

UNDP/GEF Danube Regional Project

**Policies for the Control of Agricultural Point
and Non-point Sources of Pollution
&
Pilot Projects on Agricultural Pollution Reduction
(Project Outputs 1.2 and 1.3)**

**Technical Guidelines for Manure Management
in the Central and Lower DRB Countries**

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**GFA Terra Systems
in co-operation with Avalon**



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Technical Guidelines for Manure Management in the Central and Lower DRB Countries

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Preface

The overall aim of the Danube Regional Project (DRP) is to support the activities of the International Commission for Protection of the Danube River (ICPDR) in implementing a regional, basin-wide approach in 11 countries of the Danube River Basin (DRB) to solving the trans-boundary problems associated with the protection of the Danube River - including the sustainable management of surface and ground waters, the reduction of water pollution and the protection of water related ecosystems.

Objective 1 of the DRP is the creation of sustainable ecological conditions for land use and water management. Under this objective there are two key outputs relating to agriculture:

Output 1.2 – *reduction of nutrients and other harmful substances from agricultural point source and non-point sources through agricultural policy changes*

Output 1.3 – *development of pilot projects on reduction of nutrients and other harmful substances from agricultural point source and non-point sources*

The main focus of the UNDP/GEF assistance to controlling agricultural pollution is to:

- identify the main sources of agricultural pollution within the countries of the DRB
- review the current state of policy development for agricultural pollution control in the DRB countries
- identify the main administrative, institutional and funding deficiencies in the development and implementation of these policies
- provide support for developing the concept of Best Agricultural Practice (BAP) in the DRB countries – including improvements in the management of livestock manure, minimising the use of fertilisers and pesticides, better use of crop rotations and creation of buffer zones
- identify and develop pilot programmes and projects (e.g. training and institutional development) for introducing and promoting the concept of BAP in order to improve environmental management practices in agriculture in a number of priority countries.

Phase I of Output 1.2 and 1.3 was preparatory and undertaken by GFA Terra Systems (Germany) in co-operation with Avalon (Netherlands). The GFA Terra Systems/Avalon consultancy team consisted of 6 international consultants and a network of 35 national experts in the 11 central and lower DRB countries eligible for UNDP/GEF assistance. The main focus of their work was:

- Updating available information on the use of agro-chemicals in the 11 central and lower DRB countries
- Supporting the development of existing DRB inventories of non-point source agricultural pollution
- Surveying and reviewing the current state of policy development for controlling agricultural pollution in the central and lower DRB
- Identifying priorities for the strengthening of agricultural pollution control policies in the DRB
- Preparing a general concept of Best Agricultural Practice (BAP) for promoting farm management practices which are less polluting
- Identification and preparation of potential pilot projects for demonstrating the general concept of Best Agricultural Practice (BAP) at catchment level in priority countries of the central and lower DRB during Phase 2 of the DRP
- Preparation of recommendations for agricultural policy reforms for the promotion of BAP in central and lower DRB countries to be implemented during Phase 2 of the DRP

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Acronyms & Abbreviations

BAP	Best Agricultural Practice
DRB	Danube River Basin
DRP	Danube Regional Project
EC	European Commission
EU	European Union
GEF	Global Environmental Facility
ha	hectare
ICPDR	International Commission for the Protection of the Danube River
K	Potassium
kg	kilogram
N	Nitrogen
P	Phosphate
UNDP	United Nations Development Programme

Introduction

Concept of Best Agricultural Practice (BAP)

The objective of developing a concept of “best agricultural practice” (BAP) under Output 1.2 of the Danube Regional Project is to support the design of new agricultural pollution control policies for the central and lower DRB countries – as well as encouraging compliance with existing and emerging national legislation (including that driven in many countries by the process of EU accession) – that will promote the greater integration of pollution control considerations into the day-to-day management of crops, animals and agricultural land by farmers in the central and lower DRB.

