Department of
AGRICULTURE
FISHERIES &
FORESTRY -
AUSTRALIA

GREENHOUSE AND AGRICULTURE WORKSHOP SERIES

Field Crops - Grains
Workshop Final Report

Prepared by
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FINAL REPORT

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Introduction

In 1999, Greenhouse gas emissions from agriculture accounted for 20.5% of total national net emission (AGO, 1999). Agriculture is unique, in greenhouse terms, when compared with other Australian industries, as the non carbon dioxide gases methane and nitrous oxide make up the majority of its emissions profile. These two gases are very potent greenhouse gases with methane having a global warming potential 21 times that of carbon dioxide and nitrous oxide 310 times.

Australia is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) which aims to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous human induced changes to the global climate system (AGO, 1998). Australia has taken an active involvement in negotiating and have since signed the Kyoto Protocol (to the Framework Convention on Climate Change). If this Protocol is ratified, it will commit Australia to a legally binding limit on its future greenhouse gas emissions (AGO, 1998).

Responding to the provisions of the Kyoto Protocol will therefore present a number of threats and opportunities for agriculture. The agricultural industries need to be proactive to develop mechanisms that limit greenhouse gas emissions and adapt to climate change impacts in a way that minimises any dislocation and costs and at the same time make the most of any commercial opportunities.

To assist this process, the Standing Committee on Agriculture and Resource Management (SCARM) has developed a combined Commonwealth and State Government Work Program to:

> *"provide the facilities for a joint government and industry consultation to improve the knowledge base for greenhouse issues in agriculture and provide a suite of appropriate strategies to farmers for emission reductions*".

The first phase of the Work Program involves a *Greenhouse and Agriculture National Workshop Series*, which was developed to engage nine key agricultural sectors to discuss the range of greenhouse issues relevant to their sector industry. The agricultural sectors involved are:

- Extensive Grazing sectors:
  - Beef cattle; and
  - Sheep.
- Intensives Livestock:
  - Dairy;
  - Lot Feeders; and
  - Pork Industries.
- Field Crops:
  - Cotton;
  - Grains;
  - Rice; and
  - Sugar.

The Grains workshop was held in Perth on 8 August 2001. The specific aims of the workshop were to:

- Share the latest climate change and greenhouse effect information with industry and other stakeholders;
- Identify options to reduce greenhouse gas emissions; and
- Prioritise areas where action is required.

The question posed to participants at the start of the workshop was

What are the key mechanisms available to the grains sector to reduce net greenhouse gas emissions?

The second phase of the SCARM Work Program will involve the implementation of a number of specific projects to address particular industry needs such as, providing the research necessary to fill important gaps in our understanding of greenhouse gas emission reduction options and/or communication and extension activities.

There were twenty-nine participants from industry, science and government who attended the Workshop. A list of these participants and their contact details is provided in Attachment A.

Format of the workshop

The morning session of the workshop consisted of presentations by government representatives, researchers, an industry representative and a producer. The presentations provided information to participants on greenhouse emissions in the grains sector and abatement issues. The presentations are summarised. The afternoon workshop session provided an opportunity for participants to contribute in discussions to identify strategic directions for the grains industry to reduce greenhouse gas emissions and also to identify strategic directions for the grains sector.

Background[1]

Due to its sensitivity to climate and it geographic spread, there is probably no industry within Australia with the potential to be more directly affected by climate change than the grains industry. Climate change will impact production, storage and transport infrastructure.

The science of climate change forecasts is still subject to high levels of uncertainty but several key projections have emerged that have particular relevance to the grains industry:

- Greater rainfall variability with a tendency for decreases in most regions. The projected scenario for Western Australia shows a trend for decreasing Winter/Spring rainfall in particular, which would result in the grain belt moving South.
- Higher evaporation levels partly offset by improved plant growth in carbon dioxide rich air.

[1] This has been extracted from Agriculture, Fisheries and Forestry Australia (2001) 'Critical Issues for the Grains Sector', fact sheet (unpublished paper).

- Minimum temperatures will rise before maximums, which may affect the behaviour of some pathogens particularly in the cooler humid, grain growing areas.

It is currently difficult to tell whether some of the observed climate trends confirm these predictions, or whether they are part of normal climate variability. There is little doubt however, that the possibility of climate change should be a significant element in planning longer-term assets for the industry, whether it be an improved variety or the siting of storage infrastructure.

The majority of emissions from agriculture are from methane and nitrous oxide. These are both very potent greenhouse gases.

Approximately two thirds of agricultural greenhouse gas emissions come from methane from ruminants and one quarter comes from nitrous oxide. Much of nitrous oxide comes from activities associated with crop production such as soil disturbance, residue burning and losses from nitrogen fertilisers.

