Filling the Research Gap Program

National Agricultural Manure Management Program

Poultry GHG Mitigation

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NAMMP Outcomes to Industry

These poultry studies provide the first data on greenhouse gas emissions from sheds and manure in the chicken meat industry and the egg layer industry in Australia.

- Both the meat chicken and egg layer production systems that were studied had very low GHG emissions. They were up to 8 times lower than the values previously estimated by the Australian National Greenhouse Accounts.
- Meat chicken had very modest potential for reductions of GHG emissions by altering litter depth or dietary crude levels. Increasing the depth of the litter in meat poultry shed by 20 mm failed to mitigate against total GHG emissions. Reduction of dietary crude protein by 1.5 % units, through more use of synthetic amino acids also failed to significantly affect overall GHG emissions. These modest GHG reductions are not expected to be sufficient to warrant further investigation of an Emission Reduction Fund (ERF) method for the industry.
- In the experiment in multi-tiered cage houses at an egg layer farm, the mitigation treatment of covering the stockpiled manure reduced total GHG emissions by about 88%, primarily through reducing ammonia emissions from the covered stockpile. The outcomes from this mitigation trial are considered technically sufficient to enable the development of an ERF method.
- The results from this Project also supported the further development and validation of EGGBAL and BROILERBAL which are predictive models that are now available to the Australian poultry industries.

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Aims and Outcomes

Accurate baseline greenhouse gas (GHG) emission data from the chicken meat and egg layer industries in Australia was quite limited. This project established baseline data and examined potential mitigation strategies to reduce emissions in both industries.

For the chicken meat deep litter production system, two strategies were studied: firstly, the effect of increasing the litter depth in the sheds on GHG emissions; and, secondly, the response to a reduced level of dietary crude protein.

For the layer industry, an experiment was conducted to determine the mitigation potential of covering the stockpile of manure that was generated by a caged egg production system.

Overall, the project aimed to identify plausible GHG mitigation options for standard production systems in both the chicken meat industry and egg layer industry in Australia.

Key activities

Using open path Fourier transform infrared spectrometry, continuous gas measurements of methane, nitrous oxide, carbon dioxide and ammonia were collected with paired sheds to measure baseline emissions simultaneously with a couple of mitigation scenarios.

The paired meat chicken sheds were studied for the full grow-out period of seven to eight weeks and the paired layer sheds for a two to three week period during the production cycle.

Nitrogen and volatile solids mass balance studies were run concurrently with the continuous gas measurement experiments described for both the meat chicken and egg layer shed systems

Key Findings

Baseline Australian emissions data

This project involved the first Australian studies to measure GHG emissions from meat chicken and layer hen production systems. These studies generated robust quantitative data on the methane, nitrous oxide and ammonia emissions from these two common Australian production systems.

The results provided emission factors for Australian chicken meat production and demonstrated that emissions were up to about 8 times lower than the values previously estimated by the Australian National Greenhouse Accounts. In both the meat chicken and layer hen studies, baseline GHG emissions were low, supporting revision of the Australian inventory factors.

These findings have supported a change in the national inventory regarding meat chickens, which will be implemented in the 2015 inventory. Furthermore, the data generated by this project has been invaluable in the further development and validation of EGGBAL and BROILERBAL which are

predictive models that are now available to the Australian poultry industries to estimate a range of manure parameters and emissions based on mass-balance theory. Similar programs are already being used extensively in the beef feedlot and pork industries, with PIGBAL being used to determine manure emissions in the National Greenhouse Gas Accounts.

The effect of the depth of litter used in meat chicken sheds on GHG emissions.

This first experiment was conducted at a commercial farm in SE Queensland. Different litter depths (47 mm versus 67 mm) were compared in paired tunnel ventilated meat chicken sheds on this poultry farm. Increased litter depth aimed to increase the carbon to nitrogen ratio of the litter and reduce ammonia emissions, in particular. However the results of the shed study revealed that although ammonia and methane emissions may have been marginally reduced by increasing litter depth, nitrous oxide emissions were substantially increased in the higher litter depth treatment, which was unexpected. As nitrous oxide has a very high global warming potential, the increased litter depth treatment resulted in a significant increase in total GHG emissions; the GHG emissions in CO_2 equivalent values were 0.14 kg/bird and 0.25 kg/bird for the 47 mm and 67 mm litter depths, respectively. While marginally reducing methane and ammonia emissions, increasing the depth of litter failed to mitigate against total GHG emissions in meat chicken poultry sheds.

The effect of dietary crude protein level fed to meat chickens on GHG emissions.

The second experiment utilised the same facilities, but examined a reduced crude protein (CP) diet aimed to reduce N excretion and N emissions post excretion, but at a level sufficient to maintain growth performance. The CP levels of the two diets were 21.3% and 19.8%, respectively, which resulted in a difference between the two dietary treatments of 1.5% CP units.

The results of the shed study revealed that all of the GHG emissions, including ammonia, nitrous oxide and methane emissions were marginally reduced from the shed in which the birds were fed the lower CP diets. It is expected that there was a reduction in nitrogen based emissions with the lower dietary CP level, because of lower levels of nitrogen intake and excretion. It is unclear what factor, if anything, contributed to the small reduction in methane emissions from the shed in which birds were fed the low CP diet. The resultant total GHG emissions in CO_2 equivalent values were 0.15 kg/bird and 0.17 kg/bird for chickens fed the 19.8% CP and 21.3% CP diets, respectively. Interestingly, the birds fed the lower CP diet tended to result in better bird growth performance in this trial. As an indication of total mitigation potential of an average chicken meat farm producing 1,000,000 birds per annum, the total difference in emissions in response to the lower CP diet was 29 tonne CO_2 equivalent /year, which is a very modest reduction and unlikely to be viable.

Across both the chicken meat trials, differences in total emissions from each shed were very modest and are not expected to be sufficient to warrant further investigation of Emission Reduction Fund (ERF) methods, because of the inherently low emissions observed from all treatments and the corresponding small mitigation potential on these poultry farms.

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The effect of covering a stockpile of egg layer manure on GHG emissions.

This experiment was conducted in two identical multi-tiered cage houses at a poultry farm in southern NSW. In addition, two stockpiles of layer manure were established for the trial with one stockpile left uncovered, while the other one was covered with a light impermeable tarpaulin as a mitigation treatment. Ammonia emissions from the covered stockpile were 87% less than the emissions from the control stockpile treatment, while both nitrous oxide and methane emissions were negligible in both stockpile treatments. Most of the mitigation was achieved by reducing ammonia losses, particularly during the early period after the establishment of the stockpile.

Analysis of the total GHG impact of the control and mitigation treatments revealed that total GHG emissions were 731 kg CO_2 equivalent for the control, but only 132 kg CO_2 equivalent for the mitigation treatment of the covered stockpile, a reduction of total GHG emissions of about 88%. The outcomes from this mitigation trial are considered technically sufficient to enable the development of an ERF method. However, scalability factors and cost effectiveness would need to be considered by the poultry industry to determine if such a method of covering manure stockpiles is likely to be widely applied.