出國報告（出國類別：其他-國際會議）

2016 年第六屆溫室氣體及動物農業研討會 (6th Greenhouse Gas and Animal Agriculture Conference)

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摘要

國立雲林科技大學環境安全衛生工程系洪肇嘉教授為協助執行國立台灣大學執行行政院農委會之「研析畜牧業之溫室氣體排放趨勢與測量方法」計畫，於 105 年 2 月 12 日至 2 月 20 日至澳大利亞墨爾本(Melburne, Australia)參加 2016 年第六屆溫室氣體及動物農業研討會 (6th Greeenhouse Gas and Animal Agriculture Conference, GGAA 2016)，該會議為日本學者 Junichi Takahashi 於 2001 發起探討養殖動物與溫室氣體之關係，今年為第六度舉辦，歷年舉辦國家均為已開發國家或畜產大國，閉幕會中並決議 2019 年五月於巴西舉辦 (Foz do Iguacu, Brazil)。

會議主題涵蓋面廣泛，從全球觀點及政策、至農場實務管理、到反芻動物之生理學及環境硝化去硝化機制等，畜牧尿及糞便管理之甲烷及氧化亞氮減量、整場模型及減量方案、甲烷及氧化亞氮在處理級模型之進展及適應與減量。

關鍵字: 畜牧部門；Livestock Sector；溫室氣體排放清冊；Greenhouse Gas Emission Inventory；國際交流；International Exchange

目錄

一、目的

我國 2008 至 2015 年溫室氣體排放清冊，畜牧業排放以腸胃發酵與排泄物處理的 CH_4 為主，以排放源而言，腸胃發酵 CH_4 以牛(53%)和豬(39%)為主，排泄物處理的 CH_4 以豬(64%)和家禽(25%)為主(2010 年)。牲畜部門之牛及家禽 類的排放係數採用本土研究值，其中腸胃發酵係數較於 IPCC 建議值高，排泄物處理之係數則較低。而 2010 年農業部門溫室氣體排放較 2009 年略增，主因為牛與豬隻畜養量及土地施肥量量增加影響。若依 IPCC 在 2006 規範 排放類別佔 25-30%以者，需依 Tier2 計算，則腸胃發酵排放甲烷需考慮乳牛及豬，而排泄物管理豬排放及蛋雞氧化亞氮排放，然台灣 Tier 2 仍缺乏數據，需要進一步研究，然世界各國採此計算者仍少。

全澳農牧業用地 4.9 億公頃，其中牧業用地占 55%。澳大利亞是世界天然草原面積最大的畜牧業生產大國，草地面積達 458 萬平方公里，以養羊及牛為主的畜牧業非常發達，其牛肉、羊肉、羔羊、動物產品以及動物基因材料出口量在世界上都是名列前茅，同時也是羊毛重要出口國之一，以效率、 創新為其產業特徵。而溫室氣體研究世界各國畜牧養殖情況不同，以致在進行溫室氣體國家清冊計算時採計 Tier 1、Tier 2 和 Tier 3 方法會產生差異 ，澳大利亞為畜牧業生產大國且畜牧生產模式多元化，對於降低溫室氣體之農場管理策略和畜牧生產過程所排放溫室體之測量方法之推廣和應用創新科學技術，值得我國效法。透過觀摩參酌澳大利亞研究組織，或參加溫室氣體相關會議以收集及研析畜牧業之溫室氣體排放趨勢及量測溫室氣體之方法，汲取相關經驗及技術，並為本土化應用。

藉由參加在澳大利亞墨爾本舉辦之 2016 年 6th Greeenhouse Gas and Animal Agriculture Conference(第六屆溫室氣體及動物農業研討會， 2016GGAA)，收集其溫室氣體相關研究之最新相關資訊，包括畜牧部門溫室氣體排放資料庫之依據和採計方法；並將相關資料攜回我國，以作為建議國內策略及管理方案之參考。

二、過程

國立台灣大學為執行行政院農委會委託之 105 農科-4.3.3-牧-U2「研析畜牧業之溫室氣體排放趨勢與測量方法 A study of greenhouse gas emission trends and measurement methodology for livestock sector」業務，於 105 年 2 月 12 日至 2 月 20 日派國立雲林科技大學環境安全衛生工程系洪肇嘉教授至澳大利亞墨爾本(Melburne, Australia)參加 2016 年第六屆溫室氣體及動物農業研討會 (6th Greeenhouse Gas and Animal Agriculture Conference, GGAA 2016)，行程表如附錄一。該會議為日本畜產大學學者 Junichi Takahashi 於 2001 發起探討養殖動物與溫室氣體之關係，今年為第六度舉辦，閉幕會中並決議 2019 年五月於巴西舉辦 (Foz do Iguacu, Brazil)，並規劃於 2022 年在亞洲考慮由泰國主辦。

歷年舉辦地點主要在開發國家及畜產大國，時間地點如下：

1、GGAA 2001, 1st INTERNATIONAL CONFERENCE ON GREENHOUSE GASES AND ANIMAL AGRICULTURE, November 7-11, 2001, Tokachi Plaza, Obihiro, Japan

2、GGAA 2005, 2nd International Conference on Greenhouse Gases and Animal Agriculture GGAA 2005, September, 20-24, 2005, Zurich, Switzerland

3、GGAA 2007, 3rd Greenhouse gases and animal agriculture conference, November 26-29, 2007, Hotel Grand Chancellor, Christchurch, New Zealand

4、GGAA 2010, 4th Greenhouse Gases and Animal Agriculture Conference, October 3-8, 2010, Banff, Alberta, Canada

5、GGAA 2013, 5th Greenhouse gases and animal agriculture conference, June 23- 26, 2013, Dublin, Ireland

6、GGAA 2016, 6th Greenhouse Gas and Animal Agriculture Conference, February14-18, 2016, Melbourne, Australia.

本屆 GGAA 2016 並有 Pre-conference workshop 在其 Ellinbank Dairy Research Centre on Wednesday 10 - 11 February 2016 探討以 SF6 作為量測溫室氣體甲烷及氧化亞氮之根據(SF6 methane measurement technique workshop) and Friday 12th February 2016 為開放循環呼吸室 (open circuit respiration chambers workshop).我國農委會亦在本計畫派遣嘉南藥理大學黃大駿教授與會。

GGAA 2016 International Organising Committee，包括創始人日本 Takahashi 教授，及過去與現在主辦國代表：

- Professor Junichi Takahashi, Obihiro University of Agriculture and Veterinary Medicine, Japan
- Dr Sean McGinn, Agriculture and Agri-Food Canada, Canada
- Dr Tim McAllister, Agriculture and Agri-Food Canada, Canada
- Dr Tommy Boland, University College Dublin, Ireland
- Dr Frank O'Mara, Teagasc, Ireland
- Professor Roger Hegarty, University of New England, Australia
- Professor Richard Eckard, University of Melbourne, Australia

2016 年會議議程如附錄二，參加人員名單如附錄三，主題及與畜牧及政策相關重要報告整理如下：

<u>Theme 1. Global perspectives and policy 全球觀點及政策</u>

1) 由世界銀行專家 Gerbe 發表 Achieving food security and climate change mitigation - the policy challenge for animal production (如附錄四)。

他回顧畜牧部門 GHG 及其主要來源，提出應考量效率或土壤碳積存，多樣性及減量，及危機性等問題，減量是共同利益或需求改變?公共政策應如何?從經濟觀點看，因協議及公共投資增加，應該樣考量主要畜牧部門如何達成永續目標，指標及方法以冀便管理(CDM 項目)，持續草原管理及奶產效率為主，技術則自適應，替代及經濟考量，組織財經設計應鼓勵參與。

2) FAO Martin Scholten 發表 International initiatives in support of agricultural GHG mitigation: 國際農業及畜牧組織已啟動一方案支持 GHG 減量技術之合作研究，自 GGAA2013 後已形成 Global Research Alliance，也獲致不少成果，低甲烷產量及氣候適應基因辨

識，餵食及消化與菌種，動物與飼養，糞便管理，改進土壤碳積存，精密畜養農莊等，也發行通訊，也獲許多國際組織支持，CCAFS 並在全世界挑選示範區及研發低排放技術展示(如附錄四)。

Theme 2. Improvements in the measurement of methane and nitrous oxide 量測甲烷及氧化亞氮之改進

