National Agricultural Manure Management Program

GHG Emissions from Manure Management

The National Agricultural Manure Management Program

The quantification of emissions and mitigations from manure management in Australia has been limited. In recognition of the similarities between some manure systems across the intensive livestock industries (feedlot beef, pork, poultry and dairy), and with acknowledgement of research synergies that can improve the efficiency and cost effectiveness of research in this area, the intensive livestock industries developed a joint application to the "Filling the Research Gap" (FtRG) program administered by the Department of Agriculture. From this application, funding was provided for the National Agricultural Manure Management Program (NAMMP).

The projects funded under NAMMP are discussed in complementary fact sheets. These research projects addressed the following research priorities under the FtRG program: the reduction of nitrous oxide emissions; the reduction of methane emissions; increasing soil carbon; improving modelling capacity; and, farm systems design and analysis. These projects included the quantification of emission sources within the context of developing mitigation strategies as part of the Emissions Reduction Fund (ERF).

Manure Management Systems and Emission Sources

Manure management begins with animal nutrition, which determines the mass and characteristics of manure excreted. In particular, the mass of organic material (volatile solids or VS) and nitrogen (N) represents the substrate from which emissions arise. Quantification and mitigation of manure emissions typically begins here.

Most manure management systems have three (or more) stages after excretion. Quantification of manure emissions generally requires the mass flow of manure (specifically VS and N) to be followed throughout the whole system.

Manure emissions are regulated by physical and biological processes. The amount of time that manure is held in each stage can have a significant influence on the total emissions.

The largest emission source tends to be from manure that remains in the 'post excretion management' stage for a reasonable period of time or moves to the storage or treatment stage. In some cases this can be as large as 60 to 80 per cent of emissions on a site. This offers a significant opportunity for mitigation.

Mitigation of manure emissions can be targeted at any or all of the stages throughout the system. However, because manure management systems represent a series of interlinked processes, mitigation research needs to consider the impacts of changes on later stages.

Australian Government Department of Agriculture
Australian Pork
Rural Industries Research & Development Corporation
mla Meat & Livestock Australia
Australian Egg Corporation Limited
Dairy Australia Your Levy at Work

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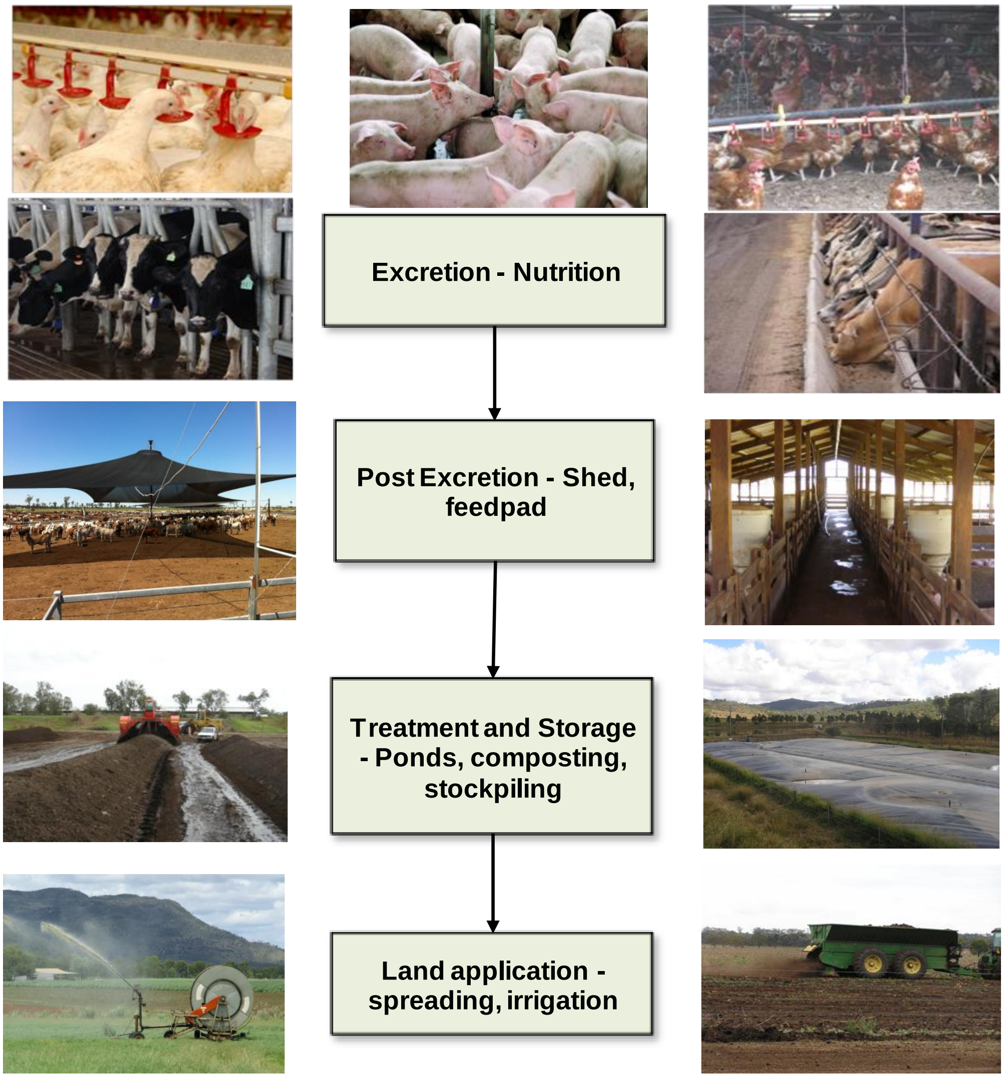
A generalised manure management process is explained by the following flow diagram:



Manure Management Emissions

The agricultural sector made up 15.5% (84.7 Mt) of the total net emissions (545.8 Mt CO_2-equivalent) of Australia in 2009 (National Greenhouse Gas Inventory Accounting, 2009). Agriculture is also the main source of nitrous oxide (19.5 Mt – equivalent to 74.5% of total) and methane (65.3 Mt – equivalent to 57.9% of total) in Australia. The main sources of agricultural GHGs from the intensive livestock industry are enteric methane and manure management emissions.

Figure 1 shows that manure management is currently estimated to be 4% of agricultural emissions. On this basis, little research effort has been directed to manure management. Despite this small contribution from manure emissions, some mitigation options in this area are attractive for research investment.

For intensive livestock production, such as grain-fed beef cattle, piggeries, dairy and poultry, manure emissions are a significant source of on-farm GHG. These industries combined account for 84% of manure management emissions. There is every expectation that significant reductions to manure emissions could be made through design and management changes driven by sound research and development. Figure 2 shows the relative contribution to manure emissions by industry in 2005.

Figure 1 – Components of all Agricultural Emissions, NGGI 2009

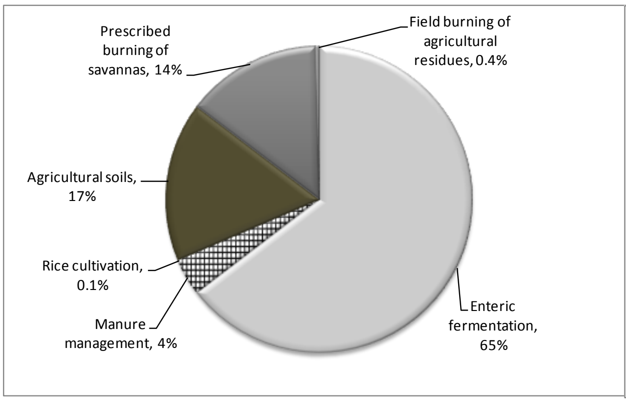
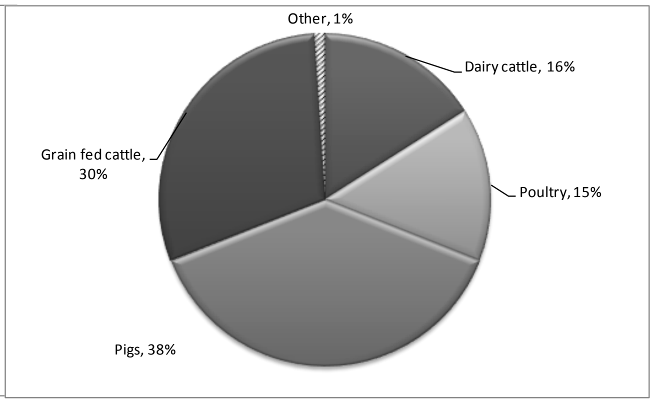


