A. Phillips, P. Brumpton (U.K.).</i>	
A survey of toxic organics in Norwegian sewage sludge, compost and manure.....	51
<i>B. Paulsrud, A. Wien, K.T. Nedland (Norway).</i>	
Animal slurry management and lombard regulations : an example of application.....	61
<i>G. Provolo, F. Sangiorgi (Italy).</i>	
Effect of housing system, litter versus totally slatted floor, on mass balances of water, nitrogen and phosphorus in growing-finishing pigs.....	71
<i>P. Robin, P.A. Oliveira, D. Souloumiac, C. Kermarrec, J.Y. Dourmad (France).</i>	
A farmer-operated system for recycling food waste and municipal sludge to agriculture.. ..	79
<i>O.J. Skjelhaugen (Norway).</i>	
A management perspective on improved precision manure and slurry application.....	89
<i>K.A. Smith and D.J. Baldwin (UK).</i>	
Management of pig slurry for nitrogen fertilization of corn.....	97
<i>Y. Fauvel and T. Morvan (France).</i>	
Chairman's summary of part 1 bis	107

Part 2 bis. Agronomic value of organic wastes..... 109

Valorisation of organic wastes in agriculture. Compostage supply for the use of organic matters as background nitrogen fertilizer.. 111
F. Bouanani, M. Domeizel, A. Prone (France).

Agronomic value of alkaline stabilised sewage sludge solids.. 121
P. Christie, D.L. Easson, J.R. Picton, S.C.P. Love (UK);

Survival of manure-derived pathogens in soil..... 129
D. Cools, G. Van der Velde, R. Merckx, J. Verhaegen, K. Vlassak (Belgium)

Environmental impact of NPK-fertiliser versus anaerobic digestion residue or compost - A system analysis..... 139
M. I. Dalemo, A.E. Björklund, U.G. Sonesson (Sweden).

Yield effect and utilization of nitrogen from solid manure 149
U. Walther and U. Herter (Switzerland).

The utilization of differently treated sewage sludges in agriculture. 159
P. Ruzek, J. Hrazdira and H. Kusa (Czech Republic).

Nitrogen regime of two bulgarian soils after 30 years of mineral and organic-mineral fertilisation (¹⁵N study)..... 167
V. Koutev and E. Ikonomova (Bulgaria).

Predicting the fertilizer nitrogen value of farm manure applications to agricultural land.. 177
F.A. Nicholson, B.J. Chambers, E.I. Lord and K.A. Smith (U.K).

Bacteriological and chemical (nitrogen, phosphorus) characterization of liquid wastes discharged by four dairy farms. (Vendée, France). 185
S. Reyne, C. Cheverry, J. Marrec (France).

Long term effects of excessive organic waste application. 195
A. Siegenthaler, H. Hänni and W. Stauffer (Switzerland)

Chairman's summary of part 2 bis 205

Part 3 bis. Measurement, modelling and control of gaseous emissions.. 207

Emissions of NH₃, N₂O and CH₄ from composted and anaerobically stored farmyard manure.. 209
B. Amon, Th. Amon, J. Boxberger A., Pollinger (Austria)

Ammonia emission from naturally ventilated building for dairy cows.....	217
<i>J.B. Dollé (France).</i>	
Comparison of ammonia losses under various conditions after organic fertilization.....	225
<i>S. Générmont, D. Flura, P. Cellier (France).</i>	
Stable isotopes to investigate decay processes in farm wastes.....	235
<i>P.J. Hobbs, R. Johnson and D. Chadwick (UK).</i>	
Emission rates of odorous compounds from pig slurries..	243
<i>P.J. Hobbs, T. H. Misselbrook and B.F. Pain (UK).</i>	
Source separation of human urine - nitrogen and phosphorus emissions.....	251
<i>H. Jönsson, B. Vinneras, A. Burström, C. Höglund, T.A. Stenström (Swedish).</i>	
Estimating ammonia losses during the composting of farmyard manure, using closed dynamic chambers..	261
<i>T. Morvan, J. Dach, P. Cellier (France).</i>	
Nitrogen deposition on forests and open land in regions with different livestock densities.....	267
<i>G. Steffens, K. Mohr, F. Lorenz (Germany).</i>	
Odour and ammonia emission control by slurry treatment and covering.....	275
<i>G. Hornig, W. Berg., U. Wanka (Germany).</i>	
Human urine and effluents from digestion of food refuse as a fertiliser to barley-Crop yields, ammonia emission and nitrate leakage.	285
<i>H. Elmsquist, L. Rodhe, M. Blomberg, S. Steineck, B. Lindén</i>	
Chairman's summary of part 3 bis	295
<u>Part 4 bis. Processing and handling of wastes</u>	297
Aeration of cattle slurry at low or high temperature in finish climate.....	299
<i>H.Heinonen-Tanski. (Finland)</i>	
Treatment of animal wastewater in constructed wetlands.....	305
<i>P.G. Hunt, A.A. Szogi, F.J. Humenik and J.M. Rice (USA)</i>	
The new AB composting process : application to the pilot unit of stan at Castelnaudary (France).....	315
<i>O. Leclerc, J.L. Martel, I. Vandeuvre (France).</i>	