主要探討量測反芻產生之甲烷，包括不同地區、物種及日夜差異測量及模型，及監測技術與呼吸室之預測及比較。

Theme 3. Advances in understanding biology and biochemistry of non-CO2 emissions from livestock 瞭解畜產非二氧化碳之生物及生化學進展

主要討論如何結合去硝化 (co-denitrification)減少尿液於草原排放氧化亞氮， pH 與土壤含水率影響等，也探討如何從餵食減少甲烷產生，包括賀爾蒙及抑制劑運用機制等。

Theme 4. New advances in methane mitigation of emissions from ruminant livestock 反芻畜牧在降低甲烷新進展

也探討賀爾蒙及抑制劑運用等餵食可減少甲烷產生，包括全球反芻調查等。

Theme 5. Mitigation of methane and nitrous oxide from excreta and manure management 尿及糞便管理之甲烷及氧化亞氮減量

報告數量最多，涵蓋主題有減少 N2O 自豬隻廢水及糞便處理排放，硝化抑制氨氧化，減少 N2O 排放於糞便及尿之草原施用等。

Theme 6. Mitigation in practice 減量之實務

考量農場管理效率、產能與 GHG 排放，抑制劑使用等，分別有巴西、印度及澳洲等案例，及分析方法。

Theme 7. Whole farm systems modeling of mitigation options 整場模型及減量方案

Theme 8. Advances in process level modeling of methane and nitrous oxide 甲烷及氧化亞氮在處理級模型之進展

兩主題混合探討，包括施肥之草原及穀類 GHG 排放模型，澳洲牛肉模型，尿及 N2O 關係，甲烷排放模型，農莊利弊及糞便管理與 N2O 排放模型，及餵草之奶農莊與牛奶碳足跡關係等。

Theme 9. Adaptation and mitigation 適應與減量

主要探討高 CO2 時採食與甲烷產量研究，添加餵食之影響，南非的策略，Offsets 等。

口頭報告共有六十餘篇，內容參見網頁，http://www.ggaa2016.org/program.php，並可下載作者提供之 Pdf 檔，摘要檔已收集並提供農委會畜牧處參考。參加人員如附錄三，收集資料列於附錄五。海報有兩百餘篇，內容已收集並提供農委會畜牧處參考，與溫室氣體政策較相關者臚列於附錄六。 此次會議上有一我國立中興大學動物系博士生 K.Teepalak Rangubhet 小姐也申請科技部補助參加國際會議，海報題目為 "INVESTIGATION OF ENTERIC METHANE EMISSION AND PROTOZOA POPULATION IN HOLSTEIN STEERS FED MUSHROOM CULTIVATION RESIDUE BASED SILAGE IN TAIWAN."

PO03 DIRECT GREENHOUSE GAS EMISSIONS FROM SOUTH AFRICAN LIVESTOCK INDUSTRIES

Lindeque Du Toit1, Willem van Niekerk2, Heinz, Meissner2, Josef van Wyngaard2

1 Tshwane University of Technology 2 University of Pretoria

PO05 GREENHOUSE GAS EMISSIONS AND RESOURCE USE OF CANADIAN BEEF PRODUCTION IN 1981 AS COMPARED TO 2011

Getahun Legesse1, Karen Beauchemin2, Kim Ominiski1, Emma McGeough2, Rolland Krobel1, Doug McDonald3,

Shannon Little1, Tim McAllister1

1 Department of Animal Science, University of Manitoba 2 Agriculture and Agri-Food Canada, Lethbridge, Alberta

3 Environment Canada, Gatineau, Quebec

PO11 SYSTEMATIC AND ACCURATE ESTIMATION OF METHANE AND NITROUS OXIDE FROM LIVESTOCK AND POULTRY IN CHINA DURING 1949-2012

Minghao Zhuang1

1 College of Environmental Sciences and Engineering, Peking University

PO40 DISAGGREGATED N2O EMISSIONS FROM IRISH AGRICULTURE

Karl Richards1, Patrick Forrestal1, Mary Harty0, Rachael Carolan2, Karen McGeough2, Catherine Watson2, Ronald Laughlin2, Eddy Minet1, Gary Lanigan1

1 Teagasc, Johnstown Castle, Environmental Research
Centre, Co. Wexford, Ireland 2 Agri-Food and Biosciences Institute, Northern Ireland 3 Queen’s University Belfast, Northern Ireland

PO136 GREENHOUSE GAS EMISSIONS DURING STORAGE OF UNTREATED LIQUID MANURE AND ANAEROBIC DIGESTATES

Khagendra Raj Baral1, Per L. Ambus2, Martin H. Chantigny3, Guillaume Jégo, Só¸ Ren O. Petersen 1
1 Department of Agroecology, Aarhus University, Denmark 2 Department of Geosciences and Natural Resource Management, Denmark 3 Soils and Crops Research & Development Centre, Agriculture and Agri-Food Canada

PO138 GREENHOUSE GAS EMISSIONS AND BIOGAS POTENTIAL FROM SWINE PRODUCTION IN THAILAND

Kalaya Boonyanuwat1, Prapas Mahinchai1, Kamon Chaweewan1
1 Bureau of Animal Husbandry and Genetic Improvement. Dept. of Livestock Development

PO209 PREDICTION OF YM FOR DAIRY COWS BASED ON NATIONAL FARM DATA

Anne Louise Frydendal Hellwing1, Martin Riis Weisbjerg1, Maike Brask1, Lene Alstrup1, Marianne Johansen1, Lone Hymøller1, Mette Krogh Larsen2, Peter Lund1
1 Department of Animal Science, AU Foulum, Aarhus University 2 Department of Food Science, AU Foulum, Arrhus University

PO218 INVESTIGATION OF ENTERIC METHANE EMISSION AND PROTOZOA POPULATION IN HOLSTEIN STEERS FED MUSHROOM CULTIVATION RESIDUE BASED SILAGE IN TAIWAN

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三、心得

GGAA 會議自 2001 年開始由日本畜產大學 Takahashi 教授籌畫於日本召開，歷經六屆，已成功為 GHG 與畜產帶來許多聯繫及推動研發、交流及合作，是 GHG 與農業、畜產之重要會議，今年我國在農委會計畫資助下分別有參與本屆 GGAA 2016 在其 Ellinbank Dairy Research Centre on Wednesday 10 - 11 February 2016 探討以 SF6 作為量測溫室氣體甲烷及氧化亞氮之根據(SF6 methane measurement technique workshop) and Friday 12th February 2016 為開放循環呼吸室 (open circuit respiration chambers workshop)之技術。並由本人全程參與研討會及收集各方資訊，也於二月十七日至 Elinbank 參觀，並收集 Climate Controlled Chambers 及參觀 In Vitro Fermentation, Greenfeed, 等設施及實驗，相關相片整理列於附錄七。

1、 本次會議為日本畜產大學學者 Junichi Takahashi 於 2001 發起探討養殖動物與溫室氣體之關係，今年為第六度舉辦，歷年舉辦國家均為已開發國家或畜產大國，2005 於瑞士，2007 於紐西蘭，2010 於加拿大， 2013 於愛爾蘭，今年於澳洲舉辦。閉幕會中並決議 2019 年五月於巴西舉辦 (Foz do Iguacu, Brazil)，並規劃於 2022 年在亞洲考慮由泰國主辦，我國可考慮屆時多參與。

2、 會議主題涵蓋面廣泛，從政策至農場實務管理到反芻動物之生理學及環境硝化去硝化機制等，今年主題有九，包括 **Global perspectives and policy** 全球觀點及政策、Improvements in the measurement of methane and nitrous oxide 量測甲烷及氧化亞氮之改進、Advances in understanding biology and biochemistry of non-CO2 emissions from livestock 瞭解畜產非二氧化碳之生物及生化學進展、New advances in methane mitigation of emissions from ruminant livestock 反芻畜牧在降低甲烷新進展、Mitigation of methane and nitrous oxide from excreta and manure management 尿及糞便管理之甲烷及氧化亞氮減量、Mitigation in practice 減量之實務、Whole farm systems modeling of mitigation options 整場模型及減量方案、Advances in process level modeling of methane and nitrous oxide 甲烷及氧化亞氮在處理級模型之進展、Adaptation and mitigation 適應與減量。

3、 在全球觀點及政策世界銀行專家 Gerber 發表 Achieving food security and climate change mitigation - the policy challenge for animal production，回顧畜牧部門 GHG 及其主要來源，提出應考量效率或土壤碳積存，多樣性及減量，及危機性等問題，減量是共同利益或需求改變?公共政策應如何?從經濟觀點看，因協議及公共投資增加，應該樣考量主要畜牧部門如何達成永續目標，指標及方法以糞便管理(CDM 項目)，持續草原管