Nitrous oxide flows within cropping and grazing systems are currently very poorly understood. There are two reasons for this:

- Unlike carbon, nitrous oxide released from the soil can change by several orders of magnitude hourly, depending on temperature and moisture, and there can be equally large variations within a field depending on the soil type. Compounding this problem is the fact that it is difficult to measure, with the main instruments being a 1 metre square atmospheric chamber which is too fine a resolution for most work. Meteorological methods are generally too coarse.
- Whilst the grains industry has invested considerable resources over a number of years into improving the efficiency of nitrogen use by crops, measuring the type and amount of nitrogen compounds released to the atmosphere in the cropping cycle has not been seen as a research priority.

There are three main reasons why nitrous oxide should be a significant issue for the grains industry:

- It is such a potent greenhouse gas and hence small emissions from this source require a very large effort in carbon sequestration to offset it. American work suggests that for every kilogram of nitrous oxide produced 140 kilograms of carbon needs to be taken from the atmosphere and sequestered into the soil as an offset.
- Traditionally the Australian grains industry has relied heavily on legumes to supply nitrogen. However with the decline of pastures over much of southern and western Australia, the advent of continuous cropping and the requirements for higher yields, an increasing amount is now being sourced from fertilisers. It is reasonable to suggest that as yields and nitrogen requirements continue to rise steeply in the industry, so too nitrous oxide releases rise at a similar rate.
- Nitrous oxide released to the atmosphere represents the waste of a costly resource and there is an urgent need for the industry to improve its generally low efficiency in nitrogen use.

It was originally thought that the major role for carbon in cropping systems were emissions via soil disturbance and energy use. Farm inventory work by Greenhouse Challenge (AGO) however, has shown that carbon releases are relatively minor

proportion of emissions on many farms and much of the current thinking is focussed on the potential role for carbon sequestration to offset emissions from other sources.

The United States of America (USA) has recently announced a major project in this area with the expectation that more than 40% of emission increases from all sectors could be offset by carbon sequestration in cropping lands chiefly through the adoption of conservation cropping regimes.

There appears to be considerably less potential for a similar result in Australia. As many in the industry know only too well, for many cropping regions just maintaining organic carbon levels is an achievement let alone gaining a meaningful increase. There may however, be some potential to follow the South American example and introduce manure crops into our system especially if this also could be used to soak up the seasonal excess water that is currently a feature of annual cropping systems.

Presentations

Warwick Jones

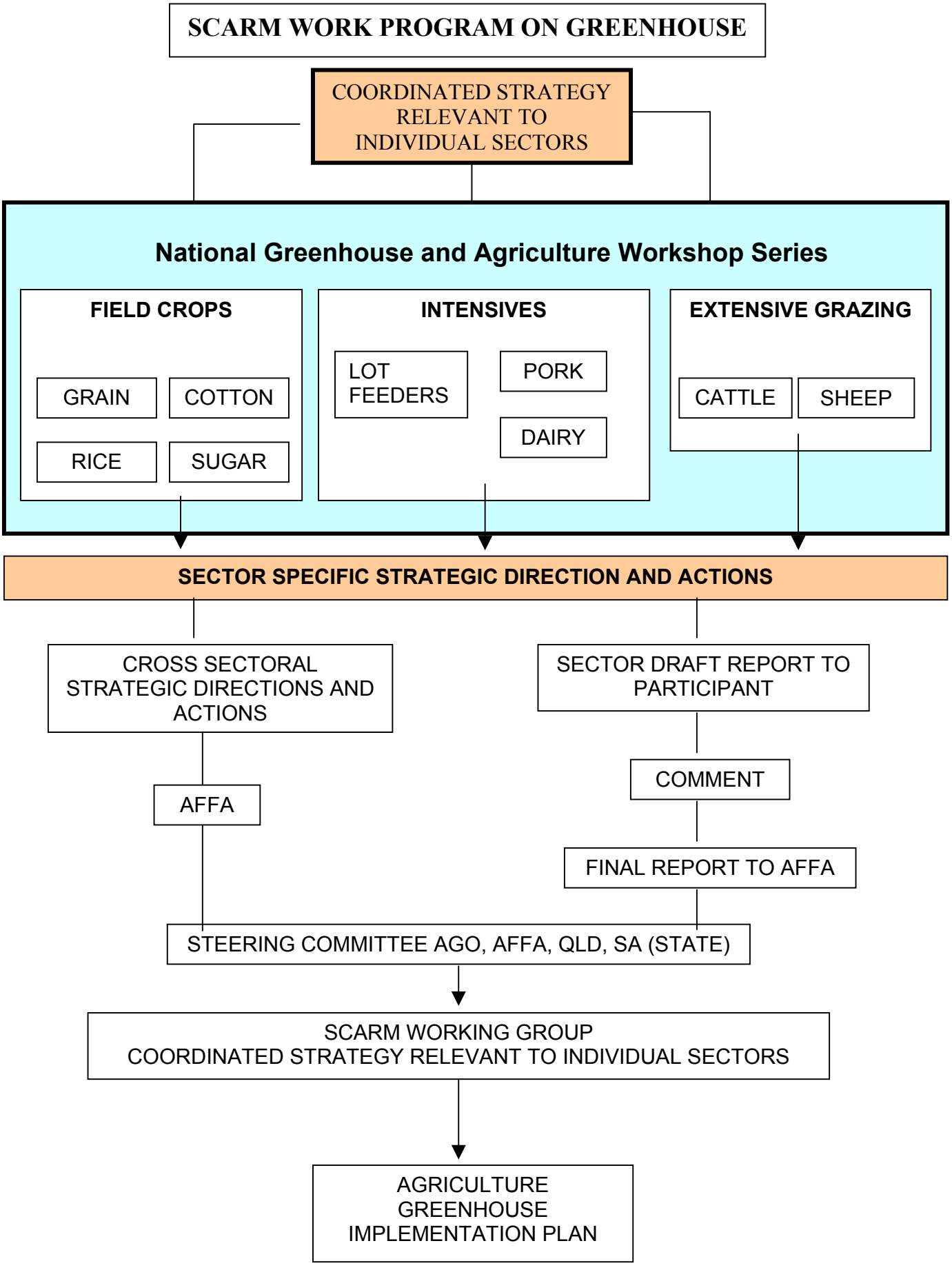
Agriculture, Fisheries and Forestry - Australia