For the purposes of this project, the term “best agricultural practice” (BAP) is only applied to farm management practices that reduce the risk of pollution occurring from **agricultural non-point sources** in the DRB – this includes classical diffuse pollution and “small point source” pollution arising from multiple, small-scale (and often accidental) discharges that occur from different farming activities.

There are no concrete and universal definitions available for what is or is not best agricultural practice (BAP). A strict or prescriptive definition of BAP has therefore been avoided– instead we have proceeded with the understanding that BAP actually encompasses a broad spectrum or **hierarchy of activities** that must be interpreted according to local agronomic, environmental, social and economic context. It is this hierarchy of activities that forms a clear and common concept for BAP throughout the DRB countries and is shown in Figure 1.

Purpose of these Technical Guidelines

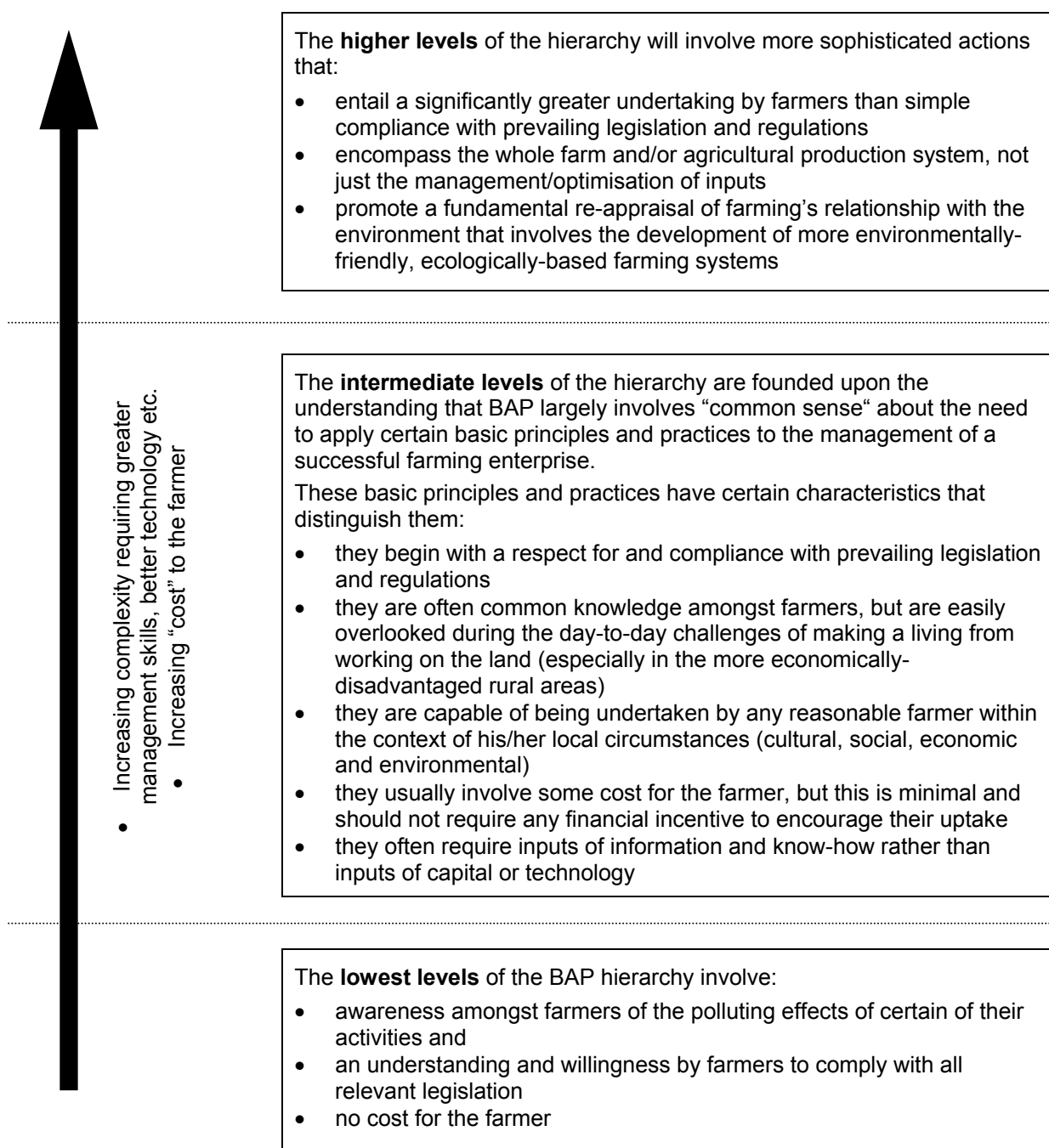
The purpose of these technical guidelines is to outline in more detail the hierarchy of BAP activities associated with manure management in the central and lower Danube countries.