理及奶產效率為主，技術則自適應，替代及經濟考量，組織財經設計應鼓勵參與。

4、 FAO 專家 Martin Scholten 也發表 International initiatives in support of agricultural GHG mitigation: 國際農業及畜牧組織已啟動一方案支持 GHG 減量技術之合作研究，自 GGAA2013 後已形成 Global Research Alliance，也獲致不少成果，低甲烷產量及氣候適應基因辨識，餵食及消化與菌種，動物見尻與飼養，糞便管理，改進土壤碳積存，精密畜養農莊等，也發行通訊及獲許多國際組織支持，CCAFS 並在全世界挑選示範區及研發低排放技術展示，我國應積極尋求與 CCAFS 之參與合作。

5、 從本次參會發現，世界各主要國家皆在發展畜產與 GHG 相關研究，多數透過大學或研究單位，尤其在畜產大國，其研究主題包括；探討量測反芻產生之甲烷，包括不同地區、物種及日夜差異測量及模型，及監測技術與呼吸室之預測及比較，去硝化(co-denitrification)減少尿液於草原排放氧化亞氮， pH 與土壤含水率影響等，也探討如何從餵食減少甲烷產生，包括賀爾蒙及抑制劑運用機制等，減少 N2O 自豬隻廢水及糞便處理排放，硝化抑制氨氧化，減少 N2O 排放於糞便及尿之草原施用，考量農場管理效率、產能與 GHG 排放，抑制劑使用等，分別有巴西、印度及澳洲等案例，排放模型，農莊利弊及糞便管理與 N2O 排放模型，及餵草之奶農莊與牛奶碳足跡關係等，與我國農委會推動之相關研究差異不大。

6、 此次會議上有一我國立中興大學動物系博士生 K.Teepalak Rangubhet 小姐也申請科技部補助參加國際會議，海報題目為 “INVESTIGATION OF ENTERIC METHANE EMISSION AND PROTOZOA POPULATION IN HOLSTEIN STEERS FED MUSHROOM CULTIVATION RESIDUE BASED SILAGE IN TAIWAN.”相對於日本有 5 位、韓國兩位，泰國數位及中國十數位，台灣相對少，且只有一海報，未來應作為重點會議，鼓勵我國畜產、動物生理及溫室氣體研究專家參與，不但能交流及發展合作，也將我國於相關研究發表於此，請亦可進一步刊載於期刊上。

四、建議事項

本次會議為日本畜產大學學者 Junichi Takahashi 於 2001 年於日本召創始，2005 於瑞士，2007 於紐西蘭，2010 於加拿大， 2013 於愛爾蘭，今年於澳洲舉辨。閉幕會中並決議 2019 年五月於巴西舉辨 (Foz do Iguacu, Brazil)，並規劃於 2022 年在亞洲考慮由泰國主辦，歷經六屆，已成功為 GHG 與畜產帶來許多聯繫及推動研發、交流及合作，是 GHG 與農業、畜產之重要會議。

1、 從參觀 EllinBank 研發中心看感想為、為促進 GHG 相關研究，有必要將我國既有及發展中之研究，借會議參觀機會展示研發能力外，也可促進交流合作。今年我國在農委會計畫資助下也派員參與其 Ellinbank Dairy Research Centre on Wednesday 10 - 11 February 2016 探討以 SF6 作為量測溫室氣體甲烷及氧化亞氮之根據(SF6 methane measurement technique workshop) and Friday 12th February 2016 為開放循環呼吸室(open circuit respiration chambers workshop)之技術，我國也有相關運用，可將相關資訊整理運用及本土化。

2、 本次 GGAA 會議為日本畜產大學學者 Junichi Takahashi 於 2001 年於日本創始，開始探討畜產與GHG關係及研發，歷經十餘年及六屆已具相當規模。閉幕會中決議 2019 年五月於巴西舉辨 (Foz do Iguacu, Brazil)，並規劃於 2022 年在亞洲考慮由泰國主辦，建議農委會及科技部應將此會亦列為重點，鼓勵相關研究者踴躍參加及發表研發成果。此外，Takahashi 教授在此領域有特殊貢獻及地位，我國應持續保持聯繫，必能延續良好關係及發揮交流合作之強項。

3、 參與本次會議已攜回不少資料，部分為教導畜產業者及農莊如何應對氣候變遷，但也加入如何減量 GHG 排放等，我國相關單位可參考及本土化，俾可我國農業及畜產業者。

4、 此會議攜回會議資料，部分可做為我國研發科、農業及畜產部門未來規畫研究主題，及國際交流合作之參考。此外，Climate Change, Agriculture and Food Security CCAFS 發展了 CGIAR 研究計畫主軸，著力於 Climate-Smart Agricultural Practice，Climate Risk Management，Low Emission Agriculture< Gender and Social Inclusion 及 Policy and Institution，並建立示範分區於東非、西非、拉丁美洲。東南亞及南亞，也有不少資料出版，https://ccafs.cgiar.org/publications，我國應緊密注意其發展及適時參與。

5、 在國際上畜產研究已建立 Global Research Alliance 並針對畜產建立相關網路及出版通訊，我國可先了解其內涵，並促進有相關研究之學者會研究單位積極參與，促進交流合作。

五、附錄

附錄一、參訪行程表：

<table>
<tr><th>日期</th><th>行　　程</th><th>附　　註</th></tr>
<tr><td>02/12
（週五）</td><td>晚上，自桃園中正機場搭機前往澳大利亞墨爾本(Melburne, Australia)</td><td></td></tr>
<tr><td>02/13
（週六）</td><td>下午抵達澳大利亞墨爾本(Melburne, Australia)</td><td>澳大利亞
墨爾本</td></tr>
<tr><td>02/14
（週日）</td><td>辦理研討會報到
• 領取資料，參與歡迎會</td><td>澳大利亞
墨爾本</td></tr>
<tr><td>02/15
（週一）</td><td rowspan="4">參加 2016 年第六屆溫室氣體及動物農業研討會 (6th Greeenhouse Gas and Animal Agriculture Conference)，部份議程同時間舉行，相關研討會議程內容請參考附件一 0217 參加其參觀澳洲國家乳業研發中心 The Australia National Centre for Dairy Research and Development at Ellinbank</td><td>澳大利亞
墨爾本</td></tr>
<tr><td>02/16
（週二）</td><td>澳大利亞
墨爾本</td></tr>
<tr><td>02/17
（週三）</td><td>澳大利亞
墨爾本</td></tr>
<tr><td>02/18
（週四）</td><td>澳大利亞
墨爾本</td></tr>
<tr><td>02/19
（週五）</td><td>資料整理</td><td>澳大利亞
墨爾本</td></tr>
<tr><td>02/20
（週六）</td><td rowspan="2">自搭機澳大利亞墨爾本(Melburne, Australia)回台灣</td><td rowspan="2"></td></tr>
<tr><td>02/21
（週日）</td></tr>
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附錄二、2016 GGAA 研討會行程表：0215--0218

Monday 15th February 2016

Room: Grand Ballroom

Chair: Richard Eckard

0900 - 0910 Welcome from Conference Chair

0910 - 0920 Welcome - Junichi Takahashi and Roger Hegarty

0920 - 0940 Opening

Theme: 1. Global perspectives and policy

Chairs: Dr Harry Clark & Dr Alexandre Berndt

0940 - 1005 Achieving food security and climate change mitigation - the policy challenge for animal production - Pierre Gerber

1005 - 1030 International initiatives in support of agricultural GHG mitigation - Martin Scholten

Theme: 6. Mitigation in practice

Chairs: Professor Roger Hegarty & Dr Cecile Martin

1030 - 1045 The concordance between greenhouse gas emissions, livestock production and profitability of extensive beef farming systems - Matt Harrison

1045 - 1100 Nitrification inhibitors to mitigate nitrous oxide - a summary of UK data - Tom Misselbrook

1100 - 1130 Morning Tea

Room: Grand Ballroom 1 & 2 Grand Ballroom 3 & 4

Theme: 6. Mitigation in practice 9. Adaptation and mitigation

Chairs: Dr Joe Jacobs & Dr Marta Alfaro Dr Cecile de Klein & Dr Mark Powell

1130 - 1145 Enteric methane emissions of nellore steers in different grazing production systems in Brazil - Alexandre Berndt Forage quality and methane production of the grazing portion of grass produced under elevated [CO2] - Adibe Abdalla

