

Composting Farmyard Manure for a More Sustainable Agriculture and Environment

B. Le Houerou and M. Benoit

National Institute of Agronomic Research (INRA), Mirecourt, France

Abstract

Research was initiated in 1991 to develop more effective systems for managing manure on dairy farms that would decrease the risks of water pollution and increase the application and utilization efficiency for a more sustainable agriculture. Two groups of farmers were involved in the study: those managing biological farms and those associated with an agricultural cooperative designated as CUMA. The study focused on conducting an initial survey of current on-farm animal waste management practices; implementing changes in management practices recommended from on-farm research or from research stations; and, monitoring the operational results of the new management practices. The results of the new composition strategy indicated that the following improvements are possible: a) decreased weight - the weight of farmyard manure to be transported to fields can be decreased from 40 to 60 percent by composting, and nitrogen leaching during the composting process is minimal; b) decreased spreading rate - the compost application rate can be lower than uncomposted material because of its greater density, improved fluidity and homogeneity; c) increased area of application - composting the manure has allowed an increase in the spreading zone from 455 to 1100 hectares; and, d) more acceptable spreading dates - composting allows a more efficient utilization of manure as a biofertilizer and soil conditioner. Compost production can be precisely scheduled for when it is needed in the field for various crops and farming operations

Background

There is growing concern that inadequate methods of processing and spreading farmyard manure on land are contributing to the pollution of groundwater with nitrate (NO_3^-). The purpose of this study was to assess current on-farm methods of waste management; implement improved practices to reduce the pollution potential of farmyard manure; and, to monitor the results of these improved practices.

Results of an earlier study of manure management practices on dairy farms in the Lorraine region of northeast France was reported by Le Houerou (1993). Surveys of watersheds in this region have shown that nitrate (NO_3^-) levels often exceed 50 mg/liter and that there is a direct relationship between the farmers manure management practices and the NO_3^- levels in groundwater (Salou, 1992). "Karst" topography and geology is prevalent in this region where soils are well-drained throughout the year which allows easy trafficking in the winter when manure is also applied.

It was essential to know the specific on-farm manure management and application practices on all fields of a particular watershed. To do this, we developed a farmer-friendly method based on the fertilizer inputs (both farmyard manure and chemical fertilizers) and yields for each field during the past several years. This method is called "BASCULE" and in English it stands for "Spatial Balance of Nitrogen in the Cropping System of a Farm" (in French: "Balance Azotee Spatialisee des Systemes de Culture de l'Exploitation"). The method focused on the effect of farm management practices and the cropping system on a particular watershed (Benoit, 1992). The method allows one to calculate a soil nitrogen balance based on the nitrogen inputs and outputs per field during a crop's succession.

In our Lorraine study of dairy farms of the Vicherey-Beuvezin Plateau, the farm survey results showed that 63 percent of the total farmyard manure produced by 39 farms was spread on 455 hectares. Moreover, the average field application rate had increased from 40 to 80 tons/hectare. When the application of chemical fertilizers was also considered, the excess nitrogen on the watershed was estimated at about 170 kg N/ha/year. These 39 farms which utilize the plateau area also use approximately 1 800 hectares of grassland that surround the plateau; however, only 27 percent of the total manure produced is spread on these grasslands (Kung-Benoit, 1992). Farmyard manure is the main source of excess nitrogen on the watershed area and in the groundwater.

Improved Management Practices

The new management practices for farmyard manure must fulfill four basic requirements to be environmentally sound and acceptable:

1. They must significantly reduce the weight and volume of manure to be spread.
2. They must decrease the rate of application per hectare.
3. They must cease application of manure during wet seasons when nitrate leaching is highest, i.e., fall and winter months.
4. They must increase the area of application to include less sensitive land and permanent grasslands.

Many of the problems associated with recycling farmyard manure on land can be resolved by first producing a high quality agricultural compost (Godden, 1986). The farmers of Vicherey-Beuvezin have followed this recommendation by organizing an agricultural cooperative (a CUMA designated as "De l'eau vive") in which their farmyard manures are composted aerobically with modern equipment and skilled management, and at a considerably lower price. Composting greatly reduces the amount of manure to be spread; facilitates the ease of handling, spreading, and transporting; and allows the material to be stored and stockpiled during wet weather. All of these benefits of composting have allowed the spreading zone of Vicherey-Beuvezin to increase from 455 to 1100 hectares.

Monitoring the New Management Practices

It has now been three years since the new and improved farmyard manure management practices were implemented. From the beginning we have monitored and assessed the changes in three parameters:

- *The Composting Process* - quality and quantity of initial farmyard manure; out-put of compost; quality and quantity of liquid effluent; meteorological data.
- *The Spreading Process* – farmer's choice of spreading fields; quantity and frequency of compost applied; time required and equipment used.
- *The Status of Groundwater Quality* - change in groundwater quality (especially nitrate) from the time of adoption of improved management practices and application of compost rather than raw manure.

Conclusions

The goal of minimizing the impact of farmyard manure management and land application on groundwater quality has global implications. The development of alternative management practices and their successful implementation and adoption by the Lorraine dairy farmers required a team effort involving the farmers, researchers, extension workers, environmentalists and society as a whole. It was really everyone's problem. In the foreseeable future agriculture must strive to become more sustainable, both environmentally and economically, as well as socially sustainable. The vital linkages between farmers and national and regional institutions that helped to resolve the groundwater quality problem discussed in this paper will likely be applied to other problems in the future.

Acknowledgments

We wish to express our sincere thanks and appreciation to the farmers in France and Belgium for their collaboration and questions; to Annie Kung-Benoit and Corinne Revest for their collaboration as extension service managers; to Jean Barlier, Claude Bazard, Damien Foissy and Gilles Rouyer from the S.A.D. Research Station in Mirecourt for their technical assistance.

References

- Benoit, M. 1992. Un indicateur des risques de pollution azotée nommé "BASCULE" (Balance Azotée Spatialisée des Systèmes de Culture de l'Exploitation). *Fourrages* 129:95-110.
- Godden, B. 1986. Etude du processus de compostage de fumier de bovin; Thèse de Doctorat en Sciences Agronomiques. Université Libre de Bruxelles; Laboratoire de Microbiologie. October 1986. 136 p.
- Le Houerou, B. 1993. Le compostage des fumiers de bovins, une des pratiques pour protéger l'eau. *Congres Gemas-Comifer*. November 16-18, 1993. Blois, France.
- Kung-Benoit, A. 1992. Réduction de la pollution nitrique: Exemple d'un diagnostic en Lorraine. *Fourrages* 131:235-250.
- Salou, M.-C. 1992. Elaboration de la qualité des eaux souterraines en zone de polyculture-élevage. *Mémoire de D.E.A.* Université de Metz. I.N.R.A., Research Station S.A.D., Mirecourt, France.