Liquid pig manure treatment in a farm plant : fate of polluting elements before and during storage in a shallow lagoon.	325
<i>L. Senez, J.C. Coquille, Y. Couton, C. Devroe, J.C. Germon, J.P. Lemière (France).</i>	
Mineralflow : A model to determine cost efficient strategies to improve pig slurry application under de Dutch MINeral Accouting System.	335
<i>C.P.A. van Wagenberg, G.B.C. Backus (The Netherlands).</i>	
Effects of an enzymatic additive on ammonia concentration on a broiler farm.	345
<i>G. Bonazzi, C. Fabbri, , L. Valli (Italy).</i>	
Comparison of the survival of <i>Salmonella Typhimurium</i> in the solid fraction from agricultural wastewater treatment plant in summer and winter seasons..	355
<i>J. Venglovsky, I. Placha, N. Sasakova, Para L. (Slovak Republic).</i>	
Adsorption properties of zeolite (clinoptilolite) and bentonite applied to pig slurry..	363
<i>J. Venglovsky, N. Sasakova, Z. Paajova, I. Placha (Slovak Republic).</i>	
Hygienic requirements in aerobic and anaerobic treatment of biological wastes.	371
<i>R. Böhm (Germany).</i>	
Chairman's summary of part 4 bis	379
Working Group Reports	381
Solid manure in Europe. Results of a survey by the working group on solid manure of RAMIRAN	383
<i>H. Menzi, B. Pain, K. Smith</i>	
Report of an enquiry of network members into the status of metals in animal manures.	401
<i>R.J. Unwin</i>	

Preface

The eighth international conference of the FAO Recycling of Agricultural Municipal and Industrial Residues in Agriculture Network (formerly the Animal Waste Management Network), was held in Rennes, France from 26 to 29 May 1998. The conference gathered nearly 150 delegates representing more than 26 countries. Colleagues from all European countries, Japan, Canada, USA, Russia and Chile were present in Rennes.

The FAO European Cooperative Network on Animal Waste Management was formed in 1976. The principal activity of the network is for members to exchange research information and to prioritise work topics, which are then undertaken by expert groups. The need to change the direction and name of the network to RAMIRAN, was agreed at the last network meeting in Godollo, Hungary in 1996. After 20 years of focusing on animal wastes, it was necessary now to include municipal and industrial wastes as these were increasingly spread on land and were also the cause of environmental pollution. Animal wastes remains a significant component of the network's activities but would be considered in a more integrated manner with other wastes which had similar benefit and problems when spread on land.