1145 - 1200 Carbon footprint of milk production under smallholder dairying in Anand district of India: A cradle-to-farm gate life cycle assessment - Manget Ram Use of dietary nitrate supplementation to reduce methane emissions in ruminants: effects of ruminal adaption and supplementary glucose or glycerol on microbial fermentation and nitrite accumulation in rumen contents in vitro - Victoire De Raphélis-Soissan

1200 - 1215 Getting traction for action: how Australian abatement methodologies are being translated to on farm practices - Tom Davison Achieving mitigation through adaptation: climate smart livestock solutions in Southern Africa - Anne Mottet

1215 - 1230 The effect of dietary nitrate on enteric methane emissions and methaemoglobin in ruminants: a meta-analysis - Jamie Newbold Greenhouse gas offsets in livestock systems - Sheilah Nolan

1230 - 1330 Lunch

Room: Grand Ballroom

Theme: 5. Mitigation of methane and nitrous oxide from excreta and manure management

Chairs: Prof Phil Vercoe & Prof Adibe Abdalla

1330 - 1355 Swine wastewater treatment technology to reduce nitrous oxide emission by using an aerobic bioreactor packed with carbon fibres - Takahiro Yamashita

1355 - 1420 Nitrous oxide emissions from livestock urine and dung - Dave Chadwick

Theme: 3. Advances in understanding biology and biochemistry of non-CO2 emissions from livestock

1420 - 1445 Molecular biology and biochemistry of archaeal DNA replication - Isaac Cann

1445 - 1510 An integrated compound library screening approach for discovery of specific inhibitors for mitigating ruminant methane emissions - Greg Cook

1510 - 1540 Afternoon Tea

Room: Grand Ballroom 1 & 2 Grand Ballroom 3 & 4

Theme: 5. Mitigation of methane and nitrous oxide from excreta and manure management

3. Advances in understanding biology and biochemistry of non-CO2 emissions from livestock

Chairs: Prof Claudia Wagner-Riddle & Dr Soren Petersen Dr Peter Moate & Dr Diego Morgavi

1540 - 1555 Nitrous oxide emissions and relationships with ammonia oxidising communities, soil conditions and the use of a nitrification inhibitor - Hong Di The importance of co-denitrification in nitrogen cycling in grazed pasture systems - Karl Richards

1555 - 1610 Acidification with sulfur of the separated solid fraction of raw and co-digested pig slurry: effect on GHG and ammonia emissions during storage - Elio Dinuccio Contribution of the co-denitrification process to soil nitrous oxide and dinitrogen emissions under ruminant urine patches - Tim Clough

1610 - 1625 Greenhouse gas emissions from dung, urine and dairy pond sludge applied to pasture. 1. Nitrous oxide emissions - Kevin Kelly High-resolution denitrification kinetics in pasture soils link N2O emissions to pH, and denitrification to soil respiration and moisture content - Sergio Morales

1625 - 1640 Reducing Gaseous Emissions from Manure Management in Ireland - Gary Lanigan Comparison of methane emissions of Belgian Blue and Holstein Friesian heifers -

Nico Peiren

1640 - 1655 Mixing dicyandiamide (DCD) with supplementary feeds for cattle: an effective method to deliver a nitrification inhibitor to urine patches - Eddy Minet Disentangling the effect of urine patch size and N content on cumulative N2O emissions - Karina Marsden

1655 - 1710 Greenhouse gas emissions from different dairy barnyard surfaces - Mark Powell Phloroglucinol degradation in the rumen promote the redirection of hydrogen when methanogenesis is suppressed - Gonzalo Martinez Fernandez

1710 Day One Ends

1800 - 2100 Evening Reception Function

Tuesday 16th February 2016

Room: Grand Ballroom

Theme: 7. Whole farm systems modeling of mitigation options

Chairs: Dr Ed Charmley and Prof Deli Chen

0900 - 0925 Assessing simulation models for field scale projections of pasture and crop GHG emissions - Jean Francois Soussana

0925 - 0950 WFS evaluation of mitigation options for the livestock industries - Richard Rawnsley and Robyn Dynes

Theme: 2. Improvements in the measurement of methane and nitrous oxide

0950 - 1015 The sulphur hexafluoride (SF6) tracer gas technique for determination of methane emissions from ruminants - Matt Deighton

1015 - 1040 The GreenFeed system for measurement of enteric methane emissions from cattle - Kirsty Hammond

1040 - 1120 Morning Tea

Room: Grand Ballroom 1 & 2 Grand Ballroom 3 & 4

Theme: 2. Improvements in the measurement of methane and nitrous oxide 7. Whole farm systems modeling of mitigation options

8. Advances in process level modeling of methane and nitrous oxide

Chairs: Alex Hristov & Carla Soliva Dr Robyn Dynes & Ermias Kebreab

1120 - 1135 F-NIRS approach of the seasonal profile of CH4 emission of dairy herds in a agro sylvo pastoral ecosystem of sub-Saharan Africa (Kolda, Senegal) - Alexandre Ickowicz Modeling the Effects of Variation in Passage Rate on Methane Emissions - Pekka Huhtanen

1135 - 1150 A real-time intra-ruminal gas monitoring system for ruminants - Greg Bishop-Hurley Quantifying the Greenhouse Gas Benefits of Changes in Livestock and Manure Management at the Farm Scale - April Leytem

1150 - 1205 Repeatability of methane emissions in Australian beef cattle - Kath Donoghue

Ex-ante farm-scale analysis of the impacts of livestock intensification on greenhouse gas emissions of mixed crop-livestock systems in western Africa - Jonathan Vayssières

1205 - 1220 Additional data to the methane inventory for sheep and the effect on the current predictions - Stefan Muetzel How can grass-based dairy farmers reduce the carbon footprint of milk? - Donal O'Brien

1220 - 1235 Methane emission measured with sensors correlates with climate respiration chamber measurement - Marleen Visker Relationships between milk fatty acid profiles and enteric methane production in dairy cattle fed grass- or grass silage-based diets - Jan Dijkstra

1235 - 1250 Evaluation of Diurnal Patterns of Methane Emissions - Scott Zimmerman

Manure (re)distribution as predictor of N2O emissions - Soren Petersen

1250 - 1320 Lunch

1320 - 1420 DSM Lunch Symposium

Room: Grand Ballroom

Theme: 8. Advances in process level modeling of methane and nitrous oxide

Chairs: Dr Jean-Francois Soussana & Andre Bannink

1420 - 1445 The AusBeef rumen model: description and comparison of improved methane prediction methods - Ermias Kebreab

1445 - 1510 Explicit modelling of urinary losses and nitrous oxide - Val Snow

1510 - 1800 Afternoon Tea & Poster Session

Wednesday 17 February 20160217 參訪行程內容

Mid Conference Tour to The Australia National Centre for Dairy Research and Development at Ellinbank

EllinBank

Date: Wednesday 17 February 2016

Time: 0900 - 1600

Cost: Tickets: $55

Includes: Bus transfer to and from Ellinbank and a boxed lunch

The National Centre for Dairy Research and Development at Ellinbank is located 110 km south-east of Melbourne in the foothills of the rolling Strzelecki Ranges of West Gippsland, Victoria. Started in the 1950s, Ellinbank has a long history of conducting research and development for the Australian Dairy Industry. Recent projects have included research into supplementary feeding of cows at pasture, partial mixed rations for dairy cows, identification of genetic markers for feed conversion efficiency in dairy cows, development of improved methods for measuring methane emissions from dairy cows, measuring the effect of various feed types on methane emissions, screening large numbers of dairy cows for their methane yield in order to identify genetic markers associated with low methane emitting animals, and measuring the effect of heat stress on cattle and their methane emissions.

Visitors will be able to inspect the Ellinbank facilities including the 217 hectare research farm with 500 dairy cows, a modern dairy, a number of animal facilities, individual feed pens with automatic recording of feed intake, and an advanced metabolic research unit used to measure feed digestion by dairy cows.

Of special interest to GGAA attendees will be a range of facilities and exhibits related to greenhouse gas measurement. The tour will include a number of stations that visitors will rotate through to view and hear short presentations on the following:

Two styles of dairy cow respiration chambers: with one set similar to those at Reading and Hillsborough in the UK, and six new (No Pollution) climate-controlled calorimeters.

