Australian Government
Department of Agriculture, Fisheries and Forestry

Composting By-products on Egg Farms

Composting can be a useful way to manage a range of wastes and by-products from egg farming, from layer manure (caged layer manure and barn litter) to egg waste and spent hens. In addition to this, the end product can be valuable as a nutrient source and soil amendment for spreading on grazing and cropping land.

Composting is a natural process involving the breakdown of organic matter by microorganisms. The resultant product is a humus like material that is a valuable soil conditioner and nutrient source. There are many benefits to using a composting process to manage wastes and by-products, including the reduction of bulk, moisture content and pathogens and the production of a stable, uniform product that does not produce offensive odour when applied to land.

Composting requires careful management of three key components:

- The Carbon:Nitrogen ratio (C:N)
- Oxygen supply
- Moisture level

There are many other management factors that need to be considered when trying to get the most out of a composting process, but most relate to the above components.

C:N ratio

Carbon (C) and nitrogen (N) are the two elements most likely to limit the composting process if they are not supplied in the correct ratio.

Generally, a C:N ratio of between 15:1 and 40:1 will provide for effective composting. Where C:N is less than 15 (not enough carbon), the carbon is consumed without necessarily stabilising nitrogen in the biological matter. The excess nitrogen can be lost to the atmosphere as ammonia (NH^3) and odour can be a problem. If the C:N is higher than about 40:1, the composting process takes longer to consume all of the carbon because microbial growth is limited by a lack of nitrogen. This can cause the composting process to stall, resulting in a partially composted product. Carbon naturally occurs in a range of forms. The form of the carbon can influence the efficiency of composting, as some forms are more readily degraded than others.

For example, the carbon found in straw is readily degradable and will compost quickly, while cellulose or lignin fibres found in paper or wood will take longer to compost.

Layer manure, egg waste and carcasses have a very low C:N ratio. For this reason it is necessary to add a carbon source (i.e. sawdust, straw or cardboard from egg processing) at a ratio of about 1 part manure/waste to 2 to 3 parts of a carbon source material (by volume). If using cardboard, the process will be helped by shredding the cardboard before composting to increase the surface area.

Oxygen supply

Composting is a process carried out by living organisms in the presence of oxygen. Under aerobic conditions, organisms break down organic matter, producing carbon dioxide as a by-product and very little odour. However, if oxygen is not present (anaerobic conditions) a compost pile may produce offensive odours.

Oxygen supply in a compost windrow or pile is influenced by the size and shape of the pile, the pore space in the material (porosity), the water content of the compost and the frequency of turning. Aeration is usually supplied by frequently turning a pile or windrow, or by using forced aeration in a static pile. Windrows will also aerate as convection forces draw air into the pile when temperatures increase.

Moisture level

Water is a key component in the composting process. Organisms require moisture to survive and increase and the composting process will slow or stop altogether if the moisture level drops too low. However, if moisture levels are too high and the material is too dense (low porosity) there may not be enough oxygen for the beneficial aerobic organisms.

Generally, the preferred moisture content for a compost mix is about 40 to 65%. Depending on the materials used in the initial compost mix, water may need to be added to achieve the ideal level.

AUSTRALIAN EGG CORPORATION LIMITED

Compositing By-products on Egg Farms cont'd

Composting will 'use' water during the process, as moisture is evaporated from the windrows or piles. For this reason, moisture levels should be monitored to keep the material between 40 - 65% (about field capacity) where the product is moist to touch but does not drip when gently squeezed. One exception to this is for composting of mortalities and spent hens. In general birds have adequate moisture to begin the composting process and may only require a small amount of moisture to wet down the feathers. At later stages in the composting process water may need to be added to ensure the process is successful.

If the windrow becomes too wet, it may cool and odour may be produced. In this case, drying can be hastened by turning the pile or adding more dry bulking material.

Temperature

Composting produces heat, coming from the biological activity of the organisms as they break-down organic matter. The process has a general pattern of temperature fluctuations that can be used to monitor the process.

After initial mixing, the temperature in the centre of the pile generally starts to rise within a few hours.

Provided windrows are large enough to maintain the heat generated, temperatures in the range of 55° - 60°C will be reached within a few days of start-up. Under ideal conditions these temperatures will be maintained for several weeks before dropping gradually to ambient temperature, at which time the compost process is complete.

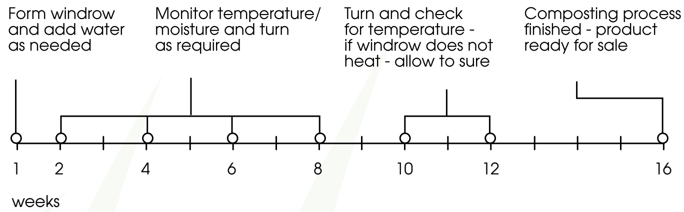
Temperature will be self regulating provided that there is sufficient nitrogen, carbon and moisture for microbial breakdown. Because of this, temperature is a useful indicator for the composting process. Composting is most rapid when the temperature is maintained between 30° - 60°C. During the initial phase, a drop in temperature will usually indicate insufficient water, oxygen supply or possibly nitrogen. When the composting process is complete, temperatures within the pile will not rise after being watered and turned.

High temperatures (above 55°C) are essential to destroy weed seeds and pathogens. Turning windrows is important to ensure all of the material is subjected to the high temperatures in the pile centre. This will ensure that weed seeds and pathogens are killed.

General compost management

Composting is generally conducted in windrows 1.5-2 m high and 3-4 m wide at the base. To maintain enough oxygen, the windrows need to be turned regularly during the initial phase, though this is not the case for carcass composting. The process should be complete in about 8-10 weeks, with an additional 4 weeks of curing time.

Figure 1. Composting time scale of events



Advantages of composting:

- Produces a consistent product that is safe for reuse in agricultural and residential areas.
- Reduces the weight and volume of the manure and processing wastes by 30 – 50%.
- Heat generated in the process destroys pathogens providing a safer end product for most uses.

Disadvantages of composting:

- Adds an additional cost to the treatment process (machinery and labour).
- Nitrogen may be lost via volatilisation.

Carcass composting

Composting is an effective way of disposing of daily mortalities and spent hens. In general, carcass composting follows the same principles as manure composting. However some differences are apparent.

Poultry carcasses have a high moisture and nitrogen content compared to many organic materials. For successful composting, it is necessary to add a carbon source (such as sawdust or chopped straw) to soak up moisture and feed the composting process.

The first step to setting up the compost is calculating the number of mortalities or spent hens for composting. For daily mortalities, this will equal the total number of birds multiplied by the mortality rate and divided by the days of occupancy, for example:

10,000 birds x 3% mortality = 300 birds
300 / 365 = 0.8 birds per day, or
= 6 birds per week.

This gives a total mass of about 12kg of carcass per week, which will require about 25kg of bulking material (i.e. 0.1m³ of sawdust). Annually, this amounts to about 5m³ of sawdust to compost the 300 birds. This amount of sawdust may be reused for 2 - 3 years to reduce expenditure.