Warwick Jones welcomed participants to the Grains Workshop part of the National Agriculture and Greenhouse Workshop Series. The workshop series is helping to advise Ministers on appropriate actions.

Jones outlined that in the mid 1990's it became obvious to Government that greenhouse was a big issue. The Australian Government then set up the Australian Greenhouse Office (AGO), the only office in the world set up specifically to deal with greenhouse issues and advise ministers of appropriate action. The Commonwealth and all State and Territory Governments developed a National Greenhouse Strategy.

Jones stated that agriculture sits within *Module 6 – Greenhouse Sinks and Sustainable Land Management* of the strategy, particularly *Module 6.9 – Incorporating consideration of greenhouse issues into agricultural management practices.* In response to Module 6.9 the Standing Committee on Agriculture and Resource Management (SCARM), a State and Commonwealth Government committee, identified the need to consult the agricultural sector on greenhouse issues and potential abatement options. This National Agriculture and Greenhouse Workshop Series has been set up to achieve this. The Department of Agriculture, Fisheries and Forestry – Australia (AFFA) were asked to organise the nine workshops. Jones noted that the sheep, beef and dairy workshops had been held, and workshops were to be held for rice, cotton, sugar, lot feeders and pork industries, following the grains workshop.

Jones presented the work program to participants and outlined the approach being taken (see flow diagram on the next page). Jones also introduced Hassall & Associates who have been engaged to coordinate the workshops and report on the outcomes.


SCARM WORK PROGRAM ON GREENHOUSE
COORDINATED STRATEGY RELEVANT TO INDIVIDUAL SECTORS
National Greenhouse and Agriculture Workshop Series
FIELD CROPS
GRAIN
COTTON
RICE
SUGAR
INTENSIVES
LOT FEEDERS
PORK
DAIRY
EXTENSIVE GRAZING
CATTLE
SHEEP
SECTOR SPECIFIC STRATEGIC DIRECTION AND ACTIONS
CROSS SECTORAL STRATEGIC DIRECTIONS AND ACTIONS
SECTOR DRAFT REPORT TO PARTICIPANT
AFFA
COMMENT
FINAL REPORT TO AFFA
STEERING COMMITTEE AGO, AFFA, QLD, SA (STATE)
SCARM WORKING GROUP
COORDINATED STRATEGY RELEVANT TO INDIVIDUAL SECTORS
AGRICULTURE GREENHOUSE IMPLEMENTATION PLAN

David Bowran

Manager of Grains Unit, Western Australian Department of Agriculture

David Bowran officially welcomed participants to Western Australia on behalf of the Western Australian Department of Agriculture. He said that greenhouse and climate change are important to the agricultural industries in Western Australia. Bowran also noted that this workshop series is part of the SCARM work program on greenhouse that will help the agricultural sectors respond to climate change related issues. Bowran identified that the States and agricultural industries are looking at how they can deliver against Australia's international commitments. The obvious role for State Government departments is in the implementation of policy. This workshop aimed specifically at the Grains Industry will help to identify what policy developments are required and help prioritise the outcomes.

Overall, Bowran identifies that the industry has mixed views on the implications of greenhouse gas emissions particularly the sorts of costs and benefits it will bring to the industries. Can an individual farmer make a contribution to greenhouse gas abatement?

Bowran pointed out that the scope to reduce greenhouse gases includes different uses of tillage systems for greenhouse gas abatement purposes e.g. changes in stubble management. Also other considerations include lifting awareness of the relative warming affects of different greenhouse gases (nitrous oxide and methane in particular) and changes in the way we are currently using nitrogen fertilisers to reduce nitrous oxide emissions.

The challenge that faces us is how agriculture can make a positive contribution and identify potential opportunities for the grains industry.

Allen Grant

Manager – Greenhouse Program, Natural Resource Management, AFFA

Allen Grant was one of the Australian delegates involved in the recent climate change negotiations held in Bonn, Germany. In his presentation, he provided an overview of the Commonwealth Government's current position on greenhouse. Overall he noted that there is international consensus that climate change is occurring and that greenhouse gas emissions are causing a big impact on the earth.