SF6 technique: Dairy cows fitted with the latest equipment to measure methane emissions by the SF6 technique.

Open Path Laser systems: An in vivo display will feature various laser systems used to measure methane emissions from grazing cows.

Nitrous oxide automatic and static chambers: A number of designed of automatic and static chambers, used to measure nitrous oxide emissions from grazed pasture, will be on display and functioning.

In vitro systems: An indoor display will feature three different in vitro systems used to measure total gas production and methane production from ruminal fluid.

Scientists will be on hand to answer your questions on all of these techniques.

Thursday 18th February 2016

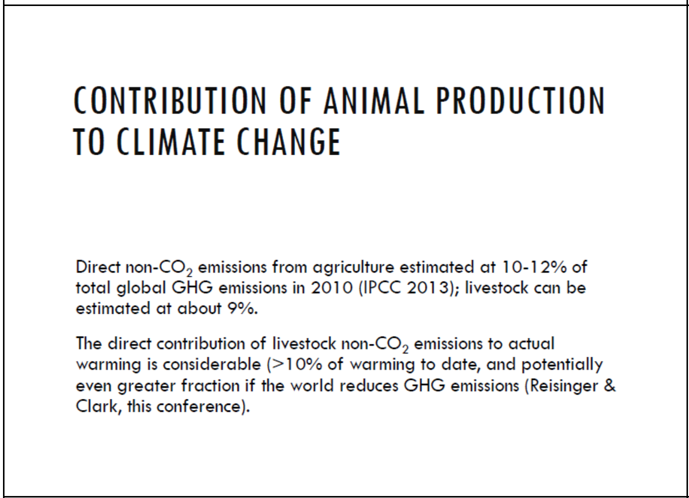
Room: Grand Ballroom 5 & 6 Grand Ballroom 4
Theme: 5. Mitigation of methane and nitrous oxide from excreta and manure management 3. Advances in understanding biology and biochemistry of non-CO2 emissions from livestock
Chairs: Tom Misselbrook & Karl Richards Karen Beauchemin & Yvette de Haas
0900 - 0915 Greenhouse gas emissions during storage of digested manure - effects of the digester hydraulic retention time - Lena Rodhe Circadian characterization of thyroid hormones, methane and heat production profiles across physiological states in replacement beef heifers - Yuri Montanholi
0915 - 0930 Reducing the contribution of stored manure to the greenhouse gas budget of dairy farms - Claudia Wagner-Riddle The application of 'omic' technologies to understand low methane animal gut systems - Stuart Denman
0930 - 0945 Using lignite to mitigate of ammonia loss from intensive cattle feedlots - Deli Chen Nutritional amendments to simultaneously minimize enteric methane emissions and nitrogen excretion from dairy cows - Mutian Niu
0945 - 1000 Methane, Nitrous Oxide and Carbon-dioxide emissions from the liquid dairy manure management chain in New Zealand as affected by acidification and separation - Tim Clough Specific and chemically-defined inhibitors of ruminant methanogens: a review - Ron Ronimus
1000 - 1040 Morning Tea
Room: Grand Ballroom 5 & 6
Theme: 1. Global perspectives and policy
Chairs: Dr Pierre Gerber and Dr Martin Scholten
1040 - 1055 A universal equation to predict methane production of forage-fed cattle in Australia - Ed Charmley
1055 - 1110 Greenhouse gas mitigation potential of the world's grazing lands: modelling soil carbon and nitrogen fluxes of mitigation practices - Ben Henderson
1110 - 1125 How much does livestock actually contribute to global warming? - Harry Clark
Theme: New advances in methane mitigation of emissions from ruminant livestock
Chairs: Dr Chris McSweeny & Professor Metha Wanapat
1125 - 1150 Enteric methane amelioration using plant secondary metabolites - Raghavendra Bhatta
1150 - 1250 Lunch
Room: Grand Ballrom 5 & 6
1250 - 1305 An inhibitor of methanogenesis that could reduce green house gas emissions by ruminants - David Yanez-Ruiz
1305 - 1320 Effect of 3-nitrooxypropanol on ruminal fermentation, methane and hydrogen emissions, and methane isotopic composition in dairy cows - Alexander Hristov
1320 - 1335 Sheep grazing a shrub and pasture inter-row system have lower methane intensity than sheep grazing pasture with grain supplementation - Philip Vercoe
1335 - 1350 Interactions between diet and rumen transcriptomic pathways and association with methane emissions - Ruidong Xiang
1350 - 1405 Global Rumen Census Program - Bill Kelly
1405 - 1420 Short-term and long-term 3-nitrooxypropanol (NOP) supplement reduces enteric CH4 by altering rumen microbial profiles in beef cattle - Mi Zhou
1420 - 1450 Conference Summary and Closing Organising Committee
1450 - 1520 Afternoon Tea

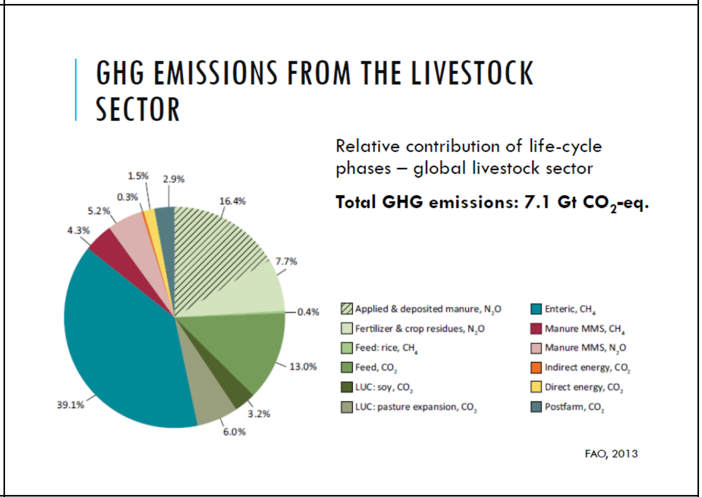
附錄三、與會名單：

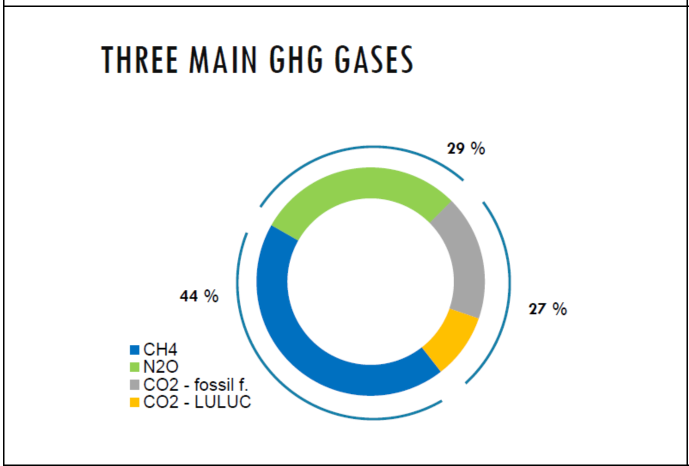
附錄四、重要政策報告：

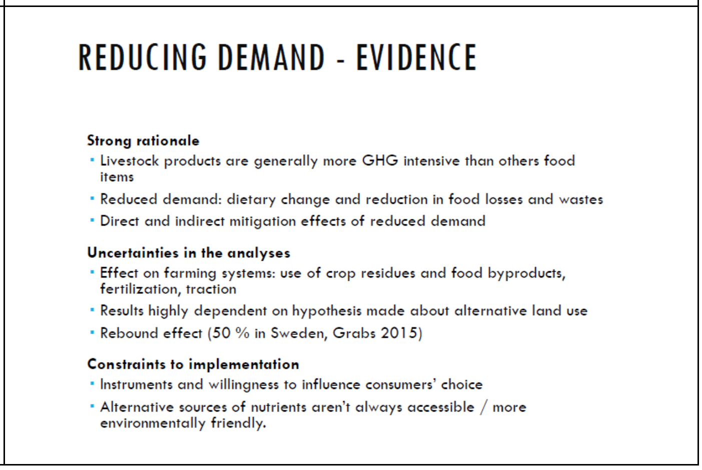
1) 由世界銀行專家 Gerber 發表 Achieving food security and climate change mitigation - the policy challenge for animal production

2) FAO Martin Scholten 發表 International initiatives in support of agricultural GHG mitigation:

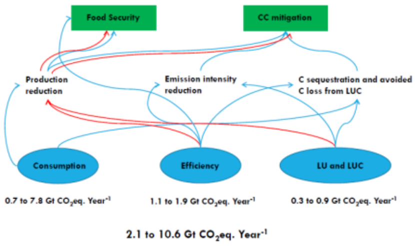








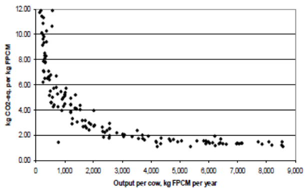
RETHINKING LIVESTOCK SYSTEMS FOR FOOD SECURITY AND MITIGATION



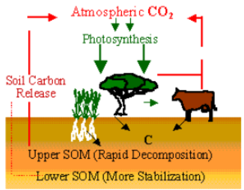
ENTRY POINTS

	High incidence of food insecurity	Food security generally achieved
High emission intensity	Where: **Marginal lands,** were production essentially relies on low productivity ruminant systems: **Sub-Saharan Africa, South Asia and Andean countries.** Policy challenges: Boost **productivity**: - Improve access to technology and resources - Strengthen access to input and output markets - Secure access to natural resources (land and water) - Improve range management	Where: **Extensive beef production** systems of **Latin America and to some extent north America and Oceania.** Policy challenges: Improve **efficiency,** reduce emissions related to **land and land use change** - Control deforestation - Secure access to land - Compensate agriculture for the generation of offsets, i.e. pay for emission reduction and C sequestration - Foster technology transfer for intensification
Low emission intensity	Where: **Monogastric based systems of East and Southeast Asia.** Policy challenges: Improve **productivity of agricultural system** - Land use planning for better crop-livestock integration - Regulation, incentives and capacity development for manure management.	Where: OECD countries with important monogastric sector and cattle herd largely engaged in milk production. Policy challenges: **Stabilize / reduce consumption and further reduce Ei** - Include agriculture (and livestock) in nation-wide mitigation targets. - Communication campaigns addressing consumers. - Regulate menus in publicly managed catering services.

POLICY QUESTIONS: EFFICIENCY GAINS OR SOIL CARBON?



Or?



Gerber et al., 2011

Tschakert, 2000

POLICY QUESTIONS: EFFICIENCY GAINS OR SOIL CARBON?

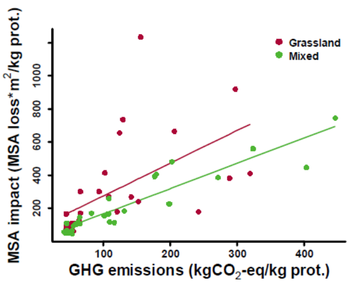
Both … and they go hand in hand, as greater grassland productivity generally goes with greater animal productivity.

Efficiency gains tend to represent most of the mitigation potential among landless and mixed-crop livestock systems – as long as agricultural land expansion is controlled.

Soil C dominates the mitigation potential (80 to 90%) in extensive mixed systems and grass based / sylvo-pastoral systems.

POLICY QUESTIONS: MITIGATION OR BIODIVERSITY?

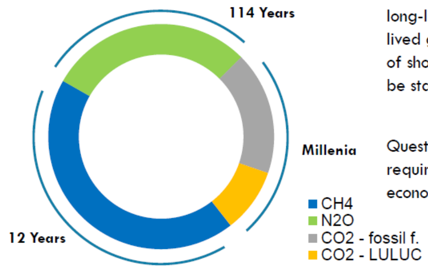
Biodiversity and GHG emissions in dairy cattle systems



Teillard et al., 2014

POLICY QUESTIONS: HOW URGENT IS METHANE MITIGATION COMPARED TO CARBON DIOXIDE?

Atmospheric lifetime of GHGs

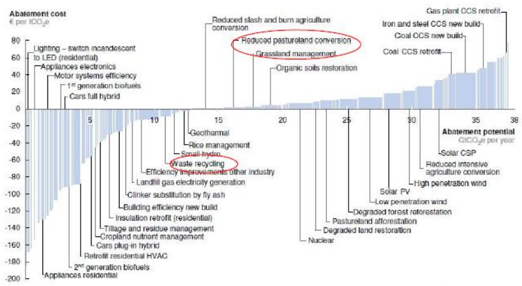


To limit peak warming, focus on long-lived gases then on short-lived gases (Allen 2015). Emissions of short-lived gases only need to be stabilised.

Questionable strategy as it requires rationality and high economic and policy flexibility.

MITIGATION AS A CO-BENEFIT ?

V2.1 Global GHG abatement cost curve beyond BAU – 2030



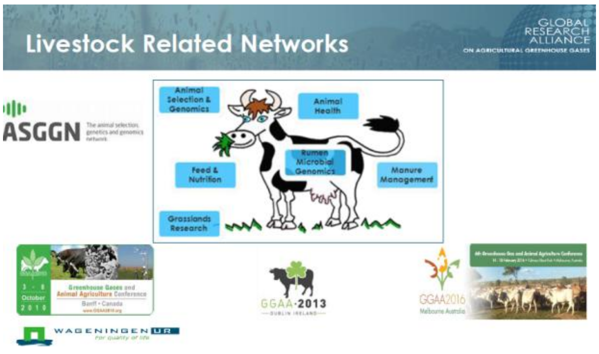
McKinsey & Company, 2010

MITIGATION AS A CO-BENEFIT ?

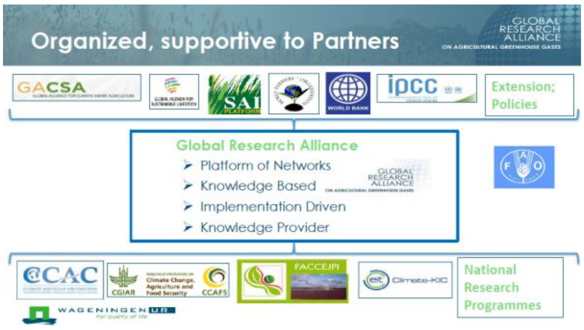
Emission levels have been influenced by:

- Air and water pollution measures (covered manure storage, manure injection)
- Efficiency gains resulting in profitability increase (ration balancing, animal health, energy use efficiency)
- Effect of specialization
- Energy policy (shift to renewable sources)
- Food waste reduction

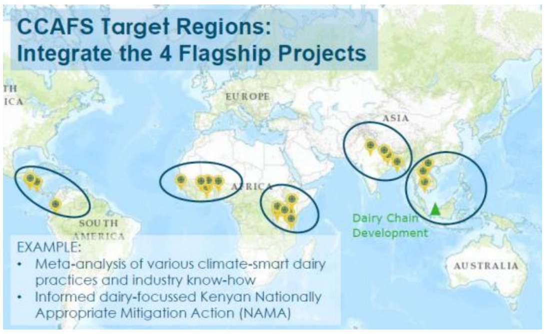

GETTING READY
Narrative – the key role of the livestock sector in achieving SDGs
Indicators and methods
CDM – manure
Sustainable grassland management
Efficiency gains in dairy
Technical packages
Adapted
Take trade-off into consideration
Are economically viable
Institutional and financial setups for inclusive participation
Boosting Investment in the Livestock Sector for Global Development


Livestock Related Networks
GLOBAL RESEARCH ALLIANCE ON AGRICULTURAL GREENHOUSE GASES
ASGGN
Animal Selection & Genomics
Animal Health
Rumen Microbial Genomics
Feed & Nutrition
Manure Management
Grasslands Research
GGAA-2013
GGAA2016
WAGENINGEN UR


Big Achievements by Integration
GLOBAL RESEARCH ALLIANCE ON AGRICULTURAL GREENHOUSE GASES
2007
2014
Genotyping Low Methane Production for Selection and Climate adaptation
Improving Feed Quality and Digestibility, Rumen Microbes (Global Rumen Census; Hungate 1000)
Improving Animal Health and Husbandry Conditions
Manure Management: Collection, Storage and Utilisation
Improving C Sequestration Soils
Precision Livestock Farming
WAGENINGEN UR


Organized, supportive to Partners
GLOBAL RESEARCH ALLIANCE ON AGRICULTURAL GREENHOUSE GASES
GACSA
SAI
WORLD BANK
ipcc
Extension; Policies
Global Research Alliance
Platform of Networks
Knowledge Based
Implementation Driven
Knowledge Provider
CCAC
CGIAR
CCAFS
FACCEJPI
Climate-KIC
National Research Programmes
WAGENINGEN UR