Because of the odour and pest potential with carcass composting, it is important that all carcasses are adequately covered with bulking material. This requires coverage with approximately 300mm of carbon bulking material (i.e. sawdust) to ensure that odours do not escape and scavengers do not discover the carcasses.

One very important consideration with carcass composting is to ensure the process has adequate oxygen at all times during the process. This will reduce the risk of botulism, which is caused by the *Clostridium botulinum* organism. Another essential step to reduce the risk of botulism is to ensure that mortalities are well managed before the composting process begins. This can be done by composting mortalities every day, or storing mortalities in a fridge/ freezer if daily composting cannot be done.

Carcass composting can be done successfully with 1- 2 turns of the compost. It is advisable to leave a carcass compost pile for a minimum of 4 weeks before turning the pile to allow time for breakdown of the carcasses. After this time the pile can be turned, but it must be re-covered with about 300mm of an inert material to ensure carcasses are not exposed on the outside of the pile. An ideal material to use for this is 'finished' compost that has been through the cycle once already.

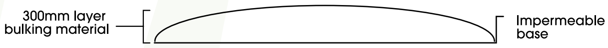
Carcass composting can be done in many ways, however the simplest option is to construct bays or a windrow with a compacted base, and turn piles on a monthly basis after the last carcass is added. If an expensive carbon source such as sawdust is being used, this material can be recycled to compost many birds to reduce cost. It should be noted that successful carcass composting needs a good source of carbon. The ideal materials are sawdust/savings, barn litter or chopped straw.

Finely mulched green waste may also be used but wood chips or course green waste are not ideal. Manure may also be used, but this should only be used at less than 25% of the total mix as it does not contain adequate amounts of carbon for effective carcass composting.

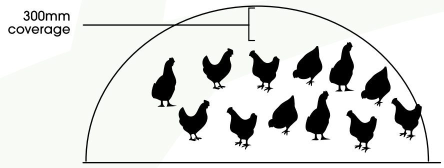
To minimise pathogen levels in carcass compost, the compost should be turned three times and reach temperatures of 55°C for three consecutive days after each turning. These temperatures should be monitored and records maintained.

Carcass compost pile construction

Step 1.



Step 2.



Compost area design considerations:

- Impermeable base to avoid leaching and improve machinery access.
- Site drainage to avoid muddy conditions and excessive moisture in the compost. Site may also require bunding to reduce runoff from the site.
- Collect nutrient rich runoff in a sump / dam; this can then be used for composting.
- Check licence requirements - some states require a separate licence for composting.

Common Composting Problems

My windrow does not heat up

Possible problems

1. Incorrect moisture – too much, too little? Aim for 40 - 65% - enough to feel wet without it dripping in your hand.
2. Insufficient mixing / oxygen. Turn windrow and observe again after 6 -12hrs.
3. Incorrect C:N ratio – is there enough nitrogen for biological activity? This should not be a problem unless too much bulking material is added - aim for a C:N ratio of between 15:1 and 40:1. To increase nitrogen, add manure.
4. Is the carbon in an accessible form for breakdown? If woodchips or other course material is used, the low surface area and low degradability can inhibit composting. Try using straw or sawdust to provide adequate carbon.
5. The composting process is finished – If all other conditions are met and the windrow has been composting for some time, failure to heat after turning is a good indication of completion of the active phase of the composting process.

My windrow is creating excessive odour

Possible problems

1. Is the moisture level too high? This may be caused by rainfall if piles absorb this water. If this is the case turn the pile and form it to shed water – add more bulking material if required.
2. Is the C:N ratio too low (too much nitrogen)? This can cause ammonia loss and odour production – solve by adding more bulking material.

Composting check list:

1. Construct pad for composting operations ensuring the base is impermeable to control drainage and ensuring that runoff is contained.
2. Add manure or spent litter to the pad with additional bulking material.
3. Mix the compost to ensure a C:N ratio of approximately 15:1 - 20:1 (this means adding about 1 to 2 parts sawdust to 1 part caged layer manure by mass – or about 2 to 3 parts sawdust to 1 part manure by volume).
4. Mix the manure with the bulking material and form into windrows, approximately 1.5m high depending on machinery size.
5. Add water if necessary during windrow formation to make up moisture to between 50 - 60% (approx. 1000L per tonne of compost mix given above).
6. Monitor windrows to ensure that heating is taking place – record temperature if required by vendors to ensure complete composting of product.
7. Turn piles weekly or bi-weekly (usually when a temperature decline is observed), adding water as required to maintain 50 - 60% moisture.
8. The composting process is complete when turning the pile will not result in heating (provided all other conditions for composting are met).

Carcass composting check list:

1. Construct bin or bay for composting operations ensuring the base is impermeable to control drainage and ensuring that runoff is contained.
2. Put down a 300mm layer of bulking material (sawdust, straw or other carbon source – not manure) on the bottom of the compost pile.
3. Add mortalities (1.5 birds per layer).
4. Birds must be composted fresh (daily) or stored in a fridge/freezer prior to composting to avoid a build-up of pathogens.
5. Ensure aerobic conditions are maintained throughout the whole process to minimise risk of botulism.
6. Add water if desired, approximately 1L per 3 carcasses (optional).
7. Add further bulking material (sawdust, straw or manure mix) at approximately 2:1 ratio of bulking material to carcass mass.
8. Ensure that carcasses are covered with 300mm of bulking material to protect from rodents/pests - use additional bulking material if required.
9. Ensure the pile is peaked so that rainfall will shed from the pile.
10. Ensure carcass compost is not accessible to livestock and that material is not spread on grazing land unless livestock are vaccinated. This will reduce the risk of botulism.

For adding additional carcasses

1. Remove the top layer of bulking material, ensuring 100 to 150mm of bulking material remains to cover the previous carcasses.
2. Add new carcasses and follow steps 3 - 7 above.
3. Ensure that the overall pile height is no greater than 3 meters.

*Water is not essential for carcass composting.

This publication was produced by FSA Consulting as part of the "Pathways to Sustainable Agriculture" for AECL. Project funded by the Department of Agriculture, Fisheries & Forestry.

Manure Sampling Procedure

Why sample manure?

Manure sampling is the only way to accurately determine the nutrient and contaminant content of your manure. However, a manure analysis is only an accurate representative if the sample has been collected, handled and analysed correctly. This procedure will outline the correct process for sampling to ensure this is done correctly.

Collection and handling

The aim of the collection procedure is to get a representative sample of the manure or litter. You will need gloves, a shovel or hand trowel, a clean bucket, a zip-lock bag and a cooler with ice (for storing and transporting the sample). The sampling procedure is as follows:

- Label a zip-lock bag with permanent marker, including property name, date, sample type and a description of where the sample was taken from, i.e. 'layer shed no. 1'.
- Sample manure after it is removed from the shed if possible*. Shed cleanout will help mix the manure / litter making it easier to get a representative sample.
- Collect approximately 25 sub-samples from throughout the pile with the shovel and mix these in the bucket.
- After the sub-samples are mixed together, collect the final sample (about 1kg) and place in the labelled, zip-lock bag. It is recommended to place a second bag over this for protection.
- Place the bagged sample in a disposable cooler with ice / ice packs for transportation.
- If the sample is to be stored for more than 48hrs, it should be refrigerated or frozen.
- If posting the sample, the laboratory will need a list of analyses to be performed. In addition to this, your address and phone number should be included. Place this information in an envelope and tape to the lid of the cooler.
- Once you have sent the sample, call the laboratory within 48hrs to ensure the sample has arrived and confirm all details.