Grant identified that 20% of the net national emissions are as a result of agriculture. Of the large amounts of money being spent on greenhouse gas abatement programs, nowhere near 20% of the dollars are being spent on reducing emissions or identifying options for reducing greenhouse gas emissions by the agricultural sector. Grant acknowledged that agricultural greenhouse gas abatement is not an easy task in comparison to some of the other large emitters such as stationary energy sources.

Grant commented that the international negotiations on climate change in The Hague (known as COP 6) held in November 2000 collapsed as a result of the USA requesting carbon sinks be incorporated as part of the Kyoto agreement. Overall the outcome from COP 6 was that there were no solutions and overall people were blaming each other for the global problem. At Bonn there was a strong push by the Europeans to force an outcome from the meeting particularly on whether sinks should be included or not. Australia achieved its primary objective to include sinks in the international agreement.

Grant said that between now and COP 7, to be held in Marrakech at the end of October 2001, Australia will be doing our numbers to get a better understanding of what influence the changes will have on the market. At the moment there are a lot of uncertainties that need clarifying and refining.

Grant questioned the sort of incentive that will be required to improve emissions and whether it is possible to achieve our target. It is not clear how cross industry impacts will be approached to achieve the target.

Grant outlined where the USA fits into the picture. The USA has promised to come up with an alternative to the protocol that includes carbon sinks and developing countries by the next session in late October. Other countries were very sceptical of this promise and are keen to see if or what the USA come up with for COP 7. Australia will compare the USA alternative with the Kyoto Protocol, prior to ratifying the Protocol.

Domestically Australia has set up the only national office to primarily deal with greenhouse issues and advise government. The Greenhouse and Agriculture Taskforce was set up with the responsibility to identify where agriculture are positioned in greenhouse. The Taskforce has representatives from Agriculture, Fisheries and Forestry – Australia (AFFA), the Australian Greenhouse Office (AGO), peak industry groups and relevant research and development corporations. The key issue that the Taskforce is dealing with is what is the strategic framework required to address greenhouse issues in Australian agriculture. Grant suggested that currently there is a considerable lack of knowledge about greenhouse issues and he commented that the Commonwealth Government do not know what messages to give producers.

Grant outlined his views on the Greenhouse Challenge Program, which was seen in part to be about education. The Kondinin Group is recruiting producers to join the Greenhouse Challenge. Grant proposed that we need to be strategic about who and how we recruit people to the Greenhouse Challenge, and the best way may be to recruit on a sector-by-sector basis. Grant suggested that the best way to recruit might be on a sector-by-sector basis.

Another program, the Greenhouse Gas Abatement Program (GGAP), is designed to reduce emissions mostly through large-scale projects. Projects for Round 1 of this program have been announced and applications have closed for Round 2. The GGAP will generally fund projects that have large-scale greenhouse gas abatement. Unfortunately, under this program individual producers are exempt and Grant encouraged producers to attempt to attract interest from various consortia and combine the agricultural applications to the GGAP program to show wider application. Even though the eligibility is strict, the AGO are looking to try and resolve this for producers. There are also renewable energy programs, for example, ethanol and methane as a renewable power. This gives agricultural producers an opportunity to diversify their incomes with greenhouse outcomes.

Grant identifies that the Australian Greenhouse Office is doing a lot of work on greenhouse carbon trading but no one is in a rush to instigate a trading scheme. It is unlikely that Australia will establish a scheme until the international system is in place. Currently it is unknown how agricultural producers will engage in an emissions trading scheme, as transaction costs may not make it economically viable.

Grant commented that the Commonwealth Government is looking at ways of incorporating greenhouse issues with natural resource management strategies such as the National Action Plan on Salinity and Water Quality.

Ian Foster

Western Australian Department of Agriculture

Foster opened by presenting a graph from the Vostok ice core showing carbon dioxide, methane and temperature over time (starting over 400 000 years ago). The graph showed a dramatic increase in carbon dioxide and methane concentrations during the industrial era.

Foster presented graphs that showed temperature increases for both the global and Australian region. The CSIRO (2001) temperature projections for Australia suggest average annual temperature increases of between 0.4 and 2.0^{o}C by 2030 and between 1.0 and 6.0^{o}C by 2070. The CSIRO research proposes that there will be increased warming inland particularly in the northwest regions and lesser warming on the southern coasts.

The CSIRO (2001) annual rainfall projections show a significant decrease in seasonal autumn-spring rainfall for Western Australia (autumn-spring projected to be between 0% and -20% by 2030 and between 0% to -60% by 2070). Summer rainfall is expected to vary between ± 10% by 2030 to ±35% by 2070. Although rainfall is harder to model compared with temperature, there is consistency among models that forecast significant changes to seasonal rainfall.

Overall evaporation rates are likely to increase with increases in temperature however concern is raised where there is less rainfall.