CCAFS FLAGSHIP 3
Low Emmision Development:
Measuring GHGs in smallholder systems
Best options for mitigation
Incentives and institutions that facilitate LED
EUROPE
ASIA
AFRICA
SOUTH AMERICA
AUSTRALIA


CCAFS Target Regions:
Integrate the 4 Flagship Projects
EUROPE
ASIA
SOUTH AMERICA
AUSTRALIA
Dairy Chain Development
EXAMPLE:
Meta-analysis of various climate-smart dairy practices and industry know-how
Informed dairy-focussed Kenyan Nationally Appropriate Mitigation Action (NAMA)


Communication
GLOBAL RESEARCH ALLIANCE ON AGRICULTURAL GREENHOUSE GASES
newsletter
Update from the Co-Chairs
Nitrous Oxide Chamber Methodology Guidelines
GlobalResearchAlliance.org
@GRA_GHG
WAGENINGEN UR

附錄五、收集資料清單：

1. GGAA2016 Program book.
2. Climate Chontrolled Chambers by No pollution Industrial System, UK
3. DSM Dairy Range Guide etc.
4. LEARN building Capability in Livestock Emission Research by New Zealand
5. Soil Carbon-reducing New Zealand’s Agricultural Greenhouse Gases by the University of Waikato.
6. Drought Feeding and Management of Beef Cattle, Victoria State Government, Australia
7. Reducing Greenhouse Gas Emission from Livestock, Global Research Alliance, New Zealand Agricultural Greenhouse Gas Research Center.
8. Animal Production Science, Vol. 26, Issue 1, 2016, p1-152

附錄六、重要海報資料整理：

PO03

DIRECT GREENHOUSE GAS EMISSIONS FROM SOUTH AFRICAN LIVESTOCK INDUSTRIES

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Globally agriculture and livestock producers have come under increasing pressure over the environmental impact of production systems. The objective of this paper was to re-calculate the direct methane (CH4) and nitrous oxide (N2O) emissions of livestock production systems in South Africa, taking into consideration the uniqueness of the South African scenario. Previous livestock greenhouse gas (GHG) inventories were based on the Tier 1 methodology of the International Panel on Climate Change (IPCC) which is based on assumptions of animals utilizing diets which are not representative of South African production systems. The methodology utilized was based on the Australian national greenhouse account National Inventory Report, which contains Australian country-specific and IPCC default methodologies and emission factors. Emission factors specific to South African conditions and management systems were calculated where possible. A Tier 2 approach was adopted for all major livestock categories including privately owned game. Methane emissions from South African livestock were estimated at 1328 Giga gram (Gg) based on 2010

population figures. Beef cattle were the major contributors to livestock GHG emissions in South Africa producing an estimated 834 Gg CH4/year. Sheep were the second highest GHG producers with 167 Gg CH4/year followed by privately owned game (131.9 Gg CH4/year), dairy cattle (130 Gg CH4/year), goats (40.7 Gg CH4/year) and pigs (8 Gg CH4/year). Ostriches, equine, and poultry produced a combined estimate of 17.8 Gg CH4/year and 2.7 Gg N2O/year. The IPCC default values for Africa underestimated emission factors across all livestock categories. This emphasizes the need to develop country-specific emission factors through quantitative research for livestock in all provinces and in all types of production systems to produce accurate baseline figures, which is critical to future mitigation protocols.

PO05

GREENHOUSE GAS EMISSIONS AND RESOURCE USE OF CANADIAN BEEF PRODUCTION IN 1981 AS COMPARED TO 2011

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This study analyzed the greenhouse gas (GHG) emissions, and breeding herd and land requirements of Canadian beef production in 1981 as compared to 2011. In the analysis, temporal and regional differences in feed types, feeding systems, cattle categories, average daily gains, and carcass weights were taken into account. Greenhouse gas (GHG) emissions were estimated using life-cycle assessment (cradle to farm gate), based primarily on Holos, a Canadian whole-farm emissions model. The 2011 beef production in Canada required only 72% of the breeding herd (i.e. cows, bulls, calves and replacement heifers) and 78% of land used in 1981 to produce the same amount of beef. Compared to 1981, both CH4 and N2O emissions were reduced by 17% and CO2 emissions from energy use declined by 14% to produce a given amount of Canadian beef in 2011. Enteric CH4 production accounted for 73% of total GHG emissions in both years. The estimated intensity of GHG emissions were 24.1 kg CO2e and 20.5 kg CO2e per kg beef carcass for 1981 and 2011 respectively, a 16% decline. The significant reduction in GHG intensity over the past three decades occurred as a result of improved productive performance (i.e. average daily gain and slaughter weight), reduced time to slaughter, increased crop yields and the shift towards use of high energy diets which enables cattle to be marketed at an earlier age. Future studies are necessary to examine the impact of other sustainability indicators including water use, air quality, biodiversity and provision of ecosystems services.

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PO11

SYSTEMATIC AND ACCURATE ESTIMATION OF METHANE AND NITROUS OXIDE FROM LIVESTOCK AND POULTRY IN CHINA DURING 1949-2012

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Aiming to investigate the greenhouse gas (methane and nitrous oxide) emissions from enteric fermentation and manure management of livestock and poultry industry in China, the present study presented a systematic estimation of methane and nitrous oxide emissions during 1949 “2012 based on the local measurement and IPCC guidelines. Results showed that as follows: (1) As far as greenhouse gas emissions were concerned among livestock, cattle contributed mostly to the greenhouse gas emissions, and then followed by dairy and goat and sheep. (2) Methane emission from enteric fermentation estimated to have increased from 9.91—1010 kg CO2 equivalent (CO2Eq.) in 1949 to 2.84—1011 kg CO2 Eq. in 2012 with an average annual growth rate of 2.91%. Methane and nitrous oxide emission from manure management has increased from 1.07—1010 kg CO2 Eq. to 6.52—1010 kg CO2 Eq. and 6.29—109 kg CO2 Eq. to 3.21—1010 kg CO2 Eq. with an average annual growth rate of 7.96% and 6.42%, respectively. Further analysis, we concluded that methane emission from enteric fermentation was the major source of the total GHG emission, followed by methane and nitrous oxide emissions from manure, accounting for 85.36%, 9.22%, 5.42% in 1949 and 74.47%, 17.11% 8.42% in 2012, respectively. (3) The total GHG emissions from China livestock and poultry increased from 1.16—1011 kg CO2 Eq. in 1949 to 3.81—1011 kg CO2 Eq. in 2012 with an average annual growth rate of 3.57% over this period. By systematical further analyze the changes during 1949-2012, we founded that the estimation of livestock and poultry methane and nitrous oxide emissions in China from 1949 to 2006 was shown to be consistent with a linear growth model, and then significantly decreased but little changed during 2007-2012. The reduction of greenhouse gas emissions from livestock and poultry industry had been underway since 2007; however, the intensity and measurement of reduction were still thus considered to be an urgent and arduous task for the Chinese livestock and poultry industry.

DISAGGREGATED N2O EMISSIONS FROM IRISH AGRICULTURE

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2 Agri-Food and Biosciences Institute, Northern Ireland
3 Queen's University Belfast, Northern Ireland

Agriculture accounts for 31% of total Irish greenhouse gas (GHG) emissions with around 40% of these emissions associated with nitrous oxide (N2O) from soils. Dairy farming in Ireland is set to expand in response to the abolition of EU milk quotas and this expansion occurs within the national policy target to reduce GHG emissions by 20% by 2020. Soil N2O emissions relate mainly to fertiliser, manures/slurry and excreta deposited on soils by grazing animals. These sources are spatially and temporally highly variable making measurements for inventory purposes difficult and resource demanding. The Agricultural GHG Research Initiative for Ireland (AGRI-I) has approached the refinement of these emission factors through the disaggregation of individual N2O sources, namely fertiliser types, dung/urine with and without fertiliser, and slurry taking rate and application timing into account. A range of potential mitigation measures such as urease and nitrification inhibitors, slurry spreading method and timing and dietary manipulations are being evaluated on direct and indirect emissions. This research to date has highlighted the importance of including indirect emissions, due to the pollutant swapping potential of abatement measures which can reduce direct emissions by increasing indirect emissions. These data will be summarised and integrated using a new farm system model to enable the testing of scenarios such as agricultural expansion, optimising production targets and reducing GHG emissions. This paper presents the Irish approach to refining GHG emission inventories and evaluating potential mitigation strategies within productive grazed grasslands.