The theme of the conference was **Management Strategies for Organic Waste Use in Agriculture** and the conference was into five sessions :

- Management strategies for organic waste use in agriculture
- Agronomic value of organic wastes
- Measurement, modelling and control of gaseous emissions
- Processing and handling of wastes
- Environmental impacts

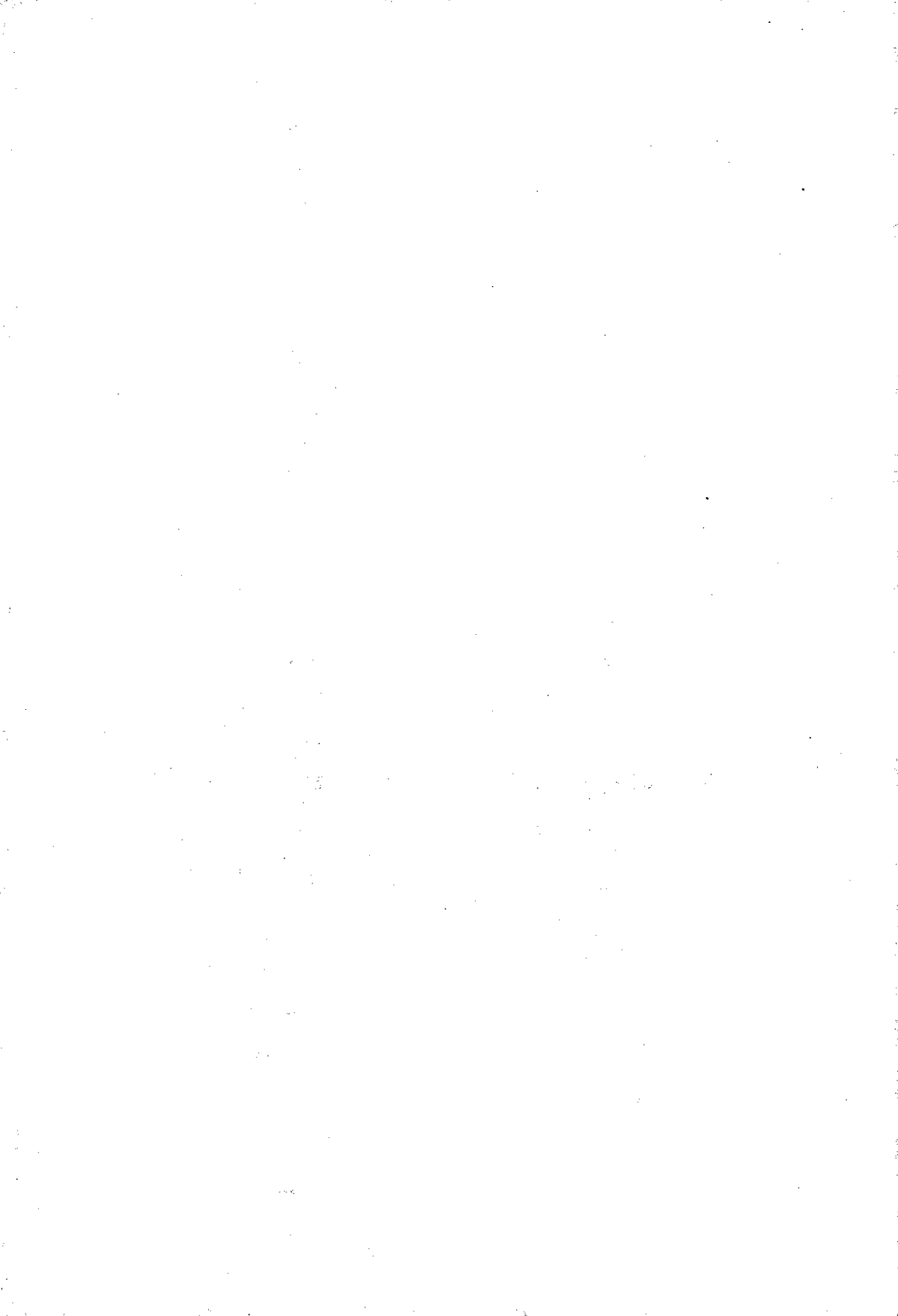
During these session, 43 papers were presented, including four invited papers (C.H. Burton, J C Fardeau, J-M. Merillot and B.F. Pain). This papers were published in a previous proceedings issue. In addition, 50 poster papers were displayed and each was allowed a short oral presentation. A selection of 39 poster papers are published in this book, together with two expert group reports (H. Menzi, R. Unwin).

The Conference confirmed the importance of the ad hoc Expert Groups as the focus of network activities between meetings. Progress on their activities will be reported at a workshop planned for 2000 to be held at the Institute of Agricultural Engineering, Milan, Italy. It is planned to hold the 9th major meeting in 2002, which provisionally will be hosted by the Research Institute of Experimental Veterinary Medicine at Kosice, Slovakia.