Foster presented some of the management considerations as a result of seasonal climatic changes and the reliability conditions over the years e.g. changes to frost, available water. He then gave an example of some modelled wheat yields using different climatic scenarios. Overall the yield is expected to change as a result of available water. It was thought that yields may increase but the protein levels decrease for grain.

Foster summarised by stating that temperature and carbon dioxide are increasing and winter/spring rainfall are likely to decline over most of Australia, whilst evaporation will increase. This indicates that there will be less water available.

Jan Skjemstad
CSIRO Division of Land and Water CRC for Greenhouse Accounting

Jan Skjemstad opened by presenting a table showing the volumes of carbon stored in natural systems e.g. carbonates, soils, seawater, fossil fuels, the atmosphere and living biomass. There are large volumes of carbon stored in soils and sediments.

The soil carbon component is a function of the carbon input and microbial respiration. Skjemstad presented different management strategies and the soil carbon losses under different conditions. He said for all management strategies, there will be some carbon lost to the atmosphere. He also outlined the soil carbon content in the top 30cm of the Australian continent is approximately 20Gt. There have been large losses of soil carbon since European settlement as a result of land clearing and agricultural practices. Skjemstad noted, however, that it is possible to return carbon to the soil. The amount that can realistically be returned to Australian soils depends on

- How much residue can be returned;
- How far carbon decline has already progressed; and
- Climatic and soil factors.

Overall the soil carbon component is highly dependent on the carbon inputs. Skjemstad believed that there was limited opportunity for the grain industry to increase soil carbon under current conventional practices. He notes that an important first step is to reduce fallow periods and return all residues. Also, the inclusion of pastures in rotations and planting of perennials on low production/ unproductive land may increase the soil carbon.

Cameron Schuster
Wesfarmers CSBP

Cameron Schuster opened by expressing that the Fertilizer Industry Federation of Australia (FIFA) was pleased to be able to contribute to this important workshop for the grains industry. He outlined that although the industry had not specifically focussed on greenhouse emissions from fertilizer use, it has identified the loss of nutrients off-farm as a key issue for the industry. He says that there is little doubt that improving the nutrient use efficiency will reduce nitrous oxide emissions.

The industry suggests that for every 1kg of nitrogen applied as fertiliser, 10 to 12 kg of carbon can be sequestered.
Schuster identified that nitrous oxide emissions are the result of microbial processes in the soil and nitrogen fertilisers can be a direct and indirect source of nitrous oxide emissions. The Australian greenhouse model assumes a nitrous oxide emission factor of 1.25% of the nitrogen (N) fertiliser applied. However, the range of emissions attributable to N fertilisers varies from 0.25% to 2.25%, which is a nine-fold variation. Schuster said that it is important to note that despite the significant increases in consumption of nitrogen fertilisers, the percentage of contribution of legume nitrogen fixation to total inputs is substantial across southern Australia. In some regions the contribution exceeded 80%, according to the National Land and Water Resources Audit (NLWRA).
Schuster presented a graph which showed changes in production of different gases and the importance of water content in the soil on gas production. Other factors that are also important are temperature, the availability of nitrogen and decomposable organic matter.

Thus soil properties, such as sodicity that affect waterlogging, irrigation and drainage practices will influence nitrous oxide emissions.
In general terms, the management strategies that increase the efficiency of nitrogen uptake by crops are likely to reduce nitrous oxide emissions into the atmosphere. Some of these strategies include the:

- Timing of application including split applications;
- Rate of application;
- Incorporation of fertiliser below the surface;
- Nutrient balance (i.e. ensure that other nutrients are not limiting); and
- Incorporation of stubble to immobilise excess surplus nitrogen.

Schuster also suggests some technologies that may be able to reduce emissions:

- Controlled release products (currently these are costly and unless the cost is significantly reduced it is unlikely that it will gain widespread use on low value agricultural crops);
- Nitrification inhibitor (in the USA, 2 million hectares of crops are being applied with nitrification inhibitors); and
- Urease Inhibitor.

There are two major initiatives being undertaken by the fertiliser industry that will assist the implementation of improved nutrient management practices. Firstly, in 1999, FIFA published the Australian Soil Fertility Manual, which was designed to provide the fertiliser industry and its customers a basic reference for information on the proper use of fertilisers, education, training and accreditation. The manual was written in a style suitable for farmers, fertiliser dealers, extension workers, consultants and teachers.

The second initiative has been the development of draft Guidelines for the development of Nutrient Management Codes of Practice. FIFA has decided to support and encourage individual industry or regional bodies to produce nutrient management codes of practice that are specific to their situation and encourage the evaluation of best management practices. The starting point for this process is a draft document “Cracking the Nutrient Code: Guidelines for Developing Nutrient Management Codes of Practice” developed by FIFA (2000).
In developing the Codes of Practice, natural resource management issues were prioritised. In the future, Schuster saw that the Codes of Practice should be expanded to include additional management tools for reducing nitrous oxide emissions.

FIFA are seeking competency training packages for Nutrient Management through the Rural Training Council of Australia.