* If sampling must be done within a shed (i.e. in a barn laid system prior to clean out) it is necessary to collect a large number of sub-samples (30-40) throughout the shed, covering areas with high and low amounts of manure coverage to get a representative sample. These samples should include surface and sub-surface litter. Sampling should be done as close as possible to the end of the cycle to be representative of the spent litter that will be available for reuse.

Manure analysis

It is recommended that a NATA accredited laboratory is used for manure analysis. Laboratories are available in most states of Australia, and manure analyses generally cost between $130 - $310 (average approx $180) for a basic analysis. Once a laboratory is selected, the next step is to document the type of analysis you require and send this with the sample. The analysis will depend on the reason for testing the manure. As a starting point, the following analysis can be used to cover most agriculturally relevant elements and properties of manure.

Table 1. Typical Manure Analysis Parameters

Parameters		
Moisture (%)	pH Water	Sodium (%)
Phosphorus (%)	EC (dS/m)	Sulphur (%)
Nitrogen (%)	Calcium (%) Z	Zinc (mg/kg)
Nitrate Nitrogen (mg/kg)	Copper (mg/kg)	Molybdenum (mg/kg)
Ammonia Nitrogen (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)
Organic matter (%)	Boron (mg/kg)	
Potassium (%) M	Agnesium (%)	

If there is concern about heavy metals, these can also be analysed. The following metals and contaminants may be requested: Cadmium; Chromium; Arsenic; and Lead.

Laboratories can also assess the level of weed seed contamination, pathogens and the degree of 'maturity' for composts. For further details contact your laboratory of choice.

Records

Records of the time, location, sampling procedure and analysis request information sent to the laboratory should all be kept with the manure analysis. Analyses collected over time will show if there are trends in the manure nutrient levels which may be of interest. This will build a farm average for the manure you produce.

This publication was produced by FSA Consulting as part of the "Pathways to Sustainable Agriculture" for AECL. Project funded by the Department of Agriculture, Fisheries & Forestry.

Australian Government
Department of Agriculture, Fisheries and Forestry

Storing Poultry Layer Manure On Farm

Providing a storage area for manure improves management flexibility and allows manure supply to be matched to demand.

Shed cleaning operations are generally timed to fit in with other operations. This can produce large quantities of manure at times when demand for reuse is low. This may contribute to low prices for manure sold off site, or the need for some form of on site storage. Having a properly designed and constructed storage facility can improve manure handling and sale prices by holding the product until demand is higher.

Manure management and storage

Storing manure can cause odour nuisance and water contamination by nutrients depending on the storage design and the manure management. High moisture manure is often associated with increased odour emissions because it promotes anaerobic breakdown. Storing manure in windrows and turning at least once is likely to reduce the moisture level of the manure and promote low odour aerobic decomposition and partial composting. For covered storages, ventilation may be required to manage odour production.

Storage systems

Different types of manure storages suit different systems and locations. If the facility is located in a rural area, windrow or stockpile storage may be an option. However, if the farm is located in a more densely populated area, a covered storage is likely to be more appropriate.

Stockpile or windrow storage

Manure can be safely stored in a stockpile or windrow for an extended period if the site has been carefully selected and constructed. Stockpiling manure needs to be done on a formed pad within a controlled drainage area.

A well prepared pad surface provides two advantages. It ensures the pad is trafficable in all weather conditions and it minimises leaching of water from the manure to groundwater.

Materials that can be used to form an impermeable pad, include:

- Concrete/paving
- Cement stabilised earth
- Compacted earth

Runoff control

All runoff from within the stockpiling area should be contained. This runoff is likely to contain nutrients and other contaminates and would have a detrimental effect on water quality if this reaches a waterway. To reduce the required volume of the holding pond, all external (clean) runoff should be excluded from the stockpiling area. Depending on site conditions, either diversion banks or below ground drains can confine and re-direct runoff. This will not be required for a covered storage.

Sediment trap

A heavy storm may carry sediment from the stockpile to the holding pond. A simple sediment trap can collect the solids before they enter the holding pond, reducing the solids and nutrient loading of the pond.

Holding pond design

The holding pond should have sufficient capacity to hold contaminated runoff from large storms and/or prolonged periods of rainfall. In most environments, an overflow frequency of 1 in 10 years is acceptable. In a locality dominated by intense summer storms, the pond should be sized to retain all of the runoff from a 1 in 10 year, 24 hour duration storm. For localities with winter dominant rain, a monthly water balance calculation should be undertaken to ensure that overflows do not occur too frequently.

Storing Poultry Layer Manure On Farm cont'd

Disposal of retained runoff

The contaminated runoff collected in holding ponds can either be evaporated or else irrigated onto pasture or a suitable crop. Careful analysis should be undertaken to ensure that evaporation ponds are able to store sufficient runoff to cope with prolonged wet periods. For effluent irrigation schemes, both long-term water and nutrient balances should be undertaken for the reuse areas.

Covered storages

Covered storages are useful where there is no option for an outside stockpile. While construction of covered storage is more expensive, the improved flexibility in manure handling may offset this cost.

There are different options available for covered storages.

Covered storages reduce the problems of unsightly manure stockpiles, and the potential for odour and fly breeding nuisance. The storage needs to be sized to contain the required amount of manure storage and to provide adequate room for machinery to operate inside.

Sizing

The required size of a manure storage area is a major determinant of the construction cost. It depends on manure production and the period of storage. For example, if manure needs to be stored for six months to coincide with cropping cycles, the storage facility needs to be large enough to hold the manure production for this six month period before space will become limiting again.

For caged layer systems, manure production is approximately 40m^3 / 1000 birds /yr. For litter based systems this figure is closer to 50m^3 - 1000 birds /yr. These numbers can be used to roughly calculate the required manure storage. As a rough guide, small windrows will require about 1m^2 of area per 1 - 1.5m^3 of manure while large stockpiles may work on a ratio of 1m^2 to 4m^3 depending on the size and height.

Buffer distances

Adequate buffers should be provided between the stockpile area and various receptors. Buffers may perform different or multiple purposes - some providing visual screens; some provide sufficient distance for odours and dust to disperse before becoming a nuisance; some provide a safety margin between the stockpile and natural watercourses. The following is a list of suggested buffer distances. However, local council and state EPA regulations will need to be observed where applicable.

Public Road	50m
Boundary	50m
Watercourse	100m
Wetland	100m
Bore	50m

Regulations

Manure storage may require licence approval depending on the amount of manure that is being stored, and this will vary from state to state. Approval may need to be gained from both the local council and the EPA.

Storage may provide a way to improve manure management and boost sale prices, and can be done in a variety of ways to suit each enterprise while maintaining the surrounding environment.

