Carrot or stick? – Would information concerning the economic value of nutrient losses, and their impact on food quality achieve greater environmental protection than regulation?

Susan M Fowler *Institute of Rural Studies, University of Wales, Aberystwyth, SY23 3AL, UK*
Lois Philipps *EFRC, Hamstead Marshall, Newbury Berkshire, RG20 0HR, UK*
Christine A Watson *SAC, Craibstone Estate, Aberdeen AB21 9YA, UK*

ABSTRACT

Organic standards have, since their origin (Soil Association 1967) required high standards of manure management, but in reality, these have not been implemented, possibly because of perceived costs of improved handling. However, a cost/benefit analysis of intermediate steps of nutrient conservation and manure handling may provide a practical solution, optimising retention of nutrients, financial and time inputs and environmental protection. Recent research on composting with conventional manures has quantified nutrient losses from heaps with different treatments (Parkinson *et al*, 2001). Financial and environmental costs and benefits of different management approaches are discussed.

Keywords: organic farming; nutrient loss; farmyard manure

INTRODUCTION

The UKROFS standards (UKROFS, 2001) state that

> *'Livestock production must contribute to the equilibrium of agricultural production systems by providing for the nutrient requirements of crops and by improving the soil's organic matter.'*

Despite the existence of standards and regulations defining organic farming, and their emphasis of the need for manure management, it receives inadequate attention from farmers, often because the perceived costs outweigh perceived benefits. This paper examines some of the actual costs and benefits of manure management. Information requirements for decision-making, and methods for producing meaningful figures that will motivate farmers to conserve this resource are proposed.

REGULATION

Organic standards regulations evolved from what was originally a manual for good husbandry, but evolved to Standards when producers attempted to reap financial reward for their careful husbandry. In the last quarter century, the rate of uptake of organic farming has increased, and the farmers adopting organic methods in the 21st century often approach organic from a commercial rather than philosophical background. As well as EU regulation 2092/91, enforced in the UK by the UKROFS regulations (UKROFS, 2001) governing the production of organic food; organic farmers are subject to statutory responsibilities to safeguard the environment, and are required to follow various Codes of good agricultural practice (MAFF, 1998a,b,c). Adherence to these Codes is a requirement of applicants to the Organic Farming Scheme. Working within a legislative and bureaucratic system, adherence to standards becomes a burden; an understanding of the principles behind the system may come with time, but some understanding of the financial implications of failing to conserve nutrients, for example, may assist the process.

The UKROFS standards give little guidance regarding manure management save requiring that 'storage facilities for livestock manure must be of a capacity to preclude the pollution of water by direct discharge, or by run-off and infiltration of the soil' (UKROFS, 2001). The Soil Association (Soil Association, 1999) and Organic Farmers and Growers (Organic Farmers and Growers, 2001) give additional guidance and interpretation, but in practice, inspectors are unwilling to impose capital expenditure.

To make sound judgements on the benefits of manure management, inspecting bodies, and farmers need information on the importance of nutrients, the likelihood of nutrients to be lost, quantities that may be lost, their economic value in terms of yield and quality losses, and any costs likely to be incurred through pollution incidents.

MOTIVATION

Parkinson (2001) identified key motivational factors for improved management of animal manures for conventional farmers as 'economic gain/perception of profitability'. They required changes be 'at least cost neutral, practical and use existing equipment where possible' and required the ability to confirm the nutrient benefit of FYM after the composting process. With the constraints on nutrient purchase for organic farmers, the motivation for improvement of treatment of animal wastes should be far greater. However, It may be that the perception of investment needed to compost efficiently discourages farmers from tackling the issues; until recently, there has been little information on the costs to the farmers for degrees of outlay for manure management.

NUTRIENT MANAGEMENT

Farms, by definition, are selling off products, and unless supplementary feeds are purchased, or returns are achieved by the return of human sewage (currently prohibited by EU regulations), declining nutrient status may seem inevitable. Of eleven rotations studied by Stockdale *et al* (2000), including nutrient inputs in manure from grazing stock, the average K deficit over the rotation was calculated at 20kg/ha.

