THE MATRESA PROJECT – TREATMENT STRATEGIES FOR LIVESTOCK MANURE FOR SUSTAINABLE LIVESTOCK AGRICULTURE

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The EU-funded MATRESA project was concluded in 2003 with the publication of a detailed reference book* that sets out a thorough review of the management and treatment of agricultural wastes across Europe. The objective was to raise awareness among European agriculturalists (including farmers, advisors and local authorities) of the current research and technology available within Europe to facilitate better management of livestock wastes to (a) minimize environmental and health hazards and, (b), gain the maximum benefit. Information was drawn from the contributions of project partners representing 24 countries - engineers, agronomists, vets and scientists were chosen for their involvement in national and European programmes.

A central finding of this review was that good management of livestock wastes (*eg*, the collection, storage, mixing, pumping and spreading of livestock manures) following existing guidelines can alleviate problems in *some* circumstances, but it is rarely a complete solution. Some livestock farms simply lack enough suitable land to safely receive the manures produced. The application of excessive quantities of livestock manure (and/or mismanagement) is already leading to a range of pollution problems. These include water contamination (by nitrates, phosphates and organic matter) air emissions (including ammonia, nitrous oxide and methane) and soil residues (including phosphates and heavy metals). Poor manure handling can also lead to disease risks to farm animals, the general public and food production in general.

Sustainable agriculture in Europe

Today, agricultural production systems in Western Europe are highly developed with individual farms tending to specialize; resources are used very efficiently and output is high. Nonetheless, as a consequence, local and regional surpluses are generated; supplies and products are transported over increasing distances. For the manures and effluent produced, local land disposal remains the main option but they often become regarded as waste streams and treated accordingly. However, the more sustainable situation essentially involves greater recycling and reduced losses to the environment; input of inorganic fertilizer can then be reduced as a result In order to reach such a situation, changes in approach will be needed from those in the agricultural business as well as from the authorities and the public in general.

Manure and effluent management

Water management issues

One of the key difficulties with handling many liquid animal manures lies with their relatively low concentrations of dry matter. For some dairy waste-waters (or dirty waters) this value can be well below 10 kg/m^3. The implications are threefold; (i) there is a need for larger storage capacity, (ii) the application to meet crop requirement is more difficult and (iii) large quantities of water are being used implying increased transportation. Reduction of manure volume by using less water thus has clear benefits and there are various guidelines for efficient water use on a farm. There has been some research on re-using partly treated slurry for flushing channels in buildings. This has the benefit of both reducing water requirement and increasing the solids concentration in the slurry. The treatment implied may be simply a physical clarification process or it may include some biological activity as well to degrade the dissolved organic matter. The limitation of this strategy lies with the cost and efficiency of the treatment process involved balanced against the penalties of the alternatives; *eg* using more water and needing to deal with larger volumes.

Transportation of livestock manures

Moving manures from region to region represents a seemingly simple solution to the environmental problems of those areas with excess nutrients. However, this approach is fraught with problems based on the scale of the operation, nutrient monitoring and in some cases, disease risks. The problem is mostly attributable to the volume of liquid slurry; in many cases, the solid wastes (eg, the farmyard manure) could be beneficially used without problem on the farm or locally. However, slurries often contain more than 95% water hence pre-concentration is important if the exercise is not to become one of moving water. Such an approach will require low cost concentration systems if it is to be viable; the implication is some form of physical process with a very dilute waste water being irrigated locally.

The relatively low concentration of dry matter in most slurries does enable transport by pipeline which may be a more practical option for shorter distances. Some pre-screening is necessary to remove suspended matter that may lead to blockage. Otherwise, the issue comes down to the question of investment in pipeline systems as much of the technology already exists. Concern over disease spread may yet be the greatest hurdle to large scale redistribution of livestock slurries.

Treatment systems in agriculture

It is unlikely that complete abatement of pollution and the other problems associated with livestock manure can be achieved by improved farming practice alone. In some situations further measures including treatment will form part of the solution. Even where there is adequate land available and a good nutrient balance, some form of treatment may still be appropriate e.g., for odour abatement or to minimize disease risks These can be physical, biological, chemical or a combination of all these processes.

Treatment has a clear role in the overall management package, but only some of systems emerging are both practicable and effective at the farm level The broad theme behind good manure management is proposed as one based on aiming for a more balanced farming system to avoid the

release of excess nutrients into the environment. This implies greater targeting of nutrients in manures to meet the crop need and a subsequent reduction in the applied level of inorganic fertilizers. However, improved monitoring in the application of the nutrients in raw and treated manures is necessary to reduce the uncertainty on the subsequent interaction with the soil and crop uptake. Aerobic treatment can remove unwanted nutrients or stabilize them to enhance plant utilization; it is also effective in odour abatement. Information is lacking though to enable an objective comparison and evaluation of such processes and although effective, the general cost is still too high for many farms. Reducing the manure burden of a farm lacking enough land implies the export of surpluses. Even with improved transportation systems, some pre-concentration is desirable.

The implied volume reduction can have an additional benefit in enabling improved water use in and around the farm. Conversion of solid manure and livestock slurries to a range of saleable products is an attractive option but quality and consistency are important. This may involve the co-processing with other organic wastes to gain a balanced blend. Separate from farming, manure surpluses may yet be a resource for industry in the future owing to the wide range of chemicals it contains.

Process equipment design and verification

There is a wide range of technology and related machinery available now for the use of processing the various livestock manures. Much of this originates from designs used in other industries especially sewage treatment and water supply. However, the satisfactory application to the much stronger effluents from agriculture does not necessarily follow; the objectives for treatment are not necessarily the same and available funds are usually much less. A key problem lies with a systematic evaluation of the individual machine or complete process; what is it achieving, what are the costs and how does it compare with the alternatives? The response to this is in part a matter of policy making, ie, setting specific environmental standards, but this is not so simple when it comes down to objectively scoring a piece of equipment. A typical claim that a process "reduces water pollution" is obviously vague and clearly much will depend on other agricultural factors. However, a more precise standard can often be identified such as aerator performance in kg oxygen dissolved per kWh of electricity consumed. Likewise, a process may be rated in terms of the percentage of nitrogen removed (or conserved as the organic form) - the full benefit of the process will still depend on other agricultural factors (*eg* spreading method and timing) but they will be the same for any process chosen.

Conclusion - are there any "best" options?

One of the first issues to arise from the workshop meetings that gave rise to this publication is the wide range of farming scenarios across Europe. Factors such as farm size, local geography and land type, climate and production method all give rise to farms with highly individual features. It is not surprising then that there are no universal solutions to the manure problems experienced on livestock farms. Rather, the many methods are likely to be as highly individual as the farms themselves. However, the situation can be rationalized to some extend by the grouping of farms according to farm type and dominant manure problem(s) - each such group would then suit a manure management strategy and for each there may be one (or more) best options.

A second general theme to arise from this collaboration was that treatment should not be as the first choice in dealing with the perceived problems on a farm. Indeed, owing to the relatively high costs often involved, treatment should only be considered when existing methods of good manure management have been implemented and found to be inadequate. However, when a problem persists despite running a good farm operation and action is required, then the treatment option is necessary.

The key message is one of correctly identifying the problem and setting out an effective and verifiable strategy to deal with it. This involves being specific on what is required of the waste management plan thus enabling the selection of effective technology that meets the requirements.

** BURTON, C.H.; TURNER, C. (editors) (2003) Manure management - treatment strategies for sustainable agriculture; second edition Silsoe Research Institute, Wrest Park, Silsoe, Bedford, UK. 490 pages.*