This publication was produced by FSA Consulting as part of the "Pathways to Sustainable Agriculture" for AECL. Project funded by the Department of Agriculture, Fisheries & Forestry.

Poultry Layer Manure - Nutrient Budgeting to Maximise Value

Poultry layer manure (caged layer manure and barn litter) can be a valuable nutrient resource for pasture and crop production systems. However, it must be managed carefully to realise the most value and to prevent losses of nutrients to the environment where they can cause harm.

Nutrient budgeting is a way to account for nutrient movements at the paddock scale to maximise the efficiency of use. It is a tool to help to keep farming operations sustainable. By understanding the nutrient demands of a crop or pasture, an appropriate manure rate can be determined. This saves money and can improve long term performance. Nutrient budgeting may also reduce the risk of losing nutrients to the atmosphere, surface water and groundwater by finding the amount of nutrient that needs to be applied to meet plant demands.

Nutrient budgets firstly require the calculation of the total inputs of nutrients for the year, including estimates of nutrients added by manure or fertiliser. Secondly, the mass of nutrients likely to be used by the crop or pasture is determined. Nutrients that are not taken up by the crop are either held in the soil or removed from the system through leaching or gaseous losses.

Setting up a nutrient budget

Nutrient budgets require knowledge of:

- Nutrient levels in the soil
- Nutrient inputs (i.e. manure, fertiliser)
- Nutrient outputs (i.e. removal through plant harvest, export of livestock and losses to the environment).

These items can be calculated on a per hectare basis for any area where the same basic management is occurring. A nutrient budget can be calculated using information from previous years to help make predictions for the coming season. The first step is to assess the level of nutrients in the soil.

What nutrients are in the soil?

The nutrient status of the soil is an important determinant of the manure spreading rate needed to grow a given crop or pasture. Soil tests provide the best information, and are particularly important in paddocks with a history of fertiliser or manure application. It is suggested that samples are collected from the surface (0 -10cm) and subsurface depths
(10 - 60cm) and analysed to find nutrient levels within the root zone.

There are two approaches to assessing soil nutrient levels: calculating the total quantity of nutrient per hectare of land, or using 'standard' nutrient targets for different crops or pastures. Calculating nutrient quantities may require agronomic advice. However, standard nutrient targets are available from reference books for most crops and regions. It is important to realise that standard nutrient target levels are influenced by the specific soil properties on your farm.

Some example phosphorus (P) levels for soils in manure use areas are given in Table 1 below. For some crops, higher levels may be required to maximise production.

Table 1. Suggested maximum available (Colwell)

Clay content	pH	Colwell phosphorus (mg/kg)
Less than 30%	Less than 7	31
Less than 30%	More than 7	59
More than 30%	Less than 7	75
More than 30%	More than 7	85

Source: Skerman 2000

Soil nitrogen levels are generally measured as total nitrogen (Total N) or nitrate (N). Total soil nitrogen levels below 500mg/kg are considered low, while levels exceeding 5000mg/kg are considered very high. Ideal soil nitrate-N levels will depend on season, crop and soil interactions and are best determined by an agronomist. However, rough estimates can be made using standard target levels from a reference book such as 'Interpreting Soil Test Results' from CSIRO.

Nutrient Budgeting to Maximise Value cont'd

Inputs – fertiliser and manure

Nutrient inputs for fertilisers are calculated by multiplying the application rate (kg/ha) by the nutrient content to give a mass of nutrient applied per hectare. For example, single superphosphate (9% P) applied at 125kg/ha to grazing land provides 11kg/ha of phosphorus:

125 x 0.09 = 11kg/ha of P

This type of calculation is needed for all fertiliser inputs. The standard analysis for fertiliser is printed on the bag or is readily available from the manufacturer.

For manure inputs, a similar calculation is needed to estimate the amount of nutrient per tonne of manure 'as spread'. The first step is to obtain an analysis for the manure from a laboratory or to use standard analysis data. An average analysis of layer manure is provided in a separate fact sheet in this series; Composition of Poultry Layer Manure. However periodic analysis of manure prior to spreading is recommended. Manure analysis results are generally provided on a 'dry basis', however all manure contains moisture at the time of spreading. This moisture acts to dilute the nutrient concentration in each tonne of manure.

To calculate the amount of phosphorus in a tonne of layer manure with a dry matter content of 70% (or a moisture content of 30%) and a total phosphorus content of 2%, use the following process:

1,000kg x 0.7 (70% dry matter) = 700kg 700 x 2% (average phosphorus content in layer manure) = 14kg P/tonne.

This same process can be applied to other nutrients in layer manure.

Outputs

Once the major system inputs have been determined, similar calculations are needed for the main outputs. Main outputs may include hay, grain or livestock products (liveweight, milk or wool). For livestock, the nutrient content of live beef is approximately 2.4kg N, 0.7kg P and 0.18kg K / 100kg live weight. For milk production, 1000L of milk will remove about 5kg N, 1kg of P and 1.5kg of K. Grazing properties export relatively small amounts of nutrients in the livestock. For example, selling 100 beef steers at 500kg/head exports about 1,200kg N, 350kg P and 90kg K per year. Crops generally remove much larger amounts of nutrient per hectare than livestock.

Nutrient outputs can be used to estimate required annual fertiliser or manure application rates.

Table 2. Yield and nutrient off-take with some crops

Crop	Yield (t/ha)	N (kg/ha/yr)	P (kg/ha/yr)
Lucerne hay	5-15	150-450	15-45
Dry land winter cereal (grain only)	2-4	40-80	6-20
Dry land winter cereal (grain+straw)	2-4 grain (+straw)	59-239	9-20
Grain sorghum	2-8	40-160	6-24
Forage sorghum	10-20	200-400	30-60
Dryland pasture hay	1-4	20-80	3-12
Irrigated pasture hay	8-20	160-400	24-60

Adapted from Reuter and Robinson 1997

The nutrient balance

Once soil nutrients levels, inputs and outputs have been quantified, the overall nutrient budget is:

outputs – soil nutrients + inputs.

The result will show if more or less nutrient inputs are required to balance the equation. If the result is positive, nutrients will be stored in the soil or lost to the environment. Losses should be avoided wherever possible, as these are both a financial cost and a risk to the environment. In particular, nitrogen and phosphorus are harmful to water and in some cases air quality, and need to be minimised by balancing the nutrient budget as much as possible without compromising yields. Nutrient budgets are a useful tool for managing fertiliser and manure applications, providing greater efficiency within the system, saving money and helping to protect the environment, giving a win-win situation.

References and further reading:

Hazelton, PA & Murphy, BW 2007, Interpreting soil results CSIRO Publishing, Collingwood, VIC. Skerman, 2000, 'Reference Manual for the Establishment and Operation of Beef Cattle Feedlots in Queensland', Department of Primary Industries, Brisbane, 1st Edition March 2000.

Reuter DJ and Robinson JB 1997 (eds). Plant Analysis – An Interpretation Manual. CSIRO Publishing, Collingwood VIC 3066.

