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In this edition we highlight a new GIA research project and detail how research outcomes have been used to revise national emission factors. We also have project site and communication activity updates across the GIA program.

Since our last newsletter the GIA program finished its operations as a collaborative project within the CRC for Greenhouse Accounting. The CRC ceased operations in June after completing its seven-year life. The GIA program is maintaining a national presence through informal collaborative linkages with many of the partners from the CRC program.

The work continues to focus on emissions of nitrous oxide and methane from agriculture, particularly in the grains and intensive grazing industries.

Copies of presentations mentioned in this newsletter are available from our web site at www.greenhouse.unimelb.edu.au under Talks.

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Item and its quantity	Estimated cost of work (Rs.)
Original purchase	6.0
Original entry	4.0
Cost of material purchased	4.0
Transport and entry	1.0
Insurance	0.5
Sub-total	9.5
Cost of work completed	9.5

Items	2002-03 (Rs.)	2003-04 (Rs.)
Total available	100.0	100.0
Cost of work completed	9.5	9.5
Balance available for sale	90.5	90.5
Cost of work completed	9.5	9.5
Balance available for sale	81.0	81.0
Cost of work completed	9.5	9.5
Balance available for sale	71.5	71.5
Cost of work completed	9.5	9.5
Balance available for sale	62.0	62.0

TABLE 1. Revised country-specific emission factors from Nitrogen (N) fertiliser, included in the 2004 National Greenhouse Gas Inventory (data from

Lower nitrous oxide emission factors

Richard Eckard and Traci Griffin

GIA research has shown that nitrous oxide emissions from nitrogen fertiliser, applied to irrigated dairy pastures and rain-fed winter wheat in Victoria (DPI sites), appear much lower than the average emission factors from northern hemisphere studies, suggesting that a combination of our climate and soils, together with a more judicious use of nitrogen

Dr Mick Meyer, CSIRO MAR) and a comparison of the unamended 2003 NGGI and the 2004 NGGI using the revised emission factors.

fertiliser results in lower greenhouse gas emissions.

The default emission factor used by the Intergovernmental Panel on Climate Change (IPCC) is 1.25%. The research conducted by DPI staff, within the CRC for Greenhouse Accounting team and DPI-GIA project, reported emission factors in the range of 0.05 to 0.1% from winter wheat systems at Rutherglen and 0.4 to 0.5% from dairy pastures at Kyabram.

Thanks to the work of Mick Meyer, CSIRO, the 2004 National Greenhouse Gas Inventory now includes a series of revised emission factors that are more industry-specific and appropriate to Australian climate and soils (Table 1).

The impact of the research conducted by the GIA program is clear when comparing the unamended 2003 NGGI to the 2004 NGGI (Table 2).

a) Firstly, the revised fertiliser emission factors have resulted in an 8.5 Gg (2635 Gg CO₂e) reduction in the estimated N₂O emissions from N fertiliser use, even though total fertiliser use increased during this period. This is also reflected in an overall decrease in the relative contribution of agricultural soils to the National emissions total of 6.9 Gg N₂O (2139 Gg CO₂e).

b) One of the objectives of the GIA research program was to reduce the uncertainty of the estimates used in the NGGI. In the unamended 2003 inventory the uncertainty associated with agricultural soils was reported as 28 to 125, whereas in the 2004 inventory this uncertainty is now reduced to 36 to 82 (Table 1).

The research by DPI scientists has also confirmed one previous Australian study, that a nitrous oxide emission factor for urine deposition in Australian grazing systems is more appropriately 0.4% than the IPCC default value around 2%. However, recent evidence in New Zealand would suggest that nitrous oxide emission factors are highly soil type dependent and further research should aim to quantify these regional differences.

New GIA Mixed Farming Systems Project

John Graham

In July GIA commenced a new project measuring greenhouse gas emissions from mixed farming systems in Western Victoria. The project will investigate the impact of the increasing trend of converting pasture only systems to a mixed grazing and crop rotation system on net greenhouse emissions at the whole farm scale. The project will also



investigate how management practices like fertiliser application and stubble management can influence emissions.

The project is a joint initiative involving the Grains Research and Development Corporation, the Australian Greenhouse Office, DPI Victoria and the Department of Sustainability and Environment Victoria. Operating over two research sites at Horsham and Hamilton, the project will principally use automated chambers to measure emissions.

