GLOBAL RESEARCH ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES

Animal Health and Greenhouse Gas Emissions Intensity Network
Third Annual Workshop

Konventum Conference Centre, Elsinore, Denmark

15th March 2016

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EXECUTIVE SUMMARY

The Animal Health and Greenhouse Gas Emissions Intensity Network (referred to as "the Network" hereafter) is a United Kingdom (UK) led initiative of the Global Research Alliance (GRA) on Agricultural Greenhouse Gas (GHG) emissions which brings together researchers from across the world to investigate links and synergies between efforts to reduce livestock disease and GHG emissions intensity reductions. The Network was established in 2013 and is currently in its third year. The third annual workshop of the Network was held on the 15th March 2016 in the margins of the Society for Veterinary Epidemiology and Preventive Medicine Conference in Elsinore, Denmark. This report is a summary of key discussions, action points and outcomes from the workshop and is aimed towards all Network members, researchers and research funders interested in the links between animal health and GHG mitigation.

The Network workshop brought together researchers and research funders to exchange information on scientific research and on other initiatives with which the Network is developing links. The workshop was attended by 21 participants representing 9 countries.

Presentations on current research linking animal disease with GHG emissions set the scene for a discussion on research priorities and knowledge gaps. Priorities include estimating both aggregate and individual regional disease burden, gathering good quality surveillance data, and disseminating and correctly targeting the message. The Network has links with a number of related initiatives and pursued these further through presentations from NEAT, STAR-IDAZ, FACCE-JPI and MACSUR. A discussion session followed the presentations and gave members and representatives freedom to discuss collaboration opportunities. The basis of future collaboration is dependent upon two linked factors: identifying tangible research needs through a gap analysis and procuring adequate funding.

An initiative that would benefit from a collaborative approach is the creation of an inventory of models and data sources relevant to animal health and disease data. This would be valuable for testing existing and new models as experimental data is often difficult to obtain. The first step in achieving this is for all Network members to send the Secretariat details of their research and published papers to be hosted on the Network webpages and accessed through the Member's Online Share Area.

Funding options for collaborative projects were identified as: ERA-GAS, SusAn, Bill and Melinda Gates Foundation and COST Action. A few Network members have agreed to further explore the funding streams.

LIST OF ABBREVIATIONS

AOB	Any Other Business
bTB	Bovine Tuberculosis
CCAFS	Research programme on Climate Change, Agriculture and Foods Security
COST	European Cooperation in Science and Technology
Defra	UK Government Department for Environment, Food and Rural Affairs
EAAP	European Federation of Animal Science
EC	European Commission
ERA-NET	European Research Area Net
ERA-GAS	ERA-NET Co-fund for Monitoring and Mitigation of GHGs from Agri- and Silvi- Culture
FACCE-JPI	Agriculture, Food Security and Climate Change Joint Programming Initiative
GASL	Global Agenda for Sustainable Livestock
GHG	Greenhouse Gas
GRA	Global Research Alliance on Agricultural Greenhouse gases
IRC	International Research Consortium
LRG	Livestock Research Group
MACC	Marginal Abatement Cost Curve
MACSUR	Modelling European Agriculture with Climate Change for Food Security
MER	Metabolic energy requirement
NEAT	Networking to enhance the use of economics in animal health education, research and policy-making in Europe and beyond
OIE	World Organisation for Animal Health
SRUC	Scotland's Rural College
STAR-IDAZ	Global Strategic Alliances for the Coordination of Research on the Major Infectious Diseases of Animals and Zoonoses
SusAn	ERA-NET Sustainable Animal Production
SVEPM	Society for Veterinary Epidemiology and Preventive Medicine
UK	United Kingdom

1 NETWORK BACKGROUND

The Animal Health and Greenhouse Gas (GHG) Emissions Intensity Network (referred to as "the Network" hereafter) is a United Kingdom (UK) led initiative of the Livestock Research Group (LRG) of the Global Research Alliance (GRA) on Agricultural Greenhouse Gases.

The Network was initiated as there is a broad consensus amongst experts and stakeholders that the GHG emissions intensity from livestock farming can be reduced through efficiency and production gains resulting from improved livestock health. The aim of the Network is to bring together relevant scientists/researchers from across the world to investigate links and synergies between efforts to reduce livestock disease and GHG emissions intensity reductions. This offers multiple win-win opportunities across a diversity of countries and the GRA provides an excellent platform for researchers to engage with one another. There are significant bodies of current research in work areas relevant to the Network and therefore opportunities for interested researchers to collaborate and for research funders to co-ordinate their efforts.

The Network aims to maintain and enhance capacity in the cross-cutting field of animal health and GHG research, facilitate interaction of practitioners, and encourage sharing of information on current and planned activities, so as to avoid duplication of effort, identify evidence gaps and help focus and prioritise research efforts. The work of the Network has the potential to provide real benefits to farmer livelihoods and food security.

Further information on the background to the Network, its objectives, value and evidence gaps is provided in the Network proposal which is available at http://globalresearchalliance.org/wp-content/uploads/2015/09/20121017-Animal-Health-and-Greenhouse-Gas-Emissions-Network-Proposal.pdf

Further information is also available on the Network webpages at http://globalresearchalliance.org/dashboard/animal-health-and-ghg-emissions-intensity-network/.

2 SUMMARY AND OUTCOMES OF THE THIRD ANNUAL NETWORK WORKSHOP

2.1 Overview of the workshop

The third annual Network workshop was held on the 15th March 2016 at Konventum Conference Centre, Elsinore, Denmark, in the margins of the Society for Veterinary Epidemiology and Preventive Medicine (SVEPM) conference (http://svepm2016.org/). This international workshop brought together researchers in animal health, veterinary science, GHG research, social science and economics, amongst other fields. It was attended by 21 participants representing 9 countries: Denmark, Finland, Ireland, Kenya, Norway, South Africa, Spain, The Netherlands and The United Kingdom (see Appendix 1 for the list of participants). Approximately half of the delegates had attended previous Network meetings.

The workshop objectives were to: report on the activities of the Network during the past year; share current scientific research in this area; progress links with relevant initiatives and identify opportunities for complementary links and co-working projects; discuss funding sources for research into animal health & GHG emissions intensity; and formulate the next steps for the Network.

The workshop was chaired by the Network Coordinator Dr Tim Robinson (ILRI, Kenya) and discussion sessions were facilitated by Dr Wim Van der Poel (Wageningen University, The Netherlands) and Mr Luke Dalton (UK Government Department for Environment, Food and Rural Affairs (Defra)). The workshop provided an excellent opportunity for delegates to get to know one another and to share relevant research via presentations and discussions. The workshop enabled further development of links between the Network and relevant initiatives: the Global Network for Animal Disease Research (STAR-IDAZ), the Agriculture, Food Security and Climate Change Joint Programming Initiative (FACCE-JPI), Modelling European Agriculture with Climate Change for Food Security (MACSUR) and Networking to enhance the use of economics in animal health education, research and policy-making in Europe and beyond (NEAT). An afternoon session was dedicated to presentations from these initiatives (including identifying potential opportunities for collaboration) whereas the morning presentations focussed on scientific presentations. The workshop also included two dedicated discussion sessions where participants addressed the important topics of *Research priorities and knowledge gaps* and *Collaboration to benefit research priorities*.