Obviously not all elements of the resulting “menu” of technical guidance will be relevant in all countries of the central and lower DRB – there has to be some interpretation according to local context. To be effective, any BAP must not only be technically and economically feasible, it must also be socially acceptable to the farming community. For example, the social and economic circumstances of many rural communities in Moldova are very difficult compared, for example, to the improving financial opportunities and technical skills of more commercially-orientated farmers in the Czech Republic now operating their businesses within the legislative and financial framework of EU legislation and the Common Agricultural Policy. When viewed like this, the proposed concept of Best Agricultural Practice is quite straightforward and easy to define as:

“...the highest level of pollution control practice that any farmer can reasonably be expected to adopt when working within their own national, regional and/or local context in the Danube River Basin”

As such, BAP can be applied as a uniform concept across the whole DRB, but the level of environmental management/performance that can be expected from farmers in different regions/countries will vary significantly according to:

- a) the agronomic, environmental and socio-economic context in which they are operating
- b) the availability of appropriate policy instruments for encouraging farmers to “move up” the hierarchy and adopt more demanding pollution control practices
- c) the availability of appropriate knowledge and other technical resources for supporting farmers to “move up” the hierarchy and adopt more demanding pollution control practices

Figure 1: Hierarchy of Best Agricultural Practice for the Central and Lower DRB Countries

Best Practice for Manure Management in the DRB

Animal manures and other farm wastes contain valuable plant nutrients, including the two most important crop nutrients - nitrogen (N) and phosphorus (P). Whilst these are essential for crop growth, these are also potential sources of pollution.

In these guidance notes, the term animal manure refers to both **solid manure** and **slurry** – where:

- Slurry consists of liquid or semi-liquid excreta produced by livestock in a yard or building. This is commonly mixed with rainwater and, in some cases, waste bedding and feed
- Solid manure comprises material from animal houses and consist of excreta mixed with the animal bedding materials used in the house (e.g. straw)

Most of the nitrogen (N), phosphorus (P) and potassium (K) contained in the diet of farm animals is excreted in dung and urine. Slurries and solid manures contain useful amounts of these plant nutrients (although not as much as in mineral fertilisers), as well as other major nutrients such as sulphur (S), magnesium (Mg) and trace elements.

Good manure management recycles as many of these nutrients as possible back into the soil where they become available to meet the nutrient requirements of the crop again. The objective of good manure management by farmers should be to make optimum use of these nutrients by:

- a) collecting and storing manure in a way that it is not lost before it can be applied to agricultural land e.g. avoiding the direct loss of manure before to watercourses due to overflowing manure stores etc., and
- b) managing the application of manure to land to ensure that the nutrients they contain are utilised as efficiently as possible to obtain yields of good quality crops

The main benefits of good manure management are to:

- improve the supply of available nutrients for crop growth and reduce the need for mineral fertilisers, and
- reduce the risk of environmental pollution, especially water pollution, caused both by the direct contamination of watercourses etc. with slurry and manure and the indirect loss of nutrients (e.g. nitrate leaching) from agricultural land over wider areas and more extended time periods

The most important principles of good manure management are:

- Ensure appropriate systems for collection and storage of manure
- Know/estimate the nutrient content of applied manures
- Apply manures evenly and at known rates
- Do not apply manures in conditions where there is a high risk of contaminating nearby watercourses
- Only apply manures when the nutrients they contain can be used by the growing crop
- Minimise ammonia losses by incorporating manures (where appropriate) into the soil as soon as possible after application
- Take into account the nutrient supply from long-term application of organic manures when calculating additional fertiliser applications

Basic technical guidance for interpreting and applying these principles is elaborated in the following pages.