This publication was produced by FSA Consulting as part of the "Pathways to Sustainable Agriculture" for AECL. Project funded by the Department of Agriculture, Fisheries & Forestry.

Composition of Poultry Layer Manure

Manure from poultry layer systems can be a valuable plant nutrient resource for grazing and cropping systems. There are two main types of layer manure; manure from caged systems and litter from barn laid or free range systems. Generally, manure from caged systems has a higher nutrient analysis and less carbon than litter. However, both of these by-products usually have a higher nutrient analysis than other animal manures.

Layer manure supplies essential plant nutrients in a 'slow release' form, which can boost plant growth for a period of weeks after application. Sufficient manure for two or more seasons may be spread in one application as nutrients such as a phosphorus will be released over time.

Like other manure and litter by-products, layer manures are not a balanced nutrient source. They have a high ratio of phosphorus to nitrogen and for this reason they are best used primarily as a phosphorus source.

It is important to carefully manage the reuse of manure, as over application and poor reuse practices can cause environmental harm. To read more about application rates, see the fact sheet in this series called 'Poultry Layer Manure - Nutrient Budgeting to Maximise Value'.

Composition

The composition of layer manure varies between different layer farms because of differences in management systems (caged layers, barn laid or free range) and diets fed.

Consequently the nutrient profile of layer manure is variable and the figures presented here are indicative only. A chemical analysis of the manure is needed to accurately determine the composition.

Manure composition also depends on the length of time the manure has been stockpiled. Generally the carbon and nitrogen content of manure will decline as the stockpiling time is extended, while other nutrients such as phosphorus are concentrated.

Table 1 shows measured chemical and physical properties of layer manure that may be used for indicative purposes.

Table 1. Average composition of layer manure

Amounts (as % of dry matter basis)	Manure (caged systems)	Litter (Barn/Free range)
pH	8.0	8.0
Moisture content (% of solids)	30	25
Nitrogen (N)	4.6	4.1
Phosphorus (P)	2	1.4
Potassium (K)	2.1	2.1
Calcium (Ca)	3.9	1.4
Magnesium (Mg)	0.5	0.3
Sulphur (S)	0.004	-
Carbon (C)	29	38
Weight per m^3 (kg)	550	550

Source: Environmental Code of Practice for poultry farms in Western Australia

Nutrient availability

Plant nutrient uptake occurs when nutrients are present in an inorganic form. Not all the nutrients in layer manure are available to the plant in the year of application. Some nutrients need to be converted from the organic to the inorganic form by microorganism decomposition before they become available for plant uptake. Of the macro nutrients available in layer manure, nitrogen and phosphorus can vary widely in nutrient availability, while potassium is stable and highly available from the time of application.

The availability of nitrogen for plant growth in the first year of application may range from 30% to 80%. Generally, about one-third of the nitrogen in layer manure is present in the ammonium form which is rapidly available to plants, while the remainder is in a slow release, organic form. Organic nitrogen will mineralise over time, releasing nitrogen for plant growth. However, the mineralisation rate depends upon a number of factors including soil health, temperature and moisture.

Composition of Poultry Layer Manure cont'd

Nitrogen is easily lost from the soil through volatilisation and leaching and this can greatly reduce the amount of nitrogen for plant growth. For example, if layer manure is spread on the soil surface and not incorporated, up to 25% of the total nitrogen may be lost to the atmosphere through ammonia volatilisation. See the fact sheet in this series called 'Spreading Poultry Layer Manure', for more information.

Phosphorus availability may also vary from 40% to 100% in layer manure. Generally phosphorus will be more easily accessed by plants where manure is incorporated, but this is not essential. Phosphorus does not move very rapidly through the soil profile and can be applied for two or more seasons in one application.

Environmental management

Layer manure is a valuable resource, but reuse needs to be managed in a sustainable way to overcome potential environmental threats, such as nutrient losses, and contamination from metals or pathogens.

Nutrient budgeting provides a starting point for preventing nutrient losses. A fact sheet 'Poultry layer manure - Nutrient Budgeting to Maximise Value' has been developed to explain this process.

Metal and pathogen contaminants can be managed using a range of approaches. The first step is to determine the risk of metal contamination. Table 2 shows the different elements that may be present at low concentrations in layer manure. Several of these elements are necessary for plant growth, but may become toxic to plants at high concentrations.

Table 2. Composition of layer manure - potential environmental contaminants

Amounts given as a % on a dry matter basis	Units	Caged Layer Manure
Arsenic (As)	mg/kg	30
Copper (Cu)	mg/kg	20
Zinc (Zn)	mg/kg	350

Source: Environmental Code of Practice for Poultry farms in Western Australia – units converted from parts per thousand to mg/kg.

Table 3 shows the recommended upper limits for several potential contaminants that may be found in layer manure. The maximum concentrations for arsenic, copper and zinc in layer manure are typically lower than the limits suggested by the Natural Resource Management Ministerial Council (NRMMC 2004).

Table 3. (mg/kg) Limits for contaminants in compost, soil conditioners and mulches for land application

Contaminant	NRMMC	NSW EPA	VIC EPA
Arsenic (As)	60	30	60
Copper (Cu)	2500	2000	2000
Zinc (Zn)	2500	3500	2500

Table: NRMMC (2004), NSW EPA (1997), VIC EPA (2004)

While the levels of contaminants are generally below the guideline upper limits, it is recommended that users of layer manure monitor soils to ensure elements do not build up to levels where toxicity becomes limiting to plant growth. If other metals are of concern, chemical analysis of the manure before use is advised.

Some pathogens potentially present in layer manure are *Campylobacter jejuni/coli, Clostridium perfringens, Clostridium botulinum, Enterococcus* spp, *Listeria monocytogenes, Salmonella* spp. Use of appropriate health and safety precautions will protect worker health. It is also a legal requirement to provide a 3 week (minimum) withholding period between spreading manure on paddocks and grazing these by livestock. Livestock must not be given access to stockpiled manure at any stage.

References and further reading:

Natural Resource Management Ministerial Council - NRMMC 2004, Australian Guidelines for Sewerage Systems-Biosolids Management, Australian Water Association, NSW. NSW EPA 1997, Environmental Guidelines for Use and Disposal of Biosolid Products, Department of Environment and Conservation, Sydney NSW. VIC EPA 2004, Guidelines for Environmental Management-Biosolids Land Application , EPA, Southbank, VIC.

This publication was produced by FSA Consulting as part of the "Pathways to Sustainable Agriculture" for AECL. Project funded by the Department of Agriculture, Fisheries & Forestry.

Composting Equipment

Composting significant amounts of material will require machinery for turning and handling the composting material. Composting can be done using different types of machinery from frontend loaders to self propelled windrow turners. These machines differ in cost, ease of operation and quality of compost produced. Using specialist equipment greatly improves efficiency when composting large volumes of material.