The workshop achieved the following outcomes:

- Update on Network activities and progress since the 2015 annual workshop
- Scientific presentations by researchers from SRUC and Cranfield University, UK.
- Further developed links with STAR-IDAZ, FACCE-JPI, MACSUR and NEAT and identified potential collaborative opportunities
- Suggested potential work areas and funding sources for the Network.

The workshop agenda is provided in Appendix 2 and photographs are in Appendix 3. This report will be circulated to all workshop participants and Network members. It will be uploaded onto the GRA website (http://globalresearchalliance.org/updates/) and summarised in the UK Agri-Science & Innovation newsletter. Readers are invited to circulate the report to interested researchers and research funders.

2.2 Overview of Presentations

2.2.1 Animal Health & GHG Emissions Intensity Network

2.2.1.1 Overview of the Network and update on recent Animal Health & GHG research – Dr Tim Robinson (ILRI, Kenya)

Network Coordinator Dr Tim Robinson presented a background to the topic (animal health and GHGs – what is the issue?) and an introduction to the Network (see Appendix 4).

In this, it was emphasised that livestock health is an important aspect of animal welfare, food safety, human health and production efficiency. Healthy animals are more productive and use their feed more efficiently to generate desired products. Unhealthy animals tend to have a lower productivity, resulting from reduced performance, utilise their feed less efficiently and require an increased need for treatment. On average, 20% of production losses are due to animal diseases. Lower productivity results in higher emissions per unit of animal product (i.e. emissions intensity). Improving animal health therefore offers an opportunity to improve emissions intensity, while also improving productivity, with important positive consequences for food security, animal welfare, food safety and public health.

The Network aims to bring together researchers to tackle the problem of improving health and output in order to reduce GHG emissions intensity. Progress to date includes:

- Successful promotion of the Network to increase membership – there are now 94 members across 27 countries
- Held three annual workshops (in Ireland, France and Denmark)
- Delivered regional activities; a workshop in Ethiopia and a session at the Association for Latin American Animal Science (ALPA) conference
- Developed links with FACCE-JPI, MACSUR, STAR-IDAZ, NEAT and Global Agenda for Sustainable Livestock (GASL) and held joint workshops with some of these (MACSUR, University of Reading, June 2015)
- Identified potential funding routes
- Increased communications via webpages, newsletters, twitter, and representing the Network at conferences.

Updates on the Network are provided in the UK Agri-Science & Innovation newsletter available at http://globalresearchalliance.org/country/united-kingdom/.

2.2.2 Scientific presentations

Presentations are summarised within the text below and copies of the slides can be found within Appendices 5-7.

2.2.2.1 Exploring interactions between climate change and livestock parasites – Dr Naomi Fox (Scotland's Rural College, UK)

Dr Naomi Fox (SRUC) presented the outcomes of Scottish Government funded research which aims to understand both the potential impacts of future climate change on livestock parasite burdens and the impacts of livestock parasite burdens on climate change. Both experimental research, using methane chambers, and modelling were used to address these aims.

Parasitic helminths impact the host by reducing weight gain and production efficiency. Parasitism in livestock was found to impact on feed efficiency, grazing behaviour and time spent on farm. Distribution and prevalence of macro-parasites are already effected by climate change and models

predict that changing temperatures could have a dramatic impact on parasite burdens. Understanding the two-way interactions between parasites and climate change can be improved through theoretical and experimental models.

2.2.2.2 The influence of bovine tuberculosis (bTB) on GHG emissions intensity in Wales – Dr Adrian Williams (Cranfield University, UK)

Dr Adrian Williams (Cranfield University) presented provisional results of the Welsh Government funded project on GHG emissions from bovine tuberculosis (bTB) in Wales. The Welsh Government aims to eradicate bTB and commissioned this work to understand the effect of current policies on GHG emissions. The impact of bTB on individual animals include increased mortality, reduced milk yield, reduced growth rate, increased metabolic energy requirement (MER), compromised welfare and higher GHG emissions per unit output. The project explored GHG emissions for milk and beef routes (e.g. cull cows, dairy calves, and suckler beef). Findings show that the disease has a relatively small impact on GHG emissions (a reduction of 70 kt CO_2e per year from eliminating bTB in Wales) however prevalence rate is already low. The relatively low environmental impact is mainly because carcasses from infected animals can largely still enter the food chain.

2.2.2.3 Can improved productivity reduce the carbon footprint of cattle systems in developing regions? – Mr Gareth Salmon (Scotland's Rural College, UK)

Increased demand for livestock products in developing countries needs to be met and managed sustainably. There is a need for improved research into quantification of GHG emissions and their management in developing regions. Gareth Salmon (SRUC) presented the research questions of his PhD which focusses on cattle systems in Senegal and the potential to reduce GHG emissions intensity through improved productivity. The project is exploring abatement potential (how much can emissions intensity be reduced on milk production), cost effectiveness (which measures are cost effective and how do they compare/rank), and barriers to change (social, cultural and institutional factors). Gareth used the Network meeting as an opportunity to gather other researchers' views on elements of the project such as determining disease incidence levels and methods for measuring productive influence.

2.2.3 Presentations from initiatives with which the Network is developing links

Presentations are summarised within the text below and copies of the slides can be found within the Appendices 8 – 11.

2.2.3.1 Global Network for Animal Disease Research (STAR-IDAZ) – Mr Luke Dalton (Defra, UK)

Luke Dalton presented an overview of STAR-IDAZ, a global initiative to address the coordination of research programmes at international level in the area of animal and, in particular, animal diseases (including zoonosis), along with details of the future of STAR-IDAZ as an International Research Consortium (IRC).

STAR-IDAZ was initially funded by the European Commission from 2011 to 2015 and consisted of 25 core partners and approximately 40 partners within regional networks. The members' priority areas were identified through the completion of a questionnaire and included: mycobacterial diseases, influenza, brucellosis and African swine fever among others.

STAR-IDAZ continues as a global network operating under a memorandum of understanding but there was enthusiasm from partners for a higher level of commitment which, in January 2016, saw the establishment of the STAR-IDAZ IRC. International Research Consortium Partners have signed a Letter

of Intent to coordinate their research programmes to address agreed research needs, share results and together deliver new and improved animal health strategies for at least 30 priority diseases/infections/issues, including candidate vaccines, diagnostics, therapeutics and other animal health products, procedures and/or key scientific information/tools to support risk analysis and disease control.