At Horsham, emissions from Canola/wheat rotations with and without nitrogen fertiliser and comparing direct drill and zero tillage will be measured. A pulse/wheat rotation will also be investigated. The chambers linked to a Tuneable Diode Laser (TDL) will measure Nitrous oxide (N₂O) continuously. A Licor infra-red gas analyser in conjunction with a 3D sonic anemometer will collect data on (carbon dioxide) CO₂ and water (H₂O) fluxes on a continuous basis, to determine water balance and the relationship between transpiration and plant production.

The investigation will seek to validate recent research outcomes from Rutherglen (Victoria) and Cunderdin (Western Australia) research, where emissions from synthetic fertilizer use in cropping systems were found to be a tenth of that predicted by current measurement models.

At Hamilton, emissions will be measured from pasture and crop legume rotation treatments sown into a 25 yr old high and low fertility perennial pasture plots on the long-term phosphate site. Treatments will be continuously measured for N₂O, methane (CH₄), and CO₂ fluxes, using the chambers linked in field to a Fourier Transform Infra-Red gas analyser (FTIR).

The GIA – Mixed Farming System project team includes Dr Roger Armstrong, Dr Sally Officer, Dr Frances Phillips and Kevin Kelly. John Graham at Hamilton is the Project Leader.

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The Licor infra-red gas analyser for measuring water and carbon fluxes and the sonic anemometer for measuring 3D windspeed.



Fiona Barker-Reid (left) and Frances Phillips (right) inspecting chamber equipment at the Cunderdin site, Western Australia. The picture was taken three weeks after sowing.

Sowing in Western Australia

Louise Barton

The Western Australia team is now in its second year of nitrous oxide (N₂O) measurements from dryland wheat at Cunderdin Agriculture College. Low and infrequent rainfall in May and June has delayed (or put a halt to) seeding in much of the central WA wheatbelt. Seeding at the Cunderdin site for the 2006 season was completed on the 26th June. Follow up rainfall has remained elusive, with only 20 mm of rain falling into the gauge in the three weeks following seeding.

Total N₂O losses from the cropped site are expected to be low based on the results from the first year of study. From the 1st June 2005 to the 31st May 2006, approximately 0.1 kg nitrogen ha⁻¹ was emitted as N₂O. This emission represents 0.01% of the nitrogen applied as urea, with much of the loss occurring following summer thunderstorm events. These data align well with the data from the Rutherglen wheat site where similar low emissions were reported.

Findings from the first year of the study were presented at the GIA National Industry Liaison Panel on the 22nd June 2006 and to the Australian Greenhouse Office on the 23rd June 2006.

GIA's Fiona Barker-Reid and Frances Phillips from DPI Victoria recently visited the Cunderdin site to inspect the gas monitoring equipment first hand. Fiona and Frances are investigating options to upgrade N2O monitoring equipment for use in the new GIA Mixed Farming Systems project.

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GIA Methane – Scientist exchange and tannins

Chris Grainger

Drs Sean McGinn and Karen Beauchemin, from Agriculture and Agri Food, Canada have completed their one year exchange at Ellinbank and have headed back for their 'normal' lives in Lethbridge, Canada. Sean and Karen played a pivotal role in calibrating the new chambers at Ellinbank and in publishing a key paper comparing the chamber methods to the SF6 collar methods. As a result of the experiments conducted during their time at Ellinbank, we are now confident that the methane chambers and field-based collar method produce the same results.



A dairy cow in the methane chambers at Ellinbank.

DIETARY SUPPLEMENTS TO REDUCE GREENHOUSE GAS EMISSIONS

The next phase of the GIA Methane project will investigate low cost dietary supplements that can be fed to dairy cattle that, in the first instance increase milk production economically, while also reducing methane production. An understanding of the diet offered to ruminant livestock and how it changes through the year is an important step in developing feed management practices that can be both economically profitable and reduce greenhouse gas production.

The problem:

Dairy cows in Victoria obtain about 70%, on average, of their dietary nutrients by grazing pasture. The nutrients provided by pasture vary during the year and the diet is supplemented with forage and grain supplements. In spring there is generally an oversupply of protein from pasture. In summer, pasture is generally of poorer quality and there is less available so both energy and protein limit milk production. This means that any dietary supplementation designed to mitigate methane and produce profitable effects on milk production should take account of the changing supply of nutrients provided by the pasture throughout the year.

Tannin as an option:

Recent studies in New Zealand have shown that the use of forages containing condensed tannins (CT), or their extracts, can reduce methane emissions. The reduction in methane due specifically to the CT ranged from 13-16%. A more recent study in Switzerland reported a 13% reduction in methane emitted when sheep were fed an extract from Black Wattle, containing 61.5% CT. Importantly there was no commensurate drop in feed digestibility

that has been reported previously to partly account for lower methane emissions. In addition, there was a favourable effect on nitrogen balance within the animal with less nitrogen excreted in urine and this would lead to lower losses of nitrous oxide from urine patches.