Guidelines for Collection and Storage of Animal Manures: Households and Small Farms

Many households and small farms in the central and lower DRB region keep small numbers of livestock, often grazing on common pastures around the village and kept in sheds and barns at night and during the winter. Manure accumulating from these animals when housed represents a risk of small-point pollution due to poor livestock housing, inadequate storage facilities, bad practices and accidents.

Improvements in livestock housing combined with simple waste handling facilities (including organization of communal manure stores to collect and store manure from households and small farms) would greatly reduce the risk of water pollution, improve environmental quality and living conditions in many villages and improve the recycling of nutrients to agricultural land.

Lack of money is the most significant obstacle to improving small-scale manure storage facilities in households and small farms, but where capital is available for investment in waste storage the following guidelines should be followed as much as possible:

1. Locate the waste store close to the livestock housing and away from any watercourse or well
2. A simple open-fronted store with a concrete base and 1.2 m tall impermeable walls should be sufficient for the storage of solid manure from most households and small farms. The concrete floor should slope at 1:100 towards the front
3. The size of the store should be selected according to a) the number of animals and b) the period of storage required when spreading of organic manures on land is not appropriate. This will vary according to winter conditions, but a minimum of at least 1 month of winter storage must be provided
4. A separate small capacity container (e.g. approximately 90 litres capacity) should be provided for the collection of other recyclable and non-recyclable household wastes. Glass and plastic must be kept separate from the manure store
5. Stack the waste in the store to increase storage capacity and to reduce the area receiving rainfall (this will reduce run-off from the store). Ideally build a roof over the store that is high enough to allow manure to be easily added to and removed from the store
6. Do not allow run-off from the livestock buildings or manure store to enter any drain, ditch, stream, river, lake or nearby well. Ideally drainage channels should be cast into the floor of buildings and base of the manure store to collect all effluent and urine. All channels must be connected to a lined pit or below-ground storage tank (e.g. 250 - 500 litres capacity) for storage of liquid waste. Effluent pits or tanks should have a heavy, well fitting lid with a lockable fastener to prevent the risk of anyone accidentally entering
7. Effluent pits or tanks should be regularly emptied – one option is to lift the effluent out with a long handled scoop or with a bucket and pour it over the solid waste in the manure store so that it is absorbed. To be most effective effluent should be applied to the store when it is almost full with dry solid manure. Another option is to use a vacuum tanker (if one is available) so that the liquid effluent collected from many households/small farms can be spread on farm land
8. Do not allow any rainfall from roofs or yards to enter the manure store
9. Consider composting the solid manure by regularly turning it and mixing with vegetable waste and post-harvest materials such as tomato vines and maize stalks

Guidelines for Collection and Storage of Animal Manures: Communal Stores

Communal manure stores are a relatively new concept in the central and lower DRB countries for collecting and storing manure from individual households in and around the village community. Such stores are a co-operative village activity designed to:

- reduce the risk of small point source pollution arising from individual households
- improve the management of nutrients in the collected manure and ensure their effective and efficient return to agricultural land
- avoid the problems associated with the common practice of dumping animal manure from households in inappropriate places – for example, into dry riverbeds, around disused buildings or into the village “rubbish tip”.