Part 1 bis

**Management strategies for organic
waste use in agriculture.**

Chairman : M. GOSS (Canada)



Poultry Housing and Manure Management Systems : Recent Developments in Italy as Regards Ammonia Emissions

Bâtiments avicoles et systèmes de gestion des déjections : développements récents en Italie, en lien avec les émissions d'ammoniac.

F. da Borso, R. Chiumenti

University of Udine, Department of Crop Sciences and Agricultural Technologies,
Section of Agricultural Engineering, Via delle Scienze, 208 - 33100 Udine, Italy
E-mail : Francesco.daborso@dputa.uniud.it

Abstract

Laying hen and broiler keeping systems strongly developed during the last years, aiming to the reduction of environmental impacts (especially of emissions in atmosphere) and to make easier poultry manure management. As concerns broiler structures, no advances technologies are applied, but simple management systems can significantly reduce ammonia and odour emissions ; to give an example, the adoption of an adequate height of litter layer and the use drop-collecting drinking nipples allowed a reduction of ammonia level to 6 ppm, in respect to about 20 ppm of the « traditional » system tested. As concerns the laying hen compartment, several studies on the vertical batteries with manure drying on belts were carried out, showing a sufficiently improved management of poultry manure. Therefore, the possibility of reaching higher levels in dry matter of manure must be closely examined.

Keywords : poultry manure, ammonia and odour emission, drying, composting.

Résumé

De nombreux systèmes ont été développés récemment dans le but de réduire l'impact environnement (notamment les émissions atmosphériques) et de faciliter la gestion des déjections avicoles (fumiers de volailles et pondeuses). En ce qui concerne les bâtiments volailles de chair, de simples mesures permettent de réduire les émissions d'ammoniac telles que l'épaisseur de la litière et l'amélioration des systèmes d'abreuvement.

En ce qui concerne les bâtiments de pondeuses, plusieurs études sur le séchage ont montré leur efficacité. Cependant ces systèmes ne permettent pas d'obtenir un taux de matière sèche du produit au delà de 50% ; ce séchage incomplet s'accompagnant de nuisances olfactives et d'émissions d'ammoniac au cours du stockage et de l'épandage.

Mots-clés : fumier volailles, ammoniac et odeurs, séchage, compostage.

1. Introduction

Modern poultry breeding techniques have been developed with the purpose of improving farm productivity, automation and environmental impacts, both indoors (i.e. animal health and welfare, workers' safety) and outdoors (i.e. preservation of soil, water and air quality and their related ecosystems). Several studies which dealt with housing and manure management systems have been carried out by our Department in order to have an insight into these aspects.

The aim of the present work is to review different housing and manure handling systems which are adopted in broiler and laying hen sectors, as far as ammonia emission are concerned.

2. Materials and methods

During a period of 3 years and taking several technical, environmental, energy and economic parameters into account, the following full scale poultry barns were monitored at a full scale :

- I. broiler litter bed floor houses,
- II. laying hen houses with different types of batteries and manure drying systems,
- III. alternative-to-cage systems for laying hens (litter bed and perches),
- IV. laying hen houses with manure drying and storage in deep pit.

When the housing systems were characterized by natural ventilation (systems I and III) ammonia concentration were measured with a photo-acoustic infrared instrument, the Bruel & Kjaer 1320 with 1303 Multiplexer; air samples were taken in several points inside the barn in order to calculate the mean indoor ammonia concentration. Ammonia emissions were calculated basing on airflow rate estimate by means of the carbon dioxide balance method; the carbon dioxide produced by animals was estimated at 41 ml CO₂ per kJ of the total heat produced by one bird (Albright, 1990).

Under artificial ventilation conditions (systems II and IV), ammonia concentrations were measured with the above mentioned instrument; however, air samples were taken in the airflow at the fan outlets. Ammonia emissions were calculated basing on airflow rate measurements by means of hot-wire and magnetic transducer anemometers.

Further details on sampling points and frequencies will be given in the specific paragraphs.