Front end loaders

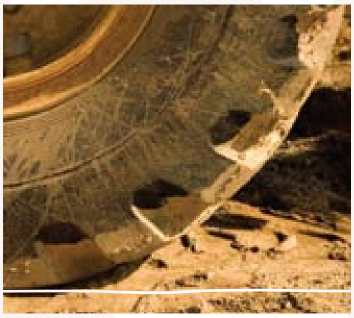
Front end loaders are often the first choice for smaller composting operations because they may be available on-farm already and have many other uses. A front end loader can be used to turn windrows and piles, and this may be a good option for carcass composting or small volumes of manure composting. However, front end loaders are slow to operate and may not adequately mix the compost piles.

Windrow compost turners

A range of windrow turners are available in Australia, both from local manufacturers and importers. These include:

- Three point linkage units
- PTO driven trail behind units
- Self powered units (turner is driven off a separate engine but mounted to a tractor)
- Self propelled units.

The scale of the operation will usually determine the required size of the compost turner. Three point linkage models are available for small to medium scale composting, while trailing units are better for larger windrows and can turn larger amounts of compost rapidly. Self-propelled turners are suitable for large scale operations where a significant amount of material is to be composted. Some features to consider when evaluating compost turners include:



Windrow dimensions

Tractor drawn models can generally turn a windrow less than 3m high, whereas some self-propelled turners may turn windrows up to 4m high by 4m wide. This affects the size and layout of the composting area and the total amount of compost that can be turned. For example, smaller windrows require more space because of the need for traffic alleys between the rows.

Turning rates

Turning rates will vary with the size and type of turner. Three point linkage turners are limited to a turning rate of between 200 - 400m^3/hr, while tractor drawn turners may have a turningrate of 400 - 800m^3/hr. Self-propelled turners can turn at rates of 1200 - 6500m^3/hr.

Power requirements

For tractor drawn turners, the size of the turner determines the power requirements of the tractor. Three point linkage models will require about 50 - 60 horsepower while a PTO driven trailing turner may require 80 -140 horsepower. Tractors will require a creeper gear to travel at a slow speed. Hydraulic assist features are available for turners to remove the need for a creeper gear.

Straddle and auger turners

Straddle turners turn the windrow in one pass. Hence, the windrow width must match the drum length. Auger turners use paddles to lift and move the compost. As they move down the windrow, the compost is moved to one side, reducing the space between windrows. These are good for composting in small areas since less tractor space is needed beside the windrows.

Water application

Some windrow turners can add water to windrows using a trailing hose system. This is ideal for medium to large scale operations and improves operational efficiency. Alternatively, some windrow turners can tow a water tanker that will supply water during turning, and this may be more appropriate for small operations without water infrastructure.

Composting Equipment cont'd

Purchasing a windrow turner

Cost is a major consideration when buying a compost turner. The size and type of turner (three point linkage, tractor drawn or self propelled) have the largest affect on price. The prices below were collected from a range of manufacturers and suppliers in Australia to provide a general price range in 2008 (prices are shown excluding GST).

The following list of suppliers is provided as a service to farmers. It is not intended to be comprehensive, nor is any manufacturer or dealer endorsed or recommended. Buyers are encouraged to carry out their own market research.

Nufab: Tractor drawn straddle turner, windrow dimensions :
3.6m wide x 1.7m high, 400 - 800m^3/hr : $60,000

Sittler: Tractor drawn straddle turner, models :
507, 509 & 512, 450 - 1375m^3/hr : $40,000 - $60,000

Self-propelled Backhus, Nufab, Frontier, and Allu models: 1,200 - 6,000m^3/hr :
$170,000 - $880,000
(can be custom made to specification).

Extras
Hose and reel for watering : $12,600

Water wagon and tank : $22,000

Hydraulic assisted models (tractor drawn) :
add $17,850 to base price.

Suppliers and dealers

Nufab Industries

Lot 27, Moore Road
PO Box 171
Dongara WA 6525
Ph: 1800 671 606 or 08 9927 1297
www.nufab.com.au

Recycle and Composting Equipment Pty Ltd
(Dealers for Sittler, Brown Bear & Frontier models)
PO Box 420
Waterford QLD 4133
Ph: 1300 723 026 or 07-3804 7949
www.composting.com.au

Dealers for Backhus models
Brentwood Recycling Systems
238 Berkeley Rd
Unanderra NSW 2526
Ph: 02 4271 7511
www.brentwood.com.au

This publication was produced by FSA Consulting as part of the "Pathways to Sustainable Agriculture" for AECL. Project funded by the Department of Agriculture, Fisheries & Forestry.

Poultry Layer Manure - How Much is it Worth?

Layer manure (caged layer manure and barn litter) from egg production systems is valuable as a nutrient and organic matter resource. Layer manures in particular are high in nutrients compared to other animal manures and generally have a higher reuse value.

Calculating the real value of layer manure as a nutrient source and soil conditioner can be difficult as many different factors need to be considered. These include nutrient content and availability, the value of trace elements and effects on soil health and structure.

Composition

The first step in estimating the value of layer manure is to determine the nutrient content. Table 1 provides a sample nutrient analysis for layer manure (from caged birds) and spent litter from chickens housed in barns. It must be noted that analysis values provided are indicative and may vary from one batch to another.

In addition to these nutrients, there are other trace minerals available in layer manure that may be highly valuable for some agricultural systems, significantly increasing the value of layer manure.

Table 1. Indicative composition of layer manure

Amounts (% dry basis)	Manure (caged systems)	Litter (Barn/Free range)
pH	8.0	8.0
Moisture content (% of solids)	30	25
Nitrogen (N)	4.6	4.1
Phosphorus (P)	2	1.4
Potassium (K)	2.1	2.1
Calcium (Ca)	3.9	1.4
Magnesium (Mg)	0.5	0.3
Sulphur (S)	0.004	-
Carbon (C)	29	38
Weight per m³ (kg)	550	550

Source: Environmental Code of Practice for poultry farms in Western Australia

Calculating potential manure value

It is possible to roughly estimate of the value of layer manure by comparing the value of the macro nutrients (nitrogen, phosphorus and potassium) in the manure with the cost of commercial inorganic fertilisers (see Table 2). This provides a starting point for assessing the value of manure as a nutrient resource. To do this, the kilograms of nutrient per cubic meter (the most common measurement) need to be calculated. These calculations are provided in the 'Nutrient budgeting of Poultry Layer Manure' fact sheet in this series.

In addition to nitrogen, phosphorus and potassium (N, P, K), there are significant amounts of calcium, sulphur and trace elements in layer manure. Comparing the value of manure with lime as a source of calcium, layer manure may be valued at around \$2.50/m³ if compared to agricultural lime at \$40/t.
In practice, the amount of calcium in layer manure is relatively small when applied at appropriate nutrient application rates for crops and pasture.

The trace elements in layer manure include magnesium, manganese, iron, boron, copper and zinc. Where required, these trace elements are highly valuable and will increase the reuse value of layer manure.