The presentation was summarised by identifying areas where further research is required and include:

- Improve the estimates of nitrous oxide emissions;
- Undertake a further National Land and Water Resources Audit relating to nutrients;
- Evaluate the extent of various agronomic practices on nitrous oxide emissions and verify current emission model with these results; and
- Evaluate the emission reduction benefits from the use of slow release nitrogen fertilisers, nitrification and urease inhibitors.

David Cattanach

NSW Producer

David Cattanach is an irrigated grain producer from New South Wales and is the first grains producer to undertake a greenhouse audit of their property under a Greenhouse Challenge Agreement. The reason he did an audit was that he saw it as a good management tool. Cattanach outlined the process used to carry out his on farm audit. The audit process included measuring:

- Petrol;
- Diesel;
- LPG;
- Electricity; and
- Nitrogenous fertilisers.

The audit process did not come up with what he and the members of the Greenhouse Challenge had thought would be his high emission areas fuel usage, instead the majority of emissions were nitrous oxide from his fertiliser use. When they examined the results and developed an action plan for fuel and energy, it was apparent there was not a lot of scope for reductions. Cattanach said that he went looking for answers and could not find any.

Cattanach asked the group for assistance to identify methods to reduce his greenhouse gas emissions and suggested that more information was required on nitrous oxide emissions and abatement options.

Summary of Workshop Discussions

Part One

Workshop participants were asked to identify two mechanisms available to the grains sector to reduce net greenhouse gas emissions. The participants grouped the key issues into thirteen categories and then prioritised them, according to their perceived importance. The issues identified (in ranked order) are:

- Ensure the baseline and information on nitrogen fertilisers is sound;
- Identify through research the best management strategies for using nitrogen fertilisers specifically for greenhouse gas abatement;
- Gain an understanding of the carbon sequestration options for the grains sector and potential opportunities;
- Develop easy to use tools to carry out on-farm emission audits for different farming systems;
- Communicate key greenhouse issues across the whole industry to improve general understanding of the most significant factors, issues and opportunities;
- Overall improve the efficiency of inputs on farm (including energy efficiency used for transport and machinery and fertilisers use);
- Gain an understanding of the regional impacts of climate change and communicate this information to the relevant communities;
- Obtain more research funding (to be invested in collaborative research, e.g. by universities and CRC's);
- Examine opportunities for alternative energy use (eg wind, solar etc) and dual energy farming (eg bio-fuels);
- Understand and identify the drivers for adoption;
- Identify whole farming systems that can increase productivity and reduce greenhouse gas emissions (looking for the win-win situations and what capacity there is to adopt changes);
- Develop cross industry greenhouse gas emission protocols; and
- Carry out research to gain an understanding of the potential trade impacts for different agricultural sectors.

The top five were further examined in workshop discussions and potential further action was identified. The following is a summary of the group's findings and actions.

Ensure the baseline information on nitrogen fertilisers is sound

As the highest priority identified by the participants, the option to improve the baseline information used for calculating the nitrous oxide emissions from nitrogen fertilisers is important to give confidence in the results or tailor the information for Australian conditions. Australia uses the emission factor of 1.25% of nitrogen fertiliser applied to a given area which is used by the International Panel on Climate Change (IPCC)[2]. However, as noted by McGuffog (2001)[3] emissions from nitrogen fertilisers can vary from 0.25% and 2.25%.

The participants identified that currently there is a lot of research that has and is being carried out for carbon emissions but very little research in the area of nitrogen. Participants felt that there was a need to obtain a better understanding of the nitrogen issues. To start this, it would be appropriate to do some desktop research and collate relevant existing data and information for nitrogen. The desktop research should examine what has been done, what has not been done and put together a plan to fill the gaps. This process will also involve actively seeking funding for research.

Participants also identified that it is important to carry out research at a regional level to gain an understanding of the likely differences between greenhouse gas emissions. They suggested that a model be developed and calibrated to examine regional conditions and the differences between dryland, irrigated and high rainfall systems.

The participants felt that this information was a priority and when it was available it should be delivered to producers in a meaningful manner (incorporated in best management practice options).

Another comment that came out of this discussion was that there needed to be an improvement of intra and inter departmental communication to ensure that the current research is not duplicated and that they do not want to reinvent the wheel where other research is already being carried out or information and experiences from carbon research could be used.

[2] Post workshop Douglas McGuffog (FIFA) contacted the International Fertilizer Industry Association (IFA) and they advised that a new report entitled "Global estimates of gaseous emissions of NH_3, NO and N_2O from agricultural land" is currently undergoing peer review and is due for publication shortly. The report was jointly commissioned by the International Fertiliser Association (IFA) and the Food and Agriculture Organisation of the United Nations (FAO), and is based on the work of A. Bouwman and L.J.M. Boumans (both from the National Institute Public Health and the Environment, Bilthoven, the Netherlands) and N.H. Batjes (International Soil Reference and Information Centre, Wageningen, the Netherlands). The study itself was contracted out to Alex Bouwman and it is important to note the conclusion in the study about the level of nitrous oxide emissions from nitrogen fertiliser is much lower than the currently used factor of 1.25% of N fertilizer applied (this factor was derived from earlier research by Bouwman). The average factor from this report is calculated at 0.8% per tonne of nitrogen applied.