The construction of a communal manure store does however require:

- co-operation amongst households
- support of local government
- source of finance for construction
- means of handling manure at the store – at least, a tractor with mechanical loader with an interchangeable fork and bucket attachment that can be used to move solid manure into and out of the store

Communal stores operate best in conjunction with the storage facilities for households and small farms already recommended in the previous section – particularly where householders and farmers have the means to regularly (e.g. once per month) transport by cart, tractor or truck solid manure from their own manure stores to the communal store.

Where funding for investment in a communal store is available, the following guidelines should be followed as much as possible:

1. Locate the store in a convenient and easily accessible location. Do not position a new manure store on sloping ground or within 20 metres of an open watercourse or within 50 metres of a spring or well where drinking water is being extracted. Stores should not be located in any areas where there is a risk of flooding
2. An open-fronted store should be constructed with a concrete base and 2 metre high impermeable walls. The concrete floor should slope at 1:100 towards the front. The manure brought from the household/small farm stores should be unloaded on a concrete apron at the front of the store or (when the store is relatively empty) unloaded directly onto the floor of the store
3. The surface area of the manure store must be calculated prior to its construction and will depend upon a) the total number of animals that manure is collected from and b) the period of storage required when spreading of organic manures on land is not appropriate. This will vary according to winter conditions, but a minimum of at least 4 months of winter storage is recommended (5 months total storage including the 1 month storage at the households and small farms). Assuming that the manure will be stacked to a minimum height of 2 metres and removed twice in a year, it is suggested to plan 3.5 square metres of storage area per one Livestock Unit that manure is collected from
4. Household wastes, especially glass and plastic, must be separated from the manure before it enters the store (this should be done at the household/small farm)
5. Stack the waste in the store to increase storage capacity and to reduce the area receiving rainfall (this will reduce run-off from the store)
6. Do not allow run-off from the manure store to enter any drain, ditch, stream, river, lake or nearby well. Drainage channels should be cast into the base of the manure store to collect all effluent and urine. All channels must be connected to a lined pit or below-ground storage tank for storage of liquid waste. The size of this tank will depend upon local rainfall conditions and the

- availability of a tanker for regular emptying (see below). Effluent pits or tanks should have a heavy, well fitting lid with a lockable fastener to prevent the risk of anyone accidentally entering
7. Effluent pits or tanks should be regularly emptied using a vacuum tanker (if one is available) so that the liquid effluent collected can be spread on farm land
 8. Do not allow any rainfall from roofs or yards to enter the manure store
 9. The transfer of the manure from the household/small farm store to the communal store will cause some aeration and mixing of the waste promoting bacterial activity and decomposition. Consider composting the solid manure by regularly turning it and mixing with vegetable waste and post-harvest materials such as tomato vines and maize stalks, but this activity may need to be kept to a minimum in order to minimise the operating costs of the store
 10. The objective should be to empty the store by the end of autumn
 11. Decide who will manage the store and how the costs of the store will be paid. Also consider safety at the store – children especially should not be allowed to play nearby and so it may be necessary to fence the store to restrict access

Where funding is not available to construct a communal manure store with impermeable base and walls, it is still desirable to collect and store manure from households and small farms as small heaps. The following guidelines should be followed for these:

12. Where heaps of manure are situated directly on the soil, the soil depth should be at least 0.5 metres
13. The heaps should not be located on sloping ground or within 20 metres of an open watercourse or within 50 metres of a spring or well where drinking water is being extracted. Heaps should not be located in any areas where there is a risk of flooding
14. Heaps should be covered with a layer of plastic material or other waterproof material to prevent rainwater either washing the nutrients into the soil or causing surface run-off

Guidelines for Collection and Storage of Animal Manures: Larger Livestock Units

Larger livestock units, including dairy, pig and poultry units owned and operated by commercial farming businesses, can be a serious source of water pollution¹. They produce large amounts of animal waste and require specific storage systems depending on whether the manure produced is liquid or solid based. It is a fundamental requirement that storage facilities of appropriate capacity are available on the farm for the correct management of these wastes. Where animals are housed during the winter or other period, there must be adequate storage capacity to safely contain all the wastes produced by the animals.