Table 2. Value of nutrients in layer manure compared to inorganic fertilisers

	Manure analysis (% dry basis)	kg per cubic meter*	Inorganic fertiliser product (\$/t)	Value of layer manure (\$/m³)
Moisture content	30	0		
Nitrogen (N)	4.6	24	Urea (46%N) @ \$700/t	\$37
Phosphorus (P)	2.0	10.5	MAP 21 (% P) @ \$1200/t	\$51
Potassium (K)	2.1	11	Potash (50%K) @ \$700/t	\$15
Maximum value of N, P, K per m³				**\$103/m³**

*1m³ is assumed to weigh 750kg with 30% moisture

Poultry Layer Manure - How Much is it Worth? cont'd

How much is it worth?

How much is layer manure worth? Typically, layer manure is sold for $10 -15/m^3 (1m^3 = approx. 750kg with 30% moisture). This is considerably less than the value of the nitrogen, phosphorus and potassium in the manure. Also, manure has the added value of organic matter (approximately 30% by mass) which is beneficial to soil, improving soil structure and water holding capacity. This value may be almost as great as the nutrient value of the manure.

However, there are also reasons why manure value will be lower than the maximum value of the nutrients, caused by difficulty in handling and application of manure compared to fertilisers.

Manure can be difficult to handle compared to conventional fertiliser, requiring specialised equipment and management. Manure also contains several nutrients that need to be balanced with plant requirements requiring understanding of the manure product and fertiliser requirements of the crop being grown. Nutrients within the manure may not be in a form that is immediately available for plant growth, increasing the need for nutrient monitoring of soils and crops. These factors increase the management and handling requirements compared to conventional fertilisers.

Because of these factors, it may be reasonable to value manure at approximately 50% of the value of the N, P and K it contains. This would give a value of approximately $50/m^3 at 2008 fertiliser values.

Gaining maximum value from manure by-products can significantly improve the profitability of an enterprise. Understanding the value of layer manure requires a good understanding of the product and the best ways to manage this product in a farming system. Several other fact sheets in this series have been produced to provide information on nutrient composition, nutrient budgeting and spreading layer manure. These fact sheets are designed to help get the maximum value out of layer manure in farming systems.

This publication was produced by FSA Consulting as part of the "Pathways to Sustainable Agriculture" for AECL. Project funded by the Department of Agriculture, Fisheries & Forestry.

Australian Government
Department of Agriculture, Fisheries and Forestry

Spreading Poultry Layer Manure

Layer manure (caged layer manure and barn litter) is a highly valuable nutrient source and soil conditioner when spread at suitable rates.

However, good spreading techniques are needed to realise the potential value of this resource. Spreading needs to occur at the optimal time to maximise nutrient availability and minimise potential adverse soil impacts like compaction. Using the right equipment and information simplifies management and improves production.

Spreading rates

A nutrient budgeting process is the best way to find the optimal long-term manure spreading rate (see 'Nutrient Budgeting for Poultry Layer Manure' fact sheet in this series).

Once the target spreading rate is known, the spreader needs to be calibrated to ensure the manure is applied at the correct rate evenly across the paddock. One way to check spreader calibration is provided in Example 1.

Example 1. Measuring your spreading rate

1. Take a strip of builders plastic or tarp (ideally 10m x 2m) and lay it down in path of the spreader.
2. Run the spreader over the drop sheet at the correct operating speed.
3. Weigh manure from 1 x 1m squares at several points across the width of the spreading pattern.
4. Take the mass of manure weighed (kg/m^2 and multiply by 10,000 to convert to kg/ha).
5. Divide the result by 1000 to get tonnes (t) per ha.

This process can be repeated for several passes to check the average spreading distribution and width.

Distribution

Poor distribution of manure by spreaders can cause uneven application and irregular crop growth. Distribution can be affected by manure consistency, the type of spreader and the operator. Generally manure with a moisture content of 25 - 30% will spread best.

Dust can be a problem from drier manure. However, if the moisture content exceeds about 35%, bridging will be a problem in many spreader designs.

For most spreaders, an application rate of at least 2t/ha is needed to achieve an even spread. For some spreaders, higher application rates may be needed to achieve good performance.

Operator efficiency may also strongly influence manure distribution. Some spreaders alter the application rate with the forward speed of travel, which can also cause variability in application where operators are not adequately trained.

Compaction

Compaction is caused by the movement of large implements across paddocks. It is generally a greater concern on crop land than on grazing land. Compaction is most likely to occur when soils with a moisture content close to field capacity are worked. Ideally, spreading would occur when the soil is quite dry. Compaction of crop land can be reduced by setting up the spreader to run on controlled traffic lines. Spreading manure on a 3 to 5 year rotation and supplementing with inorganic fertiliser as required also reduces the compaction risk and saves money by reducing the application frequency.

Timing

The optimal timing of manure applications depends upon factors like:

- Crop or pasture nutrient requirements
- Field conditions (soil moisture)
- Wind conditions
- Timing of other management events (i.e. cultivation and sowing).

The application of layer manure 2 - 6 weeks before sowing (or peak pasture demand) is recommended to allow time for nutrients to mineralise from the organic matter in the manure. However, layer manure has been successfully spread on growing crops at low application rates. If the manure has been correctly composted, the timing of application is less critical and the risk of nutrient drawdown is minimal. Ideally, manure spreading should occur when the risk of compaction is minimised.

AUSTRALIAN EGG CORPORATION LIMITED

Spreading Poultry Layer Manure cont'd

Social and environmental considerations

Manure spreading can disperse dust and odour over considerable distances. If manure is spread close to neighbours or other sensitive areas, this should occur when the wind speed is low and ideally on weekdays. Consulting with neighbours about the best time to spread manure may reduce nuisance and help avoid complaints. Odour releases can be reduced by incorporating manure soon after spreading or by irrigating after spreading.

The risk of environmental harm must be considered before spreading manure. Manure should only be spread on the intended area. It should not be spread within 30m of waterways or on steep slopes where erosion losses may occur. While a small amount of rain following application can be useful, spreading when heavy rain is forecast is not recommended.

Options for spreading manure

There are many options for getting manure spread, including: engaging a contractor, purchasing a spreader with others in a farmer group or purchasing a spreader for your own use.

Contractors may operate on an hourly rate or a 'tonnes spread' basis. Rates quoted by contractors range from $8/t to $13/t (2008), depending on the distance of transport from stockpile to spreading area and other conditions.

As spreaders are used infrequently, they are a good item for a farmer group to purchase and share, reducing the capital cost for each owner.

There are several factors to consider when selecting a spreader to buy. Most important are the type and moisture level of the manure and the amount to be spread regularly. Some design features to be considered include:

Spreading pattern

Width (to ensure an even spreading pattern and application rate are achieved).

Vertically vs horizontally mounted beaters

Vertically mounted beaters generally spread over a larger area with each pass, throwing manure beyond the width of the spreader. Horizontal beaters usually only spread about the width of the spreader.

Spinners

Spinners generally provide a wider and more accurate spreading pattern than beaters alone.

Floor width

The maximum moisture content of manure that can be spread without bridging depends upon the floor width and the width of the rear door of the spreader. Generally the belt driven machines cannot spread manure with a moisture content exceeding 40%.

Conveyor belt vs moving floor chains

These can be either hydraulic or PTO driven. Conveyor belts may need to be replaced more often as the belt wears more easily than chains.