[3] Through research carried out by Bouwman et al (1999)

Researching better use of nitrogen fertilisers

To identify the best use of nitrogen fertilisers, participants felt that a strategy was needed to prioritise research and to ensure the "best bang for your buck." To do this, participants identified that a range of stakeholders should be involved including researchers, fertiliser manufacturers and industry representatives. Participants also noted that it was vital to get growers involved in the research.

The groups felt that three key areas should be examined to identify the best management of nitrogen fertilisers for greenhouse emissions. These are:

- Assessing techniques of fertiliser application and their impact on nitrous oxide emissions (eg type, placement and timing of applications);
- Carrying out on-farm research; and
- Understanding the behaviour of nitrogen in different environments, such as examining the influence of various environments on stimulating growth and the volume of nitrous oxide released to the atmosphere.

The group identified five research projects that could be carried out:

1. Clarify the role of nitrogen in the soil nutrient cycle and validate on farm;
2. Develop appropriate measurement techniques for sampling nitrous oxide and investigate the measurement options that could be carried out at the farm scale;
3. Assess de-nitrification research technologies (eg de-nitrification inhibitors);
4. Investigate whether there are options for selective breeding of plants for their nitrogen efficiency; and
5. Research the whole farm systems and greenhouse gas emissions and confirm net emissions for agriculture (eg ruminant emissions versus legumes and nitrogen).

Gain an understanding of the carbon sequestration options for the grains sector and potential opportunities

The participants suggested that two potential options for carbon sequestration for the grains sector are soils and vegetation.

The participants opened by asking what the potential was for carbon sequestration from soils? They felt that there was limited opportunity whilst acknowledging cropping and other potential areas needed to be further investigated. They suggested that we currently did not know enough about carbon sequestration from soils and how it could be used on farm.

However, carbon sequestration through vegetation and revegetation may have potential. There is an opportunity for carbon sequestration by planting trees and perennials on the least productive land. However, the incentives available for a grain producer to do this are unclear. There is a need to explore potential areas where this could be profitable for a producer, as it is unlikely to be a direct source of income for them.

Overall comments that came out of this group were that the agricultural sector should position itself to capture offsets. Major companies are looking to achieve a carbon abatement option. The agricultural sector should obtain information from other sectors and also should be more involved in the carbon farming debate to ensure there are no economic disadvantages. Agriculture should consider how to position to have input into

the carbon farming debate as there are some potential economic advantages and disadvantages for agriculture that should be considered.

Develop easy to use tools to carry out on farm emission audits for different farming systems

The need to develop an accountable scientifically credible auditing process that measures greenhouse gas emissions is important both on-farm and nationally. An on-farm auditing process will help to:

- Establish better baseline data on emissions of carbon dioxide, nitrous oxide and methane;
- Improve the knowledge of on-farm emission profiles;
- Ensure that there is a better accounting process for calculating carbon dioxide equivalent emissions;
- Improve overall on-farm efficiency;
- Educate producers and industry of the key greenhouse gas issues and areas that require abatement strategies; and
- Provide an opportunity for farmers to participate in greenhouse gas abatement research.

The tool also gives an opportunity for the grains sector to compare its emission profile against other agricultural sectors. It can also be used to estimate the potential costs to the industry (output emissions/ $GDP) and compare this against other sectors. By examining these regional and sectorial differences, a producer may be able to use the information for making land use decisions.

The whole farm audit for greenhouse gas emissions could also be used to combine the information with production information, other environmental considerations and other management practices. The farming system could then be improved to incorporate other natural resource management benefits or practices with that of greenhouse gas abatement.

The group commented that greenhouse issues should be incorporated with other natural resource management strategies such as the National Action Plan for Salinity and Water Quality. If the information is packaged together it will be more useful to producers.

Developing the on farm emissions auditing tool could also be used to provide baseline data that could be the starting point for modelling.

Communicate key greenhouse issues across the whole industry to improve general understanding of the most significant factors, issues and opportunities

The participants felt that communicating the greenhouse message to the agricultural community is difficult as the message is still unclear and there is an uncertain political environment. What information should be provided to growers?

The participants felt that there is a need for communication to:

- Pressure government to position the industry as well as it can;
- Overcome the raft of uncertainties;
- Engage the whole community, as it is a community issue not just a sectoral issue; and
- Show leadership.

The group identified potential communication options, including:

- Toolkits and audits;
- Simple models; and
- "What if" exercises.

Educational Strategies identified by the group included:

- Educate extension officers;
- Educate students through colleges; and
- Undertake extension via media, field days etc.

Targeting the top 10-20% of growers to facilitate dissemination of information via examples.

Workshop participants did not identify who should take the lead in carrying out these communication activities, but saw it as important that the AGO was visibly involved. Options for communication partnerships may include working with the Grains Research and Development Corporation (GRDC), Commonwealth and/or State and Territory Governments, Industry bodies and producers.