The following guidelines should be followed as much as possible to prevent the risk of water pollution:

Solid Manure

1. Dairy farming systems may produce either solid or liquid based manures depending upon the type of livestock housing. Dairy cattle that are wintered in cowsheds with straw used for bedding create large quantities of solid manure which can be managed in a store of similar design to the village-level manure stores described in the previous section (impermeable floors and walls and run-off caught in a reception tank)
2. Existing storage facilities should be inspected regularly. If there are any defects discovered, corrective action should immediately be taken. If it is not possible to satisfactorily repair the facility then it should be abandoned and new facilities provided
3. Locate all new manure stores at least 20 metres away from any watercourses and at least 50 metres way from springs or wells where drinking water is being extracted. Stores should not be located on sloping land or in any areas where there is a risk of flooding
4. Do not allow run-off from the manure store to enter any drain, ditch, stream, river, lake or nearby well. Drainage channels should be cast into the base of the manure store to collect all effluent and urine. All channels must be connected to a lined pit or below-ground storage tank for storage of liquid waste. The size of this tank will depend upon local rainfall conditions and the availability of a tanker for regular emptying (see below). Effluent pits or tanks should have a heavy, well fitting lid with a lockable fastener to prevent the risk of anyone accidentally entering
5. Effluent pits or tanks should be regularly emptied using a vacuum tanker (if one is available) so that the liquid effluent collected can be spread on farm land

Slurry

6. If the cattle housing uses large areas of solid or slatted concrete floors then liquid based manure will be produced and a specialist slurry handling system will be required. Pig production systems also produce large amounts of slurry – especially where extra water is used to flush the waste out. It is essential to have adequate, well constructed slurry stores or tanks on the farm. The two basic options for a slurry storage system are:
 - A deep basin with earth bank walls can be excavated and lined with clay, heavy plastic or some other impermeable material. Slurry flows into the store by gravity or is pushed by mechanical scraper.
 - An “above ground” slurry tank with pumping equipment to move slurry into and out of the store. Mixing of the slurry whilst in storage is important to prevent settling and separation into

¹ This does not refer to the very large-scale animal production units/installations that are regulated by discharge consent or control and more appropriately referred to as “agro-industrial units” (defined according to criteria based on number of animals). The management practices used to control pollution from such units/installations are commonly referred to as “best available techniques” (BAT) rather than “best agricultural practice” (BAP)

layers of high and low dry matter contents – this produces varying nutrient content within the slurry and makes uniform distribution during spreading difficult

The slurry in both types of store should be spread using appropriate equipment – ideally a vacuum tanker or high capacity rotary spreader (depending upon what is available)

7. Existing storage facilities should be inspected regularly. If there are any defects discovered, corrective action should immediately be taken. If it is not possible to satisfactorily repair the facility then it should be abandoned and new facilities provided
8. Do not position a new manure store on sloping ground or within 20 metres of an open watercourse or within 50 metres of a spring or well where drinking water is being extracted
9. Sufficient storage capacity is essential in order to apply slurry at the right time. It depends not only on the number and type of livestock, but also on the volume of washings and rainwater going into the store and the amount of bedding material used. The size of storage facilities should cover the period when spreading of organic manures is not appropriate – depending upon local climatic conditions this should ideally be at least 6 months since as during the winter period there will be prolonged periods when it is inadvisable to apply slurry to the soil because it is too wet, or frozen or covered in snow. Having extra storage capacity is desirable where possible, as this reserve may be utilised during exceptionally long housing periods
10. Avoid the dilution of slurry where possible, as this lowers its nutrient value, makes the nutrient content more difficult to predict and increases the storage capacity required. Do not allow any rainfall from roofs or yards to enter any manure store. All roofs should be fitted with roof gutters so that this rainwater can be conducted away from dirty yard areas and to soak-away without becoming contaminated with manure or slurry