3. Broiler houses

Most of the broiler produced in Italy are bred on litter bed in floor barns. Several experimental tests were carried out by our Department with the purpose of improving litter management in these housing systems, i.e. litter material, height of the layer, number of birds per m^2 , drinking and eating equipments, litter discharge and storage methods, etc.; aim of the present review is to quantify the effects of different drinkers on ammonia emissions. With regard to this aspect, tests were carried out in 2 barns which were identical in reference to the number of animals (12,800 birds each), the size (12 m x 99 m each) and the litter material (wood sawdust). Hence, it was possible to compare ammonia levels in the air from barn equipped with nipple drinkers with those from the barn equipped with nipple drinkers plus bowls, used for preventing water dropping.

Indoor air was hourly sampled during a period of 9 days in summer; ammonia concentrations were significantly lower in the barn with nipple drinkers + bowls, apparently because of a lower moistening of litter below drinkers. The mean airflow rate was estimate to be $2.4 m^3 h^{-1} bird^{-1}$; this estimate showed ammonia emissions of 0.657 and $0.404 g day^{-1} bird^{-1}$, for the nipple and nipple + bowl drinkers respectively (Table 1).

<i>Drinker type</i>	<i>Birds / drinker, number</i>	<i>Estimated ventilation rate, $m^3 h^{-1} bird^{-1}$</i>	<i>Ammonia concentration, $mg m^{-3}$</i>	<i>Ammonia emission, $g day^{-1} bird^{-1}$</i>
Nipples	6.5	2.4	11.4	0.657
Nipples + bowls	12.4	2.4	7.01	0.404

Table 1
Results of ammonia determination in broiler barns

4. Laying hen batteries with manure drying

In Italy, a large number of laying hens are kept in new types of batteries which allow a partial drying of manure on the conveyer belts. Since 1991, the following manure drying systems were studied by our Department :

- air moved by a system of paddles over the belts (Salmet Ô);
- air blown by fans through holed air-ducts over the belts (i.e. Valli Ô);
- air sucked by fans into tunnels over the batteries where manure belts flow (Farmer Ô).

During a period of 1 year, several parameters (i.e. manure characteristics, energy consumption, environmental aspects, etc.) were monitored in full scale barns characterized by different manure drying systems. With regard to ammonia emissions, results are shown in Table 2.

<i>Manure drying system</i>	<i>Ammonia emission in winter, g day⁻¹ bird⁻¹</i>	<i>Ammonia emission in summer, g day⁻¹ bird⁻¹</i>
Paddle system	0.031	0.172
Air blown in holed ducts	0.027	0.157
Air sucked in tunnels	0.027	0.134

Table 2
*Results of ammonia determinations in laying hen barns characterized
by different manure drying systems*

Ammonia emissions from barns equipped with fan drying system batteries were lower than those from barns characterized by paddle drying system batteries, both in winter and in summer. However, it must be noticed that ammonia emissions from all the 3 manure drying systems were considerably lower than those usually shown by batteries without any drying system. In fact, previous studies concerning barns which adopted stair-step cage batteries with gutters and scrapers for manure removal showed that ammonia emissions were about 0.18 g day⁻¹ bird⁻¹ in winter and up to 0.70 g day⁻¹ bird⁻¹ in summer.

5. Alternative-to-cage systems for laying hens

Housing systems where laying hens are not confined in cages are present in several European Countries. Until today, these systems have assumed a relatively little importance in Italy, but the interest in them is growing especially in relation to the animal welfare requirements as well as to the egg marketing advantages.

Because of this increasing importance, an experimental research was carried out focusing on the environmental requirements which these alternative systems have to meet.

During 3 weeks in spring, two alternative poultry barns were monitored; they were identical in relation to the ventilation system (natural ventilation), the relative surface of the bed floor and the perches to the total surface (the litter bed floor was 1/3 of the total surface), the animal density (7 birds m⁻²), but they differed from each other in the age of breeding animals; one barn kept pullets, the other laying hens.

The mean indoor ammonia concentration was higher in laying hen barn than that one in pullet barn; the estimated ammonia emission was 0.262 and 0.192 g day⁻¹ bird⁻¹, for laying hens and pullets respectively (Table 3).