Part Two

The afternoon workshop session two initially aimed to identify the top ten specific actions the industry should take to reduce greenhouse gases, especially those that could be started immediately.

This workshop session ended up debating some of the questions that participants had. During this process some issues and actions were identified, including:

1. Identify the problem in terms of nitrous oxide and find out where the big emissions are coming from.
2. The grains industry need to know what to do and then these options need to be marketed well.
3. Growers, extension officers and community at large need to be made aware of greenhouse issues (particularly the nitrous oxide issue). Education needs to be carried out to forewarn the community of the sorts of problems that are coming as a result of greenhouse and climate change.
4. Identify the win-win actions for producers, for example:
    - Conservation tillage;
    - Efficient use of nitrogen fertilisers (to reduce costs); and
    - Other actions identified through nitrous oxide research.
5. Undertake an assessment of international competitiveness based on greenhouse gas reductions.
6. Develop an information base to develop solutions (closely linked with 1 and 2).
7. Start lobbying for a suitable time-line in which to implement nitrous oxide abatement strategies. A cohesive approach is necessary.
8. Undertake a risk assessment of particular actions (including no action based on refusal to change or ignorance).
9. Identify the drivers for adoption of abatement strategies. Examples of drivers might include avoiding trade barriers and obtaining offset advantages.
10. Seek an agreement between industry and government to show joint commitment (particularly from industry).
11. Try to take people from the denial stage to the action stage (closely linked to 3). To achieve the industry needs to say:
    - Here is the problem!
    - We don't have all the answers but here are some win-win actions that can be taken. Provide the least painful strategies first i.e. the least cost for the best results.
12. Communication of the information must come from the government then to industry representatives and then to farmers (this depends on who has information and answers).
13. Science is not the most important issue as there are others issues that will lead to greenhouse gas abatement. Research, education and other factors need to run concurrently.

Key Messages from Workshop

Overall the workshop raised the awareness of Participants understanding of greenhouse issues related to the grains industry. The workshop also identified priorities for action for the grains sector - a positive outcome.

Research and Development

Participants have identified several research and development activities that should be carried out to provide opportunities for greenhouse gas abatement. Participants suggested that the research should be carried out in collaborative way and include various researchers, industry (including producers) and government. There are five key themes that came out throughout the day that should be researched, these include

- Gaining a better understanding nitrous oxide issues;
- Developing tools to measure emissions and gaining a better understanding of on-farm emissions through an auditing process;
- Developing options to abate greenhouse gas emitted on-farm;
- Identifying areas that have production and greenhouse gas abatement benefits; and
- Further develop knowledge on how greenhouse issues are going to affect both domestic and international markets.

There has been only a limited amount of research into nitrous oxide emissions and abatement opportunities as most greenhouse gas research to date, has been carbon related. There is a need for information about nitrous oxide and the main sources of on-farm emissions. This should be done in collaboration with the CRC for Greenhouse Accounting, as there are some synergies in the work that has already been carried out. However, prior to developing the required research priorities, an audit of the research that has been (or is being) carried out on nitrous oxide issues is needed. This would prevent the repetition of work and will help to identify the gaps.

It is important that research findings be communicated to the community as soon as possible to encourage adoption. The collaborative approach that includes producers, industry, research organisations and government will speed acceptance and adoption of the findings.

Research should also be carried out on best management options that incorporate greenhouse issues with other environmental considerations and understanding of the trade offs different options have on other environmental and production issues.

Communication and Extension

Participants who attended the workshop, particularly the producers felt that much of the information that was presented to them and discussed at the workshop should be communicated to the community as a whole. Producers, extension officers and industry should be made aware of the greenhouse issues and the potential risks associated with them.

The Commonwealth Government representatives expressed to the group that message to producers is unclear as there are currently no clear-cut solutions. Research into nitrous oxide issues and potential options of abatement need to be communicated as soon as it is available. The Fertiliser Industry Federation of Australia (FIFA) has developed the best management practices for the use of fertilisers and, although the

information was not specifically prepared in relation to greenhouse emissions, it does identified best nutrient management practices that could be implemented today that have greenhouse abatement potential.

Participants felt that it was important for the industry to position itself to respond to greenhouse. In doing this they felt that the industry should lobby government to ensure that the government makes the best policy decisions it can that includes agricultural issues (and more specifically issues grain sector issues). Participants also felt that an agreement should be made between government and industry to show the commitment of both parties to respond to greenhouse issues.

Workshop participants did not identify who should take the lead in carrying out these communication activities, but saw it as important that the AGO was visibly involved. Options for communication partnerships may include working with the Grains Research and Development Corporation (GRDC), Commonwealth and/or State and Territory Governments, Industry bodies and producers.

Institutional Impediments

Institutional impediments were identified specifically relating to the research and development organisations and the separation of research effort. Participants felt that the research and development activities should be carried out collaboratively.

Governments, both Commonwealth and State and Territory, were seen to need to work together to ensure that the same messages are delivered and similar activities be carried out constructively.

Further Information and References

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