Rotation speed

The rotation speed of the beaters affects the width of spread and application rate.

Size

Spreaders vary greatly in size, from 1t capacity to over 20t capacity. The smaller capacity spreaders (1 - 2t) are unsuitable for spreading large amounts of manure because of the time spent loading and travelling. Larger capacity trailing units are probably the best option for on-farm use. Trailing units vary in size from less than 5t to over 20t capacity. Dual purpose units can be used for spreading other products such as lime and fertilisers, which may offset the cost. However these require a more consistent manure with lower moisture levels.

Price

The size of a spreader generally determines the price. As a guide, 2008 prices for different makes of spreaders available in Australia are:

Trailing spreader: 4.1 - 9.5m^3 (3-7t manure) : $23,000 - $60,000

Trailing spreader: 14m^3 and above (9 + t manure) : $52,000 - $89,000

Truck mounted: 8 - 10t capacity : $50,000 - $60,000

References and further reading:

Kondinin Group 2006, Fertiliser Spreaders Research Report, Farming Ahead, no. 175, 18-21.

This publication was produced by FSA Consulting as part of the "Pathways to Sustainable Agriculture" for AECL. Project funded by the Department of Agriculture, Fisheries & Forestry.

Subjective On Farm Monitoring

Subjective monitoring is one way of measuring the impact of your farm on neighbours and other nearby sensitive land uses. This can help to avoid complaints and demonstrate social responsibility within the local community. Monitoring should focus on the main causes of off-farm amenity impacts such as odour, dust, noise and light. Regular subjective monitoring can also help to identify the effects of changes in management practices on amenity impacts.

Odour intensity assessments

Odour intensity is best assessed at a series of designated assessment points around the property boundaries. A designated staff member responsible for monitoring environmental impacts should regularly undertake odour assessments (say every 3 months). The assessments need to occur when odour is most likely to create a nuisance.

The assessments can be undertaken using the German Standard VDI 3940: Determination of Odorants in Ambient Air by Field Inspection as a guide. The VDI scale and procedure are provided in the odour monitoring record included at the end of this fact sheet.

To ensure accuracy in assessments it is important that the assessor is not desensitised to the odour. Hence, the assessments can only occur if the assessor has not been in or around the sheds for at least three hours.

During the assessment the following data must be recorded in the odour monitoring record:

- The number of fans operating (if mechanically ventilated).
- The number of hens on farm.
- In-shed air temperature.
- Prevailing weather conditions, including wind direction, estimated wind speed and shade temperature.

This data forms the basis of the monitoring program to be maintained over time.

Dust assessments

Dust intensity should also be measured at designated assessment points, following a regular monitoring program (say every 3 months). Dust levels are assessed by visual criteria. A designated person should always undertake dust intensity evaluations to ensure a consistent approach. Dust assessments need to occur at the most likely time of peak dust emissions, such as when traffic volumes are high.

During the assessment, the following data need to be recorded in the dust monitoring record (included with this fact sheet):

- The number of fans operating (if mechanically ventilated).
- Prevailing weather conditions, including wind direction, estimated wind speed and shade temperature.
- Vehicle movements (i.e. number/hr).

Similar but more frequent assessments and recordings should be made during prolonged dry periods or after a complaint, when the wind speed is moderate to strong and the wind is blowing from the poultry sheds towards the dust monitoring point. The results of the visual assessments should be kept in the dust monitoring record.

Subjective On Farm Monitoring cont'd

Noise level assessments

Noise level should also be measured at designated assessment points following a regular monitoring program (say every 3 months). These assessments should be carried out by a designated staff member.

The assessments are to occur:

- After 6:30pm.
- When the wind is light to moderate.
- During a period of high activity, such as the loading of eggs, manure or spent hens.

The assessment characteristics must be recorded in the noise assessment record.

The designated monitoring staff member should also monitor the level of rattling noises from storage silos, augers, fans and feeder lines at a set interval (say every 3 months).

Light intensity assessments

Light intensity is less likely to change over time than odour and dust. However it is suggested that a designated staff member should undertake periodic field assessments of light impacts at designated light monitoring points. This is to confirm that farm external lighting levels remain acceptably low and that vehicle lights do not cause light related nuisance.

The assessment can be recorded in the light monitoring record included in this fact sheet.

Increased monitoring will be needed if there is a significant change in the potential light impact (e.g. loss of vegetative screens, modification to lighting at the facility).

Regularly monitoring potential sources of nuisance and recording the findings of these assessments provides information to assess changes in the level of impact over time. If increases in impacts can be linked to particular management practices then ways of minimising impacts on receptors can be investigated and implemented before problems arise.

This publication was produced by FSA Consulting as part of the "Pathways to Sustainable Agriculture" for AECL. Project funded by the Department of Agriculture, Fisheries & Forestry.

Dust Monitoring Record

Dust Monitoring Points	Name	Date & time	Wind direction	Wind speed	Dust from farm	
					Absent	Present
DMP 1						
DMP 2						
DMP 3						
DMP 4						
DMP 5						
DMP 6						
DMP 7						

Australian Government
Department of Agriculture, Fisheries and Forestry

AUSTRALIAN EGG CORPORATION LIMITED

Light Monitoring Record

Light Monitoring Points	Name	Date & time	Light source visible Yes/No	Strength of visible light		
				Weak	Moderate	Strong
LMP 1						
LMP 2						
LMP 3						
LMP 4						
LMP 5						
LMP 6						
LMP 7						

Australian Government
Department of Agriculture, Fisheries and Forestry

AUSTRALIAN EGG
CORPORATION LIMITED

Noise Assessment Record

Noise characteristics for assessment of potential noise impacts.

Name	Date	Noise Monitoring Points Characteristics of noise nuisance						
		NMP 1	NMP 2	NMP 3	NMP 4	NMP 5	NMP 6	NMP 7

0	Not Audible	**A**	Sound pressure level
1	Definitely not annoying	**B**	Its duration
2	Very little annoyance	**C**	The rate in which it happens
3	Some annoyance	**D**	Its audibility
4	Annoying	**E**	Continuous at steady level or has a fluctuating, intermittent, tonal or impulsive nature
5	Quite annoying	**F**	Whether it has vibration components
6	Very annoying		
7	Extremely annoying		

Australian Government
Department of Agriculture, Fisheries and Forestry

Odour Monitoring Record

Step 1 : Using the odour intensity scale provided, record the odour intensity every 30 seconds over a 10 minute period.

Step 2 : Enter the highest intensity level experienced during the 10 minute period into the record below.

Step 3 : When an odour intensity of 3-6 is experienced, corrective action is required.

Odour intensity scale

Odour intensity	Intensity level
Extremely strong	6
Very strong	5
Strong	4
Distinct	3

Odour intensity	Intensity level
Weak	2
Very weak	1
Not perceptive	0

Name	Date	Time	Wind direction	WInd strength	Odour Monitoring Points						
					OMP 1	OMP 2	OMP 3	OMP 4	OMP 5	OMP 6	OMP 7

AUSTRALIAN EGG CORPORATION LIMITED