PO136

GREENHOUSE GAS EMISSIONS DURING STORAGE OF UNTREATED LIQUID MANURE AND ANAEROBIC DIGESTATES

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Manure from intensive livestock production is often stored for several months before field application, and during this period greenhouse gases (GHG) are emitted as CH4 and N2O, and indirectly via NH3 emission. Biogas production via (co)digestion of manure and other residues provides sustainable energy, but removal of volatile solids (VS) may also reduce GHG emissions during storage. In this pilot-scale study 3-4 month old pig slurry (PS; 17 g kg-1 VS, 3.6 g kg-1 total N) and cattle slurry (CS; 46 g kg-1, 2.8 g kg-1 total N), fresh digestate from Maabjerg Bioenergy (MB; 30 g kg-1 VS, 4.3 g kg-1 total N), and a mixture of CS and dewatered sewage sludge from a wastewater treatment facility (CS+SS; 49 g kg-1 VS, 3.4 g kg-1 total N) were stored between June 2014 and April 2015; GHG emissions were monitored and the regulation of CH4 emissions studied in more detail. All treatments were duplicated in two randomized groups of covered tanks with continuous ventilation. The ventilation air was subsampled for determination of NH3 (acid traps) and GHG (mixed sample, 15 s per 15 min). Samples were collected continuously during three months, and then during one week per month. In a separate campaign, the relationship between CH4 flux and ventilation rate was investigated using gas chromatography combustion isotope-ratio mass spectrometry (GC-C-IRMS) analysis of 13C/12C ratios in CH4 to determine if CH4 oxidation occurred. Losses of total N in NH3 ranged from 18% in PS to 3% in CS which formed a crust. N2O emission factors (relative to total N stored) ranged from 0.02 to 0.40%, highest in treatment CS with a crust. Emissions of CH4 were directly related to VS (r^2 = 0.90), suggesting that VS removal prior to storage will reduce CH4 emissions correspondingly. The overall GHG balance ranged from 1.4 to 2.7 kg CO2 eq kg-1 VS in the order PS<MB<[CS+SS]<CS, 85-95% coming from CH4. The monitoring results are used to

PO138

GREENHOUSE GAS EMISSIONS AND BIOGAS POTENTIAL FROM SWINE PRODUCTION IN THAILAND

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Greenhouse gas emissions inventories provide a baseline to develop mitigation projects for reducing emissions. However, a detailed inventory of livestock gas emission is not suitable for Thailand. This study attempts to fill this gap. The methodology selected comes from the 2006 intergovernmental Panel on Climate Change (IPCC) guidelines to quantify emissions from swine production. Tier 2 methodology was implemented using swine population in 2014, analyzed comparing between biogas production ratio of year 2005 and 2014. First of all, EF for manure management were analyzed by tier 2 method. Swine production in 2005 and 2014 produced 12 and 40% respectively. The emission of CH4 in 2005 is higher than in 2014 (2.07 vs 1.53 Mt. CO2eq). The total direct nitrous oxide (N2O) emissions from manure management were 0.07 and 0.05 Mt. CO2eq for year 2005 and 2014 respectively. By increasing of biogas production ratio from 12% to 40% decreased greenhouse gas emission. This biogas can substitute methane for liquefied petroleum gas (LPG) and generate electricity. Additional benefits from anaerobic digestion of manure include the recovery of nutrients from the digested effluent, which could be used as biofertilizer and soil amendment. However, lack of experience with anaerobic digester and biogas production is a great limitation for the implementation of this technology in medium and small farms. It is necessary to extend this technology in swine farm farms and other animal production for mitigation option of GHG emission in Thailand. Keywords : biogas, swine, greenhouse gas

PO209

PREDICTION OF YM FOR DAIRY COWS BASED ON NATIONAL FARM DATA

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Background Proportion of ration gross energy lost as methane (Ym) is an essential component of international and national protocols for estimating methane emission from livestock. By default, IPCC methane emission is based on a fixed value for Ym of 6.5 % for dairy cows. The aim was to develop a simple model that predicts Ym for dairy cows, and to use the model to predict Ym based on national farm data. Materials and methods 185 observations were compiled including 41 rations from 10 dairy cow experiments, where methane emission was measured by means of indirect calorimetry using the same experimental equipment. Diets covered reasonably the variance in feeds typically fed in Northern Europe. All cows were fed ad libitum and milked twice daily. Data were analyzed using Proc Mixed in SAS with Ym as dependent variable, and intake, milk yield, and ration concentration of fat, ash, NDF and starch as independent variables and experiment as random. Farm data for milk yield and feed intake for Holstein and Jersey cows were obtained from the Danish Normative System. Ration compositions were compiled from uploaded reports on 2013/2014 farm feed rations in the on-line Dairy Management System. In 2013, dry matter intake averaged 6209 and 7424 kg/year and milk yield averaged 8735 and 9626 kg ECM/year for Jersey and Holstein, respectively. Results The model predicted an Ym of 6.02 for Holstein and 5.98 for Jersey cows based on on-farm feed intake, milk yield and ration composition. Ym decreased with increasing DM intake, and ration content of fat, ash, and starch, and increased with increased content of NDF. Conclusion The predicted Ym for Holstein and Jersey cows fed rations typically used in Northern Europe was lower than the IPCC default value of 6.5 %, but within the range (5.5-7.5 %) suggested by the IPCC.

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PO218

INVESTIGATION OF ENTERIC METHANE EMISSION AND PROTOZOA POPULATION IN HOLSTEIN STEERS FED MUSHROOM CULTIVATION RESIDUE BASED SILAGE IN TAIWAN

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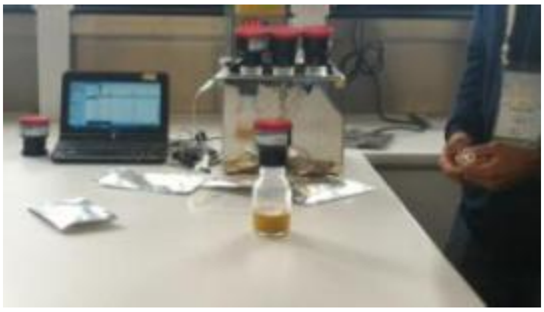
Methane production in the digestive tract of ruminants is one of the major sources of global methane emissions. In the current study, effects of golden needle mushroom (Flammulina velutipes) cultivation residue based silage on the enteric methane emission and total protozoa population in rumen were investigated. Four different mushroom cultivation residue silage (MCRS) formulas were examined by ensiling golden needle mushroom cultivation residue with urea and roughage corn at different ratios as 90:0:10 (MCRS1), 89:1:10 (MCRS2), 80:0:20 (MCRS3), and 79:1:20 (MCRS4), respectively. Five Holstein steers (mean BW 542±72 kg) were arranged into a 5 x 5 Latin square with 5 treatment diets containing regular beef cattle ration, and four treatment rations with 20% MCRS supplemented forage. The results reveal that Holstein steers fed the treatment rations without MCRS showed significantly higher ($P < 0.05$) methane emission (246 g/day) and protozoa population (60 x 10^5/mL) than that fed diets with MCRS ensiled with 10% roughage corn (MCRS1 and MCRS2). In addition, there is a significant ($P < 0.01$) interaction between roughage corn and urea on the enteric methane emission, and a significant ($P < 0.05$) positive correlation between methane emission and protozoa population ($R = 0.433$) is observed under the feeding of MCRS supplements. In conclusion, our results indicate that MCRS can serve as an effective regulator for methane mitigation, which can be simply monitored by the change of rumen protozoa populations in Holstein steers in Taiwan.

Key Words: Enteric methane, Mushroom cultivation residues silage, Protozoa, Steer

附錄七、照片：

	
參加 GGAA 2016 會議	Porf. Takahashi 開幕致詞
	
會議報告	參訪 Ellinbank 研發中心
	
參訪 Ellinbank 研發中心	展示模擬反芻液法及試管法
	
Greenfeed 機器設施	Greenfeed 機器設施

	
Greenfeed 機器設施	牛隻用移動式 GreenFeed
	
SF6 偵測說明	牛隻穿上 SF6 偵測儀
	
牛隻呼吸室展示 - 外部	牛隻呼吸室展示 - 內部
	
牛隻呼吸室展示 - 餵食	新陳代謝室外觀

	
牛隻穿戴裝置	牛群汙染監測
	
牛群汙染監測	