Dirty Water

11. So-called “dirty water” is produced by rainwater falling on dirty yards, as well as water used for washing surfaces and equipment. It can also include urine where this is collected separately from the solid waste. The quantity of soiled water produced can vary enormously from farm to farm according to the type of farming activity, the local rainfall levels and the area of uncovered concreted yards to which animals have access. It must also be collected, stored and disposed of correctly
12. “Dirty water” has a lower concentration of nutrients than animal manures and so presents a lower risk of pollution. It can be applied to soil more often than manures as the risk of applying excessive amounts of nutrients to the crop is lower. “Dirty water” must still be carefully collected and all water falling directly onto dirty concrete yard areas must be intercepted by a channel cast into concrete at the edge of the dirty yards and channelled away to below ground dirty water storage tanks
13. The tanks must be of sufficient size to allow for maximum daily rainfall and the capacity of the waste handling system to dispose of it safely to land. It is recommended to have 8 - 12 weeks storage capacity for dirty water in the event of unsuitable soil and/or weather conditions
14. In the case of dairy farms, the dirty water storage tanks must also store the daily volumes of washing water that has been used to wash the milking equipment and the dairy. Typically up to 50 litres of water per cow per day (350 litres per week) can be used for these washing operations
15. A basic principle of good farm waste management is to keep clean water separated from dirty waters and wastes. Therefore water from roofs, clean concrete areas etc. should be diverted to a clean water outlet in order to minimise the storage requirements for dirty water. Covering the solid manure store with a rainproof cover will also help to reduce the volume of dirty water produced

Guidelines for Application of Animal Manures to Agricultural Land

Animal manures are a potentially valuable source of plant nutrients when applied to agricultural land, but need to be managed carefully to ensure a) that growing crops make the best use of the available nutrients during their growing season and b) that the risk of water pollution is avoided.

When to Apply Animal Manures

1. Animal manures should be applied to agricultural land at a time of year when the nutrients they contain can be used by a growing crop. This is especially important for liquid manures like slurries with a high content of ammonium nitrogen (50 - 70%) which is converted into nitrate in a few weeks and therefore becomes susceptible to high leaching losses.
2. As a general rule:
 - the application of slurry or solid manures should be carried out as early as practicable in the growing season in order to maximise the uptake of nutrients by crops and to minimise pollution risks
 - the application of slurry and other concentrated organic fertilisers to land should be avoided during the non-growing season (typically October to March depending upon the region)
 - check the weather forecast before spreading. Do not apply organic manures when heavy rain is forecast within the next 48 hours
3. Ideally solid manure and slurry should be applied and immediately cultivated into the soil (using methods such as ploughing, discing or through the use of a rotary cultivator) just before the sowing or planting of crops – but this is only possible for spring-sown crops. Application before autumn-sown crops is common, but should be avoided if possible because climate and soil conditions in autumn can still favour high nitrate losses, particularly on permeable soils
4. Slurry may be applied directly to growing crops, although care should be taken to avoid plant and soil damage. Slurry should normally not be applied if:
 - the soil is at field capacity² and the soil is so wet that tractor-drawn machinery will damage it
 - the soil is deeply frozen or/and covered with a snow layer
 - the crops are at a sensitive stage
 - the days after application are followed by dry and hot weather or by deep frost

The optimum time for application of slurry to cereal crops is not only limited by the risk of nitrogen leaching losses, but the growth stage is also of great importance. For example, the most effective time for applying slurry to winter cereals is before the beginning of tillering i.e. shortly before the time of the crop's main nutrient requirement
5. On grassland, the nitrogen efficiency is not much affected by the application date because the time for nutrient uptake is normally longer than for arable crops. To avoid the risk of bacterial infection, slurry should not be applied on pasture land, but only on grassland to be cut for silage or hay
6. Dirty water may be spread on land all year round providing weather and ground conditions are suitable. However, spreading may have to be postponed for long periods where soils are saturated, covered with snow or are frozen.