Tannin extract from the bark of the Black Wattle tree is currently imported into Australia mainly from South Africa. It could be incorporated into concentrate feeds for use in dairy cattle diets. It can also be delivered to cattle via their drinking water. The tannin extract offers the following advantages for inclusion in the diet of cattle when protein supply in the diet is in excess:

- * potential reduction in methane per kg DM intake of 15%
- * potential reduction in nitrous oxide due to a reduction of 13% in N in urine

The effects on milk production are unknown at this stage, but there is strong evidence for a reduction in methane using CT. The logical time to use the CT in the diet would be in the spring when there is an oversupply of protein in the pasture offered to the cows. Data needs to be collected on the effects of CT on milk production in spring and what inclusion rates are necessary to gain the reduction in greenhouse gases, but not negatively impact on feed digestion and milk production.

Whole Cotton Seed:

In the summer period, when pasture quality is poor (low protein and energy) and there is less available, dietary supplements need to be able to provide more energy and protein. Oilseeds such as whole cottonseed (19.6-24.0% protein, 13.1-16 MJ energy per kg DM, 23% oil and NDF 39%) are a good option and are currently favourably priced at about \$200 to 210 per tonne.

In summary, the diet of the herd could be supplemented with tannin and WCS reducing both methane and Nitrous oxide while also increasing milk production, as follows:

- * Spring – supplement with CT to reduce methane and nitrous oxide
 - * Summer/Autumn – supplement with whole cottonseed to improve milk production and reduce methane
- Experiments to study both these supplements are planned for the next 12 months at DPI Ellinbank.

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*The Hon Peter McGauran MP,
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Out 'n' about - communications

Traci Griffin

- * Greenhouse Industry Forum – Ellinbank DPI Centre
- * Final Industry Liaison Panel meeting
- * Talking Politics
- * Victoria Farmers Federation

Greenhouse Industry Forum – Ellinbank DPI Centre

In April GIA and the Western Port Greenhouse Alliance (WPGA) hosted an information forum on greenhouse emissions and energy use for dairy and beef farmers in the Gippsland region. Over forty farmers and NRM representatives attended. The day included presentations by GIA team members Richard Eckard, Chris Grainger and John Graham and a tour of the cow calorimeters.

WPGA is one of four greenhouse alliance groups supported by the Victoria Greenhouse Strategy across Victoria. Recently WPGA received \$600,000 under the Victorian Government's Sustainability Fund for ongoing work to educate and support beef and dairy businesses to reduce greenhouse emissions, water consumption and waste landfill in the Western Port region. GIA will support WPGA with this ongoing work.

Final Industry Liaison Panel meeting

The final panel meeting under the CRC for Greenhouse Accounting was held in Canberra in June. Since 2004 the panel has been a key communication conduit between the GIA team and stakeholder groups associated with program activities. The panel facilitated effective knowledge exchange between research teams, government agencies and agricultural groups about greenhouse emissions for Australian agricultural systems.

During the forum panel members and guest from across Australia enjoyed presentations from each of the GIA project sites. Highlights included a presentation by Dr Mick Meyer (CSIRO) on the revised emission factor work for synthetic fertiliser and a facilitated discussion by Richard Eckard about future challenges and directions for greenhouse research.

Talking Politics

The Hon Peter McGauran MP, Federal Minister for Agriculture, Fisheries and Forestry, visited Ellinbank in February. The Minister was briefed on the GIA Methane research project and toured the calorimeter chambers. Parliamentary Secretary to the Hon Peter McGauran, Ms Sussan Ley also received a briefing in Albury on the GIA program and greenhouse emissions from Australia's agriculture sector in August.

Victoria Farmers Federation (VFF) QBE Crop Nights

In July GIA was invited to participant in the VFF's annual crop nights, a series of information forums for grain growers at various locations across regional Victoria. The aim of the presentations were to develop farmers understanding of greenhouse emissions from grain and intensive grazing systems and raise awareness of the GIA research program.

Over 175 farmers participated in the crop nights; locations included Rainbow, Underbool, St Arnaud, Horsham, Hamilton and Tungamah. Feedback was supportive of GIA's efforts to increases farmers understanding about greenhouse and the program's efforts to increase the accuracy of the emission estimates that profile their industries.

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