IRC Partners have a combined research budget of $US 2.5 billion to spend on IRC objectives up until 2021. To achieve these goals, Working Groups consisting of researchers will be established for each of the priority topics and, guided by a Scientific Committee, will perform research gap analyses. The Scientific Committee, consisting of independent experts, will present the gap analyses to the IRC partners and advise them on how their programmes might be aligned. A Secretariat will be established to provide the Working Groups with literature reviews and support them in their gap analyses, support the Scientific Committee and Executive Committee logistically and facilitate information exchange within and between all three levels.

The priority topics on which Working Groups will be established include helminths; Immunology/vaccinology; Diagnostics; and, Innovative anti-infective approaches. The full list of diseases and crosscutting issues can be found at http://www.star-idaz.net/?page_id=10.

It was noted that the GRA, at the suggestion of the European Commission, is currently discussing the possibility of establishing an IRC on GHG emissions from agriculture.

The next steps for STAR-IDAZ are to host a meeting in Buenos Aires in April 2016 to agree membership and establish working groups. This leaves an opportunity for links with the Animal Health & GHG Emissions Intensity Network to remain as there is a shared goal to “improve and protect animal health”. The Animal Health & GHG Emissions Intensity Network was invited to participate in STAR-IDAZ working groups and link into regional groups.

2.2.3.2 Animal health and pathogen modelling in MACSUR: progress and next steps – Dr Richard Kipling (Aberystwyth University, UK) and Dr Şeyda Özkan (Norwegian University of Life Sciences, Norway)

MACSUR is a knowledge hub, funded through FACCE-JPI and is currently in its second phase (summer 2015 to May 2017). It is using priorities identified by members to develop the next set of working objectives.

MACSUR encompasses and brings together crop, trade and livestock and grassland modellers. Within its wider programme, the knowledge hub is engaged in a number of activities relevant to livestock health. Over the past year the livestock and grassland theme of MACSUR (LiveM) has hosted workshops at the University of Reading, UK (one day of which was joint with the Animal Health & GHG Emissions Intensity Network) and at Wageningen University, The Netherlands. A position paper providing an overview of ruminant systems modelling in Europe in the context of climate change (Kipling et al., In press) has been produced, as well as a review paper (based on the Reading workshop) on ‘challenges and priorities for modelling livestock health and pathogens in the context of climate change’ (Özkan et al., Accepted). The latter paper included contributions from the Animal Health & GHG Emissions Intensity Network. The review identified over 20 key challenges in the field of health and disease modelling. This demonstrates the need to develop a unified terminology and better understanding across models and researchers, in order to share best practice and build capacity. A third major output is a review paper based on the Wageningen workshop (focusing on grassland modelling) (Kipling et al. In Press). The aims with these papers have been 1) to define the research

agenda for both livestock health and disease modelling, and grassland modelling in Europe in the context of climate change, and 2) to help modellers to see their work in a wider context, in order to facilitate learning and capacity building across disciplines and countries.

Within the MACSUR framework, two tasks focus directly on modelling livestock health and pathogens. These tasks have work-plans for further outputs before the end of the knowledge hub in May 2017:

Task 2.1 – Impacts of climate change on animal health, production and reproduction. Led by Dr Andrea Vitali (University of Tuscia). This task aims to produce two position papers and one research paper.

Task 2.2 – Impacts of impaired health, disease and productivity change on GHG emissions. Led by Dr Şeyda Özkan (Norwegian University of Life Sciences). Deliverables include producing three draft proposals:

1. An assessment of current models predicting the impacts of pathogens and poor animal health on GHG emissions intensity (Led by Dr Şeyda Özkan).
2. A review of current modelling on livestock pathogens and disease spread under climate change conditions (Lead to be determined)
3. Adapting to climate change is difficult but possible: a review of current trends in modelling animal disease interventions in relation to climate change and stakeholder behaviour (Lead to be determined)

Further information on the deliverables are available in Appendix 9.

MACSUR will be hosting a LiveM conference, which will be held on the 15-16 June 2016 in Potsdam, Germany. Dr Nick Wheelhouse will attend and represent the Animal Health & GHG Emissions Intensity. Network.

2.2.3.3 NEAT Progress: Next steps in the economics of animal health – Dr Keith Howe (Royal Veterinary College, UK)

The aim of NEAT (and from which it derives its name) is networking to enhance the use of economics in animal health education, research and policy-making in Europe and beyond. A further objective is to strengthen and enhance the use of economics in animal health in higher education and professional environments, as worldwide there are limited numbers of people interested in this area of work.

The funding for NEAT ended in September 2015, however some work by members has continued in order to prepare presentations on key topic areas for free access from the NEAT website (www.neat-network.eu). Discussions are currently ongoing as to how best to sustain momentum into the future and include:

- Look for pragmatic options to continue what we are already doing;
- Set up the International Society for Economics and Social Sciences of Animal Health (ISESSAH);
- Inaugural ISESSAH conference to be held in March 2017 (pre-SVEPM) in Inverness, Scotland;
- Continue to refine and update curricula produced as teaching materials;
- Transfer teaching materials into book or internet format;
- Strengthen data collection, analysis and publication by encouraging and fostering people's engagement;
- Review existing journals which publish work in the economics of animal health (EAH);
- Take decision about potential launch of dedicated EAH journal;
- Support NEAT-type initiatives for the Americas.

The priority areas identified by the Animal Health & GHG Emissions Intensity Network are very closely linked to those of NEAT and therefore maintaining contact was advocated.

2.2.3.4 Links with FACCE-JPI and opportunities for collaboration – Dr Órlaith Ni Choncubhair (Teagasc, Ireland)

FACCE-JPI has a key principle of aligning national research strategies, programmes and infrastructures. The alignment of European member states is a strategic approach to modifying national research programmes and optimising the use of national research funds. When related to a thematic scope it requires a common vision and strategic research agenda to enable the development of an implementation plan that prioritises research topics and instruments in light of national priorities and funding.

The research aligns under core themes and there are three types of joint actions/instruments. In total, 12 joint actions are currently either ongoing or in development. Associated with FACCE-JPI, there are two European Research Area Networks (ERA-NET) funding sources:

- ERA-GAS
    - Co-fund for monitoring and mitigation of agricultural and forestry GHGs.
- SusAn
    - To mobilise resources and develop more sustainable animal production systems in Europe.

There are a number of synergies between ERA-GAS and SusAn with an example of an overlap being the comparison of animal production systems.

There is the opportunity to develop further cooperation with FACCE-JPI; the first step would be to identify areas of common interest (within a workshop) and influence the Implementation Plan for additional activities (expected July 2017).

2.3 Overview of Discussion Sessions

2.3.1 Session 1: Research priorities and knowledge gaps – Dr Wim van der Poel (Wageningen University, The Netherlands)

Summary of discussion topics

The discussion session was led by Dr Wim Van der Poel (Wageningen University, The Netherlands) and covered the perceived research priorities and knowledge gaps that provide opportunities for the Network to address. Initial exploration focused on the data gaps and models, in the field of health and pathogens that need to be developed to further address the climate change problem.