The most important means of transferring nutrients around the farm, and an obvious opportunity for loss, is through livestock grazing and excretion, and the subsequent treatment of the excreta.

Some nutrient management may be achieved through attention to diets. A study on modelling of nitrogen and phosphorus utilisation in dairy cows (MAFF, WA0311) showed the strong linear relationship between N intake and output in general. As protein intake increases beyond 400 gN/d the amount of N excrete in urine increased exponentially, as N in excess to animal requirement is converted to urea. Weller and Cooper (2001) describe the increase in crude protein levels of white clover/perennial ryegrass swards through the season, resulting in levels far in excess of the requirements of mid or late lactation cows, with the excess being lost to the environment (Tame, 2001).

The most common treatment of farmyard manure (FYM) is for it to be cleared from buildings at regular intervals and stored outside. Organic standards advocate composing, but this is rarely attempted in earnest. The ideal situation for composting is for it to take place in covered yards on concrete. This may be impossible for some farms, and various intermediate treatments are possible, however all have drawbacks and cost implications. Any situation involving transporting fresh manure means transporting bulk, and field storage will bring problems of accessibility in winter, soil compaction, lack of moisture control and leaching. If heaps are covered to prevent leaching, usually no attempt is made to turn the heaps.

The principal benefits of composting FYM are reduction in material mass, volume and water content; the killing of potentially harmful pathogens and weed seeds; and the production of a stabilised organic material that spreads more uniformly. In composting three turns of the heap were found to eliminate wild oat, blackgrass and dock seeds (Parkinson, 2001). These weeds are of particular importance in organic systems as remedial action is costly.

The difficulty is that the process of turning the heap, essential for the composting process, causes nutrient losses, and those losses increase with increased turning. There are two principal pathways of loss from manure heaps; through leachate and to the atmosphere as gaseous emissions. As composting is a microbial process its success depends on moisture content, aeration and temperature. If rainfall is not prevented from penetrating the heap, it can inhibit the process on all three counts.

Parkinson (2001) quantified losses of C, N, P and K under different treatments (stacked or turned, covered and uncovered). The success of composting was found to be weather dependant, with wide variations in results caused by contrasting rainfall. Mass loss is important for reduction in cost of transport and distribution, and is closely related to carbon loss; the greatest loss of which occurs after initial turns. Higher temperatures in heaps under-cover produced a mass loss of 67% after three turns. During composting NH_4-N concentrations tended to fall while nitrate-N concentrations rose. This nitrate-N was retained if the heaps were covered, but was otherwise lost through leaching. No consistent change in total P with turning regime was found, but potassium was lost in significant and variable quantities following turning, the mean loss for turned treatments was 54% of original K.

Information from ADAS/EFRC work (ADAS, 2001) suggests lower nutrient contents in organic than conventionally produced FYM and slurry. This may result in lower losses, but the loss processes will be similar, and of greater impact on the system. Although N is considered to be the limiting factor that determines the productivity of organic systems, the ability to fix N through the use of legumes may lead to less careful management of N than is necessary or wise. The economic and practical reality may be that K is of more importance to organic farmers because of the absence of a K fertiliser suitable for routine use (Shepherd et al., 2000).

FINANCIAL INCENTIVE

Parkinson (2001) used case studies on five farms to evaluate the additional costs of treatment of FYM compared with normal farm practice. The storage available on most farms could cope with the additional demands. Addition costs of composting treatment compared with usual farm practice were calculated both using farm labour and machinery and contract labour and machinery. Because of the particular circumstances of the farms the range in costs was high, but the average marginal cost of three turns of the heap was £2.50 t^{-1} if contract machinery and labour was used, and only £1 t^{-1} if farm machinery and labour was used. If the FYM source is valued *solely* as a source of potassium, calculations illustrate the relative costs of K conservation as £126 t^{-1} K (using farm labour and machinery) compared with £2,800 t^{-1} K for purchase of an approved product

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From: Powell et al. (eds), ***UK Organic Research 2002: Proceedings of the COR Conference, 26-28th March 2002, Aberystwyth*****, pp. 133-136.**