Where to Apply Animal Manures

7. Do not spread solid manure or slurry on:
 - wet or waterlogged land
 - frozen or snow covered ground

² Field capacity is when the soil is fully wetted and more rain would cause water loss by drainage or surface runoff

- areas that are likely to flood at sometime in most winters
 - land which slopes steeply towards ditches, streams, rivers or lakes ³
8. Avoid polluting surface waters and wells and bore holes by leaving a buffer strip between them and the land on which manures and slurry are applied. The recommended buffer strips are as follows:
- Streams and drains - 10 metres
 - Lakes and main river channels - 20 metres
 - Domestic/farm wells and bore holes - 50 metres
 - Public water supply sources - 100 metres
- It is essential that the recommended buffer strip widths are observed in the case of domestic wells and public water supply sources. The width of the strip required for streams/drains and lakes/main river channels will depend in each case on soil type, slope and vegetative cover.
9. In areas where the overlying soil is thin and/or where the underlying bedrock has cracks or is fissured or karstic in nature, there is a danger in polluting groundwater. In such situations great care is needed when applying animal wastes or dirty water to this type of land. If the risk of pollution is very high, even under suitable spreading conditions, then organic manures should not be spread on such lands

How to Apply Animal Manures

10. In order to obtain the best crop yield results from the application of manure and slurry it is necessary to use specialised spreading machinery that will allow the accurate spreading of manure/slurry at the required rate and with an even distribution. This machinery should be maintained in good working condition so that the desired application rates can be achieved and overlapping applications avoided
11. The application rates of organic manures should reflect both the nutrient requirements of the crop being grown and the nutrient status of the soil. In no situation should the total nitrogen content of the organic manure applied to a given area in a 12 month period exceed 250 kg/ha (e.g. approximately 36 tonnes per hectare of fresh pig manure)
12. Do not attempt to supply all of the nutrient requirements of crops with organic manures – some supplementation with fertilisers may be necessary and desirable to avoid excessively high applications of organic manures
13. To make maximum benefit of the nutrient value of organic manures it is advisable to obtain nutrient analysis of the soils and manures so that management may be modified to maximise benefits and minimise risk to the environment. Alternatively if analysis is not possible, refer to tables of nutrient content of different manures published by national advisory services
14. Where pig slurry or poultry manure are used to supply the maximum nitrogen application rates, there is a risk that the phosphorus (P) content of these materials may lead to a build up excess levels of P in the soil, leading to water pollution due to run-off or leaching of P. No application of these wastes should be made to soils that already contain high levels of P. However cattle, sheep and goat manures produced on the farm may be applied to land in such circumstances
15. The nutrient content of dirty water is normally low. In these cases, the rates of application will be determined largely by hydraulic loadings, i.e. the ability of the land to safely absorb the quantity of liquid applied to it, rather than the nutrient content of the dirty water
16. One useful approach – especially on larger livestock units and for disposal of manure from communal manure stores - is to prepare and follow a simple Manure Management Plan which takes into account the nutrient content (N, P and K) of collected manure together with soil nutrient status, crop uptake and nutrient requirements to identify where and when manures should be

³ The risk of surface runoff increases with slope, but slopes are rarely simple features and it is not practicable to define critical angles of slope

applied. The Plan should also include a map of the available agricultural land defining areas suitable for spreading and their suitability at different times of the year. A simple six-step approach is suggested:

Step 1: Calculate the quantity of manure and slurry that will be produced (or collected) in one year and its nutrient value

Step 2: Calculate minimum areas of land required for spreading the manure and slurry

Step 3: Produce a map of potential manure and slurry spreading areas

Step 4: Identify the manure spreading areas that will be used during the year

Step 5: Plan where and how to spread the manure and slurry

17. It is important to be aware that the long-term application of manure and slurry increases the amount of total soil nitrogen and therefore slowly increases the supply of nitrogen that is available from the soil to crops. Consequently, the rates of organic manure to obtain optimum yields decrease with time and the risk of over-fertilisation causing nitrate leaching increases