Horizon scanning work conducted by MACSUR/LiveM identified that further experimental data are required in order to increase confidence in model outputs. Good quality surveillance data are also required. There is a large difference in availability of surveillance data in different countries, for example the level and quality of data collected in developing countries is often unknown. It is therefore important to clarify the level of detail currently collected in terms of the prevalence of disease and how well diseases have been identified. Detailed data on disease prevalence is limited due to lack of funding, however there maybe information held by organisations in developing countries that has not been published. The Bill and Melinda Gates Foundation was identified as a potential source of funding, providing the focus was on developing a technical solution as opposed to quantifying the benefit of reducing the disease.

There is a need to show stakeholders, namely farmers, that improving animal health improves production and is related to a reduction in GHG emission intensity. Therefore social science and economists need to feature in any approach that is taken. Involvement of social scientists will provide a better understanding of reasons why people do what they do and therefore help guide solutions that will influence change. Transfer of knowledge between peers and providing evidence that mitigation works, for example via demonstration farms, were identified as ways of proving benefits of improving animal health. Incentives for farmers need to be considered due to the urgency of the problem. An economic approach will have the greatest impact on the uptake of measures based on scientific evidence, as economics is a key driver. Benefits need to be communicated, ensuring that research doesn't go unused.

It was questioned whether there are ongoing prioritisation studies that identify diseases and intervention methods. Luke Dalton (Defra) has data on diseases by country (including priority diseases and level of funding) from which 15 priority diseases have been identified (see page 10 of http://www.star-idaz.net/wp-content/uploads/2016/01/Governance-Structure-MO-STAR-IDAZ-v2.pdf) (the intention is to increase this to 30 priority diseases). There are opportunities for the Network to review the list and to look at disease effects on GHGs. The list of diseases discussed fitted well with the work carried out by MACSUR. The European Commission will shortly be publishing their priority list (a shortlist under the Animal Health Law) and other priority lists have been published (e.g. by the World Organisation for Animal Health (OIE)). It would be beneficial to overlay various priority lists. Further opportunities relating to livestock disease were identified:

- Address the knowledge gap on disease interaction (based on the understanding that diseases do not exist in isolation);
- Evaluate the overall burden of disease, as opposed to the impact of a specific disease;
- Identify whether tackling the diseases on the priority list would reduce GHGs and also reduce human health/zoonotic impacts.

However, it was recognised that priorities differ between countries, especially between developed and developing countries.

The design of farming systems was identified as a potential area of research, in terms of climate change adaptation and risk management. The current economically viable systems in each country will have to shift in response to the effects of climate change. For example, methane and carbon dioxide are produced from poor quality silage; however in Africa it is often not possible to make high quality forage (silage etc.) and so there are opportunities to reduce emissions by tackling this. Economic growth, development and urbanization will shift systems and influence their development. The factors to take into account were considered along with how system shifts would influence the policy framework. MACSUR activity has resulted in the production of regional case studies, which could be relevant to investigating systems further.

List of research priorities and knowledge gaps identified

- Modelling and horizon scanning (link with MACSUR activities)
- Gather good quality surveillance data
    - Need improvement of data collection and availability
    - Need more information on disease in relation to GHGs
- Estimate the burden of diseases (regionally)
    - Aggregate burden and individual burden
- Incorporate socioeconomic drivers
- Ensure the message is communicated and correctly targeted and demonstrate the benefits to farmers
- Carry out a global scoping study
    - Much can be done with existing information
    - Joint approach from the Network, MACSUR, STAR-IDAZ, CCAFS
- Prioritise diseases
    - Linking networks and international organisations working on prioritisation (potentially overlay priority disease lists)
    - Include economic/productivity, GHG and public health aspects
    - Consider climate and other drivers (e.g. market drivers).

2.3.2 Session 2: Collaboration to benefit research priorities – Mr Luke Dalton (Defra, UK)

Gap analysis to identify research priorities

There may be a benefit of conducting a detailed literature review to identify research needs. A workshop could then be held to agree the results. The list of research gaps identified could be input into a spreadsheet and hosted on the Members Online Shared Area. Network members would indicate the topics and provide details of what they are currently working on and planning to work on which would identify areas for collaboration. An example of an initial research gap could be burden of disease (how does a disease or collection of diseases impact upon productivity parameters, i.e. birth rates or growth rates). Professor Richard Bennett (University of Reading, UK) could be contacted as he has carried out work on the burden of disease using a herd model. There is a large amount of data available that could be bought together by researchers; this will require funding to progress.

Dr Tim Robinson (ILRI, Kenya) is involved with the LiveGaps project (funded by the Bill and Melinda Gates Foundation - https://research.csiro.au/livegaps/) which is investigating livestock yield gaps in targeted countries (currently India and Ethiopia with plans to move onto Tanzania and Nigeria). A methodological approach to gap filling is being used, but the project could be extended to include modelling.

Inventory of models

An inventory of models and data would be beneficial as although there are a lot of relevant data, these are not always accessible or stored in a uniform space.

Looking at inventories and typologies of models will bring researchers together to think about modelling priorities. This will help to answer the question: "What does modelling need in order to address climate change problems?" MACSUR have drafted a paper that sets out what is needed for modelling livestock health and pathogens in the context of climate change (Özkan et al., Accepted). Partners also have access to some farm-scale data. However disease and health scale information is more disparate and therefore more difficult to collect. STAR-IDAZ have set up a data sharing agreement among their members and plan to explore options for how data are catalogued and stored in order to maximise access for animal health and other researchers.

The Network/Group need to decide on the level to work at: either at a practical level producing a data sharing system (alongside stakeholders) or at the strategic level, developing methods for how to compile and analyse data.

An additional associated priority is to test models using existing data to ensure they work in a real-world scenario.

Project funding options

In summary, the funding options discussed were:

- COST Action
- Marie Sklodowska-Curie Action
- ERA-NET
    - ERA-GAS
    - SusAn

COST Actions are "a flexible, fast, effective and efficient networking instrument for researchers, engineers and scholars to cooperate and coordinate nationally funded research activities." (http://www.cost.eu/COST_Actions). Following this workshop, the Network submitted an application to COST in April 2016, led by Dr Wim Van der Poel (Wageningen University, The Netherlands). The STAR-IDAZ hosted Member's Online Shared Area (https://animalhealthghge.star-idaz.net/index.php?w=profile&pwd=1) could be used to drive the discussion about COST action applications.

An opportunity to collaborate with MACSUR Phase 3 (modelling work) was also raised by Dr Richard Kipling (Aberystwyth University, UK).

Marie Sklodowska-Curie actions (http://ec.europa.eu/research/mariecurieactions/) were identified as a funding option at the Network and MACSUR joint workshop in June 2015.

The Marie Sklodowska-Curie Innovative Training Networks (ITN) could be investigated to fund PhD or Masters Students to carry out some of the work areas identified by Network members. The ITN

required several countries to be involved with the proposal and including an industry component is preferential. A number of different institutes could provide students to do a small part of the gap analysis, however it would need someone to coordinate and ensure a framework was in place from the start of the work.