Figure 2 – Manure Management Emissions by Livestock Class, NGGI 2005



Industry Specific Emission Sources

Pig production

Emissions from manure management during pig production differ between manure treatment systems. Particularly, differences exist between liquid effluent systems and deep litter systems. For liquid systems, close to 100% of agricultural emissions arise from the effluent ponds (CFI Methodology for the destruction of methane generated from Manure in Piggeries), with the vast majority of this being methane (Wiedemann et al. 2010a). Appreciable losses of ammonia also arise from effluent treatment, with smaller volumes of nitrous oxide thought to occur from land application of effluent and solids following treatment.

When applying the CFI methodology (as noted), deep litter emissions are dominated by nitrous oxide from the pig shed, with smaller amounts of methane and ammonia (leading to indirect nitrous oxide emissions). Solid storage and application emissions are also relevant for deep litter systems.

Chicken meat and Egg production

Research completed by FSA Consulting (Wiedemann et al. 2011 – "*Environmental Assessment of Chicken Meat Production using Life Cycle Assessment*" and Wiedemann & McGahan (2011)) show results for the environmental intensity of chicken meat and egg production.

From these studies (which were based on modelled systems rather than measurements), the most important emission sources for the chicken meat industry were found to be:

- Nitrous oxide and ammonia from chicken meat grow-out sheds
- Nitrous oxide from land application of chicken meat litter.

For the egg industry, the most important emission sources were found to be:

- Nitrous oxide from land application
- Shed emissions (methane, ammonia, nitrous oxide).

Dairy

In 2005 the emissions from the Australian Dairy Industry were equivalent to 7266 kt CO_2-equivalent from enteric fermentation, 815 kt CO_2-equivalent due to N loss after excretion of urine and faeces to the soil, 574 kt CO_2-equivalent from manure management systems and 100 kt CO_2-equivalent from the direct application of effluent to the soil.

During the manure management of dairy waste, there are significant amounts of methane and nitrous oxide gases emitted. In 2005, this was equal to 26.8 kt of methane and 34.3 t of nitrous oxide. These emissions are equivalent to 17% of all Australian livestock emissions from manure management.

It was found that >90% of GHG emissions from manure management originated from storing untreated dairy effluent (retention time is assumed to be 80 days) and the subsequent methane emissions that arise due to anaerobic conditions.

Emissions of nitrous oxide from dairy feed pads may also be significant, though less research has been focused on this area.

Feedlot Beef

The study "*A Scoping Life Cycle Assessment of the Australian Lot Feeding Sector*" (Wiedemann et al. 2010b) identified the key emission factors for the manure stream, allowing prioritisation of R&D needs for the industry.

While there remains a lack of fundamental research to quantify emission sources from feedlot systems, there is a reasonable expectation that nitrogen emissions (collectively) represent the largest emission source.

Feed pad emissions represent the largest contributor to overall manure management at a feedlot. Less emissions arise from the manure after pen removal such as in storage ponds and land application.

References

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- Wiedemann, SG, McGahan, EJ & Watts, PJ 2010b, A scoping life cycle assessment of the Australian lot feeding sector, Meat and Livestock Australia Ltd, Project number B.FLT.0360, Sydney, NSW.
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