Network funding options

Options for securing future funding for the Network Secretariat function were explored including COST Action or using support team based within the University of the Network Coordinator. It was thought that if funding for project work was secured, it would be easier to identify additional funds for the Network Secretariat tasks.

One suggestion was for the Network to become self-funded i.e. members pay a contribution to the cost of holding a meeting (i.e. meeting room hire and catering). This method is in place for some of the other LRG networks. The European Federation of Animal Science (EAAP) follows a similar model of funding. Alternatives include asking conferences to organise meetings alongside their events, or rotating meeting organisation amongst a group of key Network members.

Summary of actions

- Luke Dalton (Defra) to provide advice on conducting a gap analysis to identify research priorities;
- Dr Tim Robinson (ILRI) to keep the Network updated with details of the LiveGaps project;
- Dr Wim Van der Poel (Wageningen University, The Netherlands), Dr Tim Robinson (ILRI, Kenya), Professor Ilias Kyriazakis (Newcastle University, UK), Şeyda Özkan (Norwegian University of Life Sciences, Norway), Jean-Christophe Bambou (INRA, France) and The Secretariat to apply for COST Action; - **Achieved April 2016**
- Investigate Marie Sklodowska-Curie as a route for funding project work (determine how this is being progressed by MACSUR);
- Network Coordinators and Secretariat to explore options for ensuring a sustainable future for the Network.

2.4 AOB

Over the past three years a lot of relevant work has been carried out by Network members, although not directly through the Network. In order to showcase the expertise and range of work delivered by members of the Network it would be beneficial to showcase this on the Network website (http://globalresearchalliance.org/dashboard/animal-health-and-ghg-emissions-intensity-network/).

All members are invited to send details of relevant research and publications to animalhealthnetwork@adas.co.uk for inclusion on the Network website.

Dr Tim Robinson (ILRI) closed the workshop by thanking all delegates for attending and Adele Hulin and Alice Willett for organising the event and their work over the last three years with the Network.

As well as in the appendices, presentations are available from the Network Secretariat and have been uploaded to the Members Online Shared Area login.

Please contact animalhealthnetwork@adas.co.uk to become a Network member and receive all communications.

APPENDIX 1: PARTICIPANTS LIST

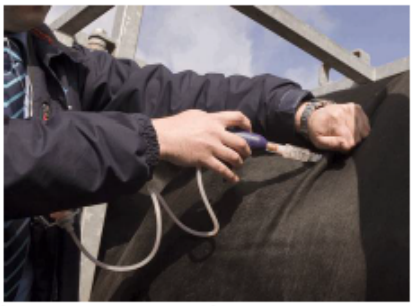
Research Institute	Title	Forename	Surname	Research interest/Title/Network role	Country
Moredun Research Institute	Dr	Dave	Bartley	Principal Investigator	UK
University Of Helsinki	Ms	Paula	Bergman	PhD Student	Finland
Welsh Government	Dr	Arjen	Brouwer	Veterinary Adviser	UK
Defra	Mr	Luke	Dalton	STAR-IDAZ Project Manager	UK
University of Copenhagen		Anil	Demeli	PhD Student	Denmark
SRUC	Dr	Naomi	Fox	Quantitative Ecologist	UK
Pretoria University	Dr	Gerhard	Harmse	Senior Lecturer	South Africa
Exeter University and Royal Veterinary College	Dr	Keith	Howe	Senior Research Fellow & Honorary Research Fellow	UK
ADAS UK Ltd	Miss	Adele	Hulin	Researcher / Network Secretariat	UK
Moredun Research Institute	Mr	Coren	Jack	PhD Student	UK
University of Copenhagen		Ipek	Keskin	PhD Student	Denmark
Aberystwyth University	Dr	Richard	Kipling	Project Officer	UK
Teagasc	Dr	Órlaith	Ní Choncubhair	Post-doctoral researcher	Ireland
Norwegian University of Life Sciences	Dr	Şeyda	Özkan	Research Scientist	Norway
Norwegian University of Life Sciences	Dr	Clare	Phythian	Associate Prof. Flock Medicine	Norway
ILRI	Dr	Tim	Robinson	Principal Scientist / Network Coordinator	Kenya
SRUC	Mr	Gareth	Salmon	PhD Student	UK
Ministry of Agriculture, Food and Environment	Mr	Rubén	Sánchez Martinez	Support unit Coordinator, Directorate General for Animal and Plant Health	Spain
Wageningen University	Dr	Wim	Van der Poel	Research Leader	The Netherlands
ADAS UK Ltd	Miss	Alice	Willett	Consultant / Network Secretariat	UK
Cranfield University	Dr	Adrian	Williams	Principal Research Fellow	UK

Introductions to presenters or delegates are possible through the Network Secretariat by emailing animalhealthnetwork@adas.co.uk

APPENDIX 2: WORKSHOP FLYER INCLUDING AGENDA

Animal Health & Greenhouse Gas Emissions Intensity Network Workshop

15 March 2016
09.30 – 16.30



The third Annual Network Workshop is being held in the margins of the **Annual Meeting of the Society for Veterinary Epidemiology and Preventive Medicine – SVEPM 2016** at

Elsinore, Denmark

About the Network

The Animal Health & Greenhouse Gas (GHG) Emissions Intensity Network of the Global Research Alliance on Agricultural Greenhouse Gases (www.globalresearchalliance.org/) aims to bring together researchers from across the world to investigate links and synergies between efforts to reduce livestock disease and reducing GHG emissions intensity.

Workshop objectives

- Report on the activities of the Network during the past year;
- Share current scientific research in this area;
- Progress links with relevant initiatives and identify opportunities for complementary links and co-working projects;
- Discuss funding sources for research into Animal Health & GHG emissions intensity;
- Formulate the next steps for the Network.

Registration and further information

The workshop takes place on Tuesday 15th March 2016 and the agenda is given below. It is free for you to attend but please register beforehand.

Both researchers and research funders are invited to participate.

To register please contact: Alice Willett, ADAS UK Ltd.
Email: animalhealthnetwork@adas.co.uk
Phone: +44 (0) 1954 267666

SVEPM encourage all conference participants to stay at the conference venue: Konventum (www.konventum.dk). The closest other accommodation options are 35 minutes away (walking).
For **venue and accommodation** information please refer to http://svepm2016.org/conference-info.html

Registration deadline: 4th March 2016

Workshop Agenda

The workshop supports the Network objectives; to maintain and enhance capacity in the cross-cutting field of animal health and GHG research, facilitate interaction of practitioners from relevant research communities (e.g. animal science, veterinary medicine, epidemiology, GHG's, food security, economics) and encourage sharing of information on current and planned activities, so as to avoid duplication of effort, identify gaps and help focus and prioritise research efforts.

For further details about the Network, please see http://globalresearchalliance.org/dashboard/animal-health-and-ghg-emissions-intensity-network/

Time	Agenda Item	Speaker
09:30 – 09:40	*Arrive & Coffee*	
09:40 – 09:55	**Welcome and round table for introductions**	Tim Robinson (Network Co-Coordinator)
09:55 – 10:15	**Overview of the Network and update on recent Animal Health & GHG research**	Tim Robinson (Network Co-Coordinator)
10:15 – 11:45	**Scientific Presentations**	
10:15 – 10:35	Exploring interactions between climate change and livestock parasites	Naomi Fox (Scotland's Rural College, UK)
10:35 – 10:55	The influence of bovine tuberculosis on GHG emissions intensity in Wales	Adrian Williams (Cranfield University, UK)
10:55 – 11:25	*Tea/Coffee*	
11:25 – 11:45	Can improved productivity reduce the carbon footprint of Senegalese smallholder cattle systems?	Gareth Salmon (Scotland's Rural College and The University of Edinburgh, UK)
11:45 – 12:45	**Discussion Session: Research priorities and knowledge gaps**	
12:45 – 13:45	*Lunch*	
13:45 – 14:45	**Presentations from initiatives with which the Network is developing links**	
13.:45 – 14:.00	STAR-IDAZ International Research Consortium on Animal Health	Luke Dalton (Defra, UK)
14:00 – 14:15	Animal health and pathogen modelling in MACSUR: progress and next steps	Seyda Ozkan (NMBU, Norway) & Richard Kipling (Aberystwyth University, UK)
14:15 – 14:30	NEAT Progress: Next steps in the economics of animal health	Keith Howe (Royal Veterinary College, UK)
14:30 – 14:45	Links with FACCE-JPI and opportunities for collaboration	Dr. Órlaith Ní Choncubhair (Teagasc, Ireland)
14.45 – 15.15	*Tea/Coffee*	
15.15 – 16.00	**Discussion session: Collaboration to benefit research priorities**	
16.00 – 16.30	AOB, Summary and Close	Tim Robinson (Network Co-Coordinator)

APPENDIX 3: WORKSHOP PHOTOS

APPENDIX 4: ANIMAL HEALTH & GHG EMISSIONS INTENSITY NETWORK – DR TIM ROBINSON (ILRI, KENYA)

Department
for Environment
Food & Rural Affairs

Animal Health and Greenhouse Gas Emissions Intensity Network

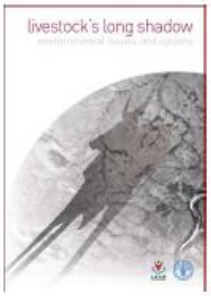
Presented by: Tim Robinson, ILRI
Presented to: Annual Workshop – 15 March 2016

Overview of presentation

- Animal Health and GHG – What is the issue?
- Introduction to the Network
- Relevant Research
- Next Steps

Animal Health & GHG – What is the issue?

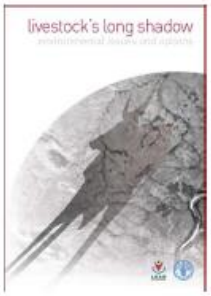
Global importance
- 40% agricultural GDP
- Employment
- 1/3 of humanity's protein
- Demand ↑
- Production ↑
- Environmental impact?



Steinfeld et al. (2006)

Animal Health & GHG – What is the issue?

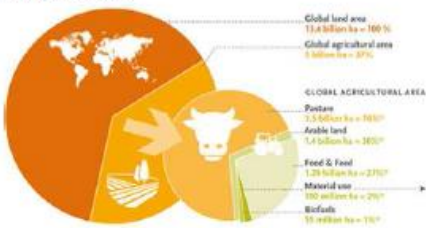
Period of change
- Environmental balance
- Trend towards intensification and industrialisation
- Shift of species



Steinfeld et al. (2006)

Animal Health & GHG – What is the issue?

Land degradation
- 70% agricultural land
- 30% land surface



European Bioplastics – http://en.european-bioplastics.org/blog/2013/04/15/land-use/

Animal Health & GHG – What is the issue?

Land degradation
- 70% agricultural land
- 30% land surface
- Deforestation
- Overgrazing

WWF

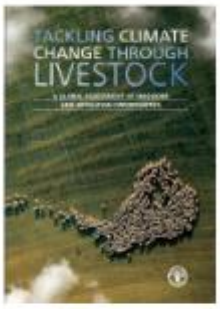
Animal Health & GHG – What is the issue?

Virtues

- c. $1.4 trillion – value of livestock sector
- 40% of agricultural GDP
- Employ 1.3 billion people
- Provides 17% of calories and 26% of protein, globally
- Utilises primary production of no direct value for human consumption
- Contribute nutrients and traction for mixed farming
- Serve as a bank and insurance against hard times (e.g. drought)

Tackling climate change …

- Tighter estimates of contributions
  - Sector accounts for 14.5% of emissions
  - 80% of this comes from ruminants
- Options for mitigation
  - Feed/forage balancing, digestibility, and efficiency
  - Improved animal health
  - Reduce the proportion of animals held for reproduction compared to production
  - Reduced average age at first reproduction and slaughter
  - Improved quality of pastures, fodder, and/or feed and access to information
  - Improved manure management
  - Improved carbon sequestration



What can be done?

- On average, 20% production losses due to animal diseases
- ↑ mortality
- ↓ fertility
- ↓ productivity (disease & parasite)
- = ↑ **emissions intensity** (individual & herd level)

So … what of animal health

- Lost opportunity or a drop in a bucket?
- Tripple win?
  - Environment
  - Productivity
  - Animal Welfare
- A few examples exist
  - Mostly from developed economies
- Analytical framework
  - Economic analysis
  - Lifecycle Assessment (LCA)
  - MACC analyses

Animal Health Network

Network context and aim

- GHG emissions intensity from livestock farming could be reduced through efficiency and production gains resulting from improved livestock health
- The Network aims to bring together researchers (in veterinary science, epidemiology, animal science, modelling etc) to explore links and synergies between animal disease control and Greenhouse Gas (GHG) emissions intensity reductions

Network objectives

1. Share information on current and planned reserach and funding activities
2. Maintain and enhance capacity in this field of research
3. Encourage and facilitate a joined-up approach
4. Establish common agreement on priority issues and explore funding opportunities
5. Pursue synergies with stakeholders and other relevant initiatives

Network Co-ordinators

Network Champions

- Network Champions
  - Abdul Chaudhry, Michael Macleod, Jos Houdijk (UK)
  - Wim van der Poel (The Netherlands)

We are looking for Network Champions from other countries – please let us know if you are interested!

Network Secretariat

Network information

- Network Secretariat animalhealthnetwork@adas.co.uk
- UK Agri-Science & Innovation Newsletter http://www.globalresearchalliance.org/community/alliance-member-countries/member-country-page-united-kingdom/
- GRA Livestock Research Group Newsletter
- Network webpages at www.globalresearchalliance.org

Progress to date

- Wide promotion to increase membership
  - 94 members across 27 countries
- 3 Annual Network workshops (Ireland, France & Denmark)
- 1 regional workshop (Ethiopia)
- Developed links with FACCE-JPI, MACSUR, GASL, STAR-IDAZ and NEAT
- Identified potential funding routes
- Communications e.g. newsletter, webpages, twitter, attending conferences

Links with initiatives and networks

MACSUR

NEAT

STAR-IDAZ
Global Network for Animal Disease Research

GLOBAL AGENDA FOR SUSTAINABLE LIVESTOCK

Key goals

- Identify tangible Network outputs
- Pursue funding opportunities
- Facilitate interaction of research communities via workshops and online members area
- Complement other GRA-LRG Networks
- Continue to link with relevant initiatives

What would success look like?

- Self-funded and secure in the long term
- Provides input to modelling Networks
- Funding from national and international activities
- Production of scientific papers on AH GHG
- Identification of research hotspots
- Exchange of postdocs between organisations involved in relevant research
- Input of the Network to inventories, position papers, FAO initiatives etc.

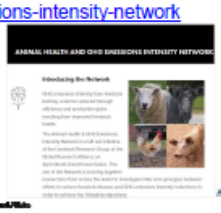
Challenges to the Network

- Legacy of the Network once Defra funding ends (June 2016)
- Secure funding for research projects on Animal health and GHG's
- Enable more countries to be able to participate in Network workshops

Relevant research projects

Contact details

- Network Secretariat animalhealthnetwork@adas.co.uk
- Twitter: @AHGHGN
- Network Website
- http://globalresearchalliance.org/dashboard/animal-health-and-ghg-emissions-intensity-network

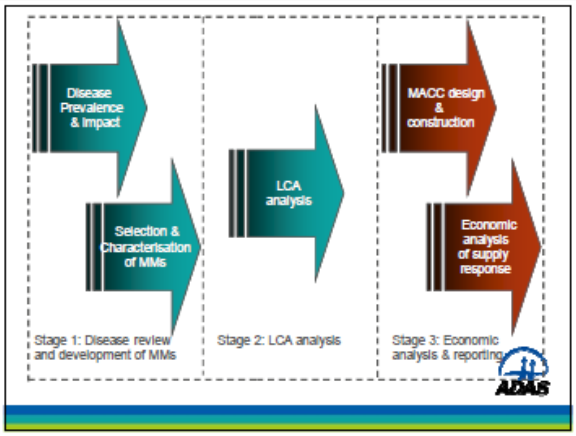


GLOBAL RESEARCH ALLIANCE
AGRICULTURAL GREENHOUSE GASES

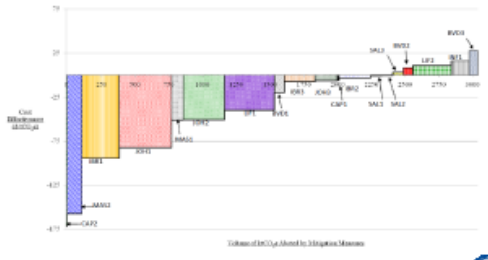
Modelling the Impact of Controlling Endemic Cattle Diseases and Conditions on Greenhouse Gas Emissions. (Defra project AC0120)

- An **interdisciplinary team** of veterinary experts, LCA modellers and economists;
- Drawing on **existing datasets** for animal diseases, GHG emissions and economics of milk and beef production;
- Using **established methodologies** and models for MACCs and supply-demand effects;
- Allowing for the **practicalities** of disease control on farms, including barriers to uptake of cost-effective actions.

Cranfield UNIVERSITY fera ahdb AHVLA xlvets ADAS



Marginal Abatement Cost Curve for control of endemic disease in dairy cattle in the UK



ADAS

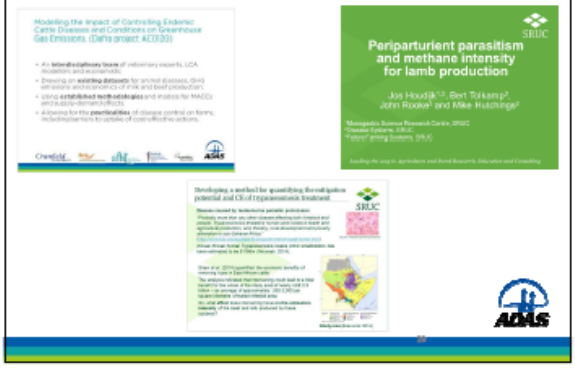
Key findings

- The work provides a 'proof of concept' that interventions intended at improving cattle health can be modelled to quantify GHG abatement in terms of scale and cost-effectiveness.
- A large number of treatments are cost-effective for farmers, especially in the dairy sector … but action is needed to inform and prompt change.
- Efficiency gains are likely to lead to increased production but price effects are small. A key factor is net land use change i.e. is released from livestock production.
- The opportunity for GHG abatement from animal health actions identified in this UK study could potentially be multiplied many times over if applied to cattle and other livestock globally.

www.adas.uk

ADAS

Relevant research projects



Periparturient parasitism and methane intensity for lamb production

SRUC

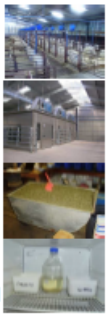
Jos Houdijk[1,2], Bert Tolkamp[2], John Rooke[3] and Mike Hutchings[2]

[1]Monogastric Science Research Centre, SRUC
[2]Disease Systems, SRUC
[3]Future Farming Systems, SRUC

Leading the way in Agriculture and Rural Research, Education and Consulting

Background, objective & approach

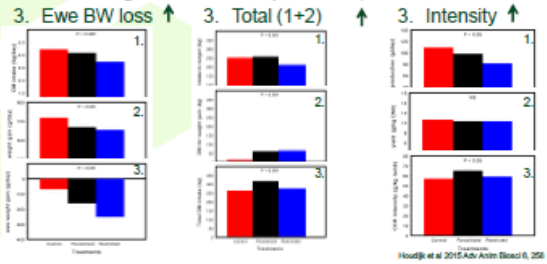
- Pathogen exposure reduces feed intake
  - We expect that parasitism would reduce methane output (per unit of time)
  - We need to know whether parasitism affect methane yield (per unit of intake) or methane intensity (per unit of output)
- We have assessed ewe parasitism impact on methane intensity for lamb production
- Three experimental treatments were used
  - Control (sham-infected), fed *ad libitum*
  - Parasitised (trickle-infected), fed *ad libitum*
  - Restricted (sham-infected), fed at 0.8 × control



Houdijk et al 2015 Adv Anim Biosci 6, 258

Performance, feed need & methane

Performance	Ewe feed need	Methane
1. Intake ↓	1. To target =	1. Output ↓
2. Litter BW gain ↓	2. Compensation ↑	2. Yield =
3. Ewe BW loss ↑	3. Total (1+2) ↑	3. Intensity ↑



Houdijk et al 2015 Adv Anim Biosci 6, 258

Discussion, conclusion & implication

- Accounting for parasitism-reduced productivity
  - ewes under challenge require **longer** feeding to reach **similar weaning lamb body weight** and **additional feed to compensate** for higher rate of **maternal weight loss**
  - this **increased feed requirement** increases total methane output during production cycle
- Data support the view that periparturient parasitism increases methane intensity for lamb production
  - Combined effect from anorexia, reduced feed value (data not shown) and maternal weight compensation
- Disease and GHG?
  - Impact on GHG yield and resource efficiency

Houdijk et al 2015 Adv Anim Biosci 6, 258

Acknowledgements

- Funding
  - Scottish Government
- Technical assistance
  - Dave Anderson, Terry McHale, Jo Donbavand
  - Ross McGinn, Dave Ross, Lesley Deans
- GHG intensity calculations (on-going)
  - Michael Macleod, Eileen Wall

jos.houdijk@sruc.ac.uk

Relevant research projects

Developing a method for quantifying the mitigation potential and CE of trypanosomosis treatment

Disease caused by tsetse-borne parasitic protozoans

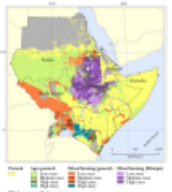
"Probably more than any other disease affecting both livestock and people, Trypanosomosis threatens human and livestock health and agricultural production, and, thereby, rural development and poverty alleviation in sub-Saharan Africa."
(http://www.fao.org/ag/againfo/programmes/en/paat/home.html)

Annual African Animal Trypanosomosis losses within smallholders has been estimated to be $1166m (Nkrumah 2014).

Shaw *et al.* (2014) quantified the economic benefits of removing tryps in East African cattle

The analysis indicated that intervening could lead to a total benefit for the whole of the study area of nearly US$ 2.5 billion – an average of approximately US$ 3,300 per square kilometre of tsetse-infested area.

So, what **effect** does intervening have **on the emissions intensity** of the meat and milk produced by these systems?



Study area (Shaw et al. 2014)

Quantifying the GHG effects of intervening against tsetse and tryps

SRUC

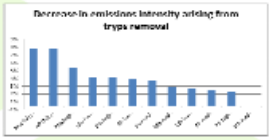
- The GHG emissions are quantified using an excel version of GLEAM (FAO's Global Livestock Environmental Assessment Model – see FAO 2013a). Scope: cradle to farm gate.
- Impacts of tryps removal on production and economic performance quantified in Shaw *et al.* (2014). Primary effects (see table). Secondary effects included: % of adult males used for work; no of days oxen work; cow replacement rates; slaughter ages and offtake rates; herd growth rate.

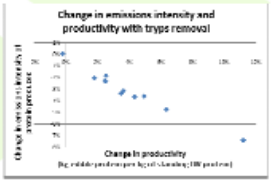
Parameter	Cattle production systems									
	Pastoral		Agro-pastoral		Mixed farming (general)		Mixed farming (Ethiopia)		Grade Dairy	
	T+	T-	T+	T-	T+	T-	T+	T-	T+	T-
Mortality (% per year)										
Female calves	20	17	18	15	16	13	24	20	21	18
Male calves	25	22	20	17	18	15	26	22	26	23
Adult females	7.5	6.5	7.0	6.0	8.0	7.0	9.0	7.5	12	10
Work oxen	9.0	7.2	8.5	6.8	9.0	7.2	10.0	8.0	–	–
Fertility and milk										
Calving rate (% per year)	54	58	52	56	51	55	49	54	53	57
Lactation offtake (l per year)	275	296	285	306	300	322	280	301	1 900	2 042

Note: T+ with trypanosomosis present; T- if trypanosomosis were absent. Source : Shaw et al. (2014)

Effect of removing tryps on emissions intensity (EI)

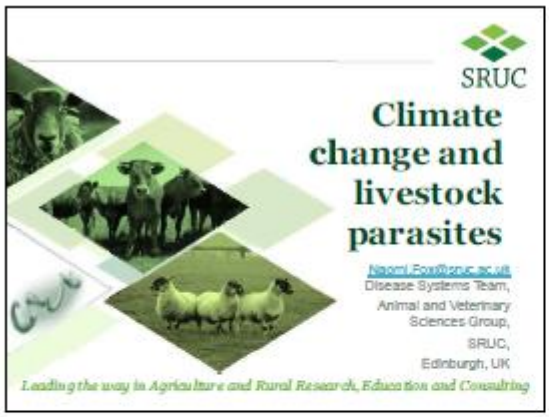
SRUC

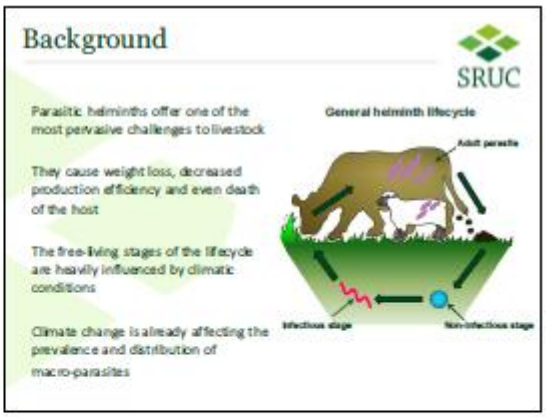


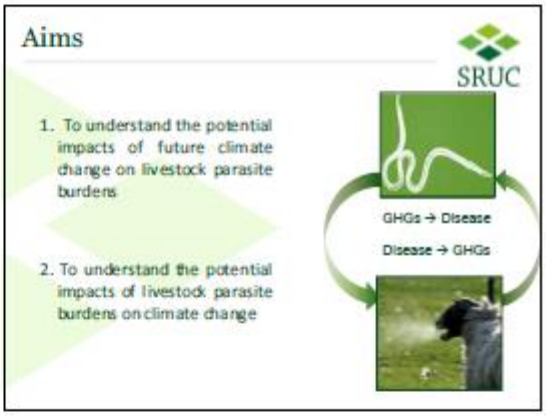


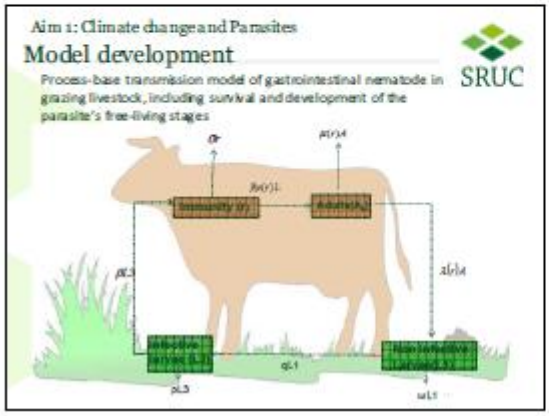
- There are significant increases in production and emissions across all the systems when tryps is removed.
- Production increases by more than emissions so EI decreases
- The biggest decrease in EI is in the high yielding dairy systems
- There appears to be a link between improving productivity and decreasing EI.
- The main drivers of the reduction in EI are:
  - Increased milk yield reduces the GHG per kg of milk secreted by the cow.
  - Increased fertility rate means a greater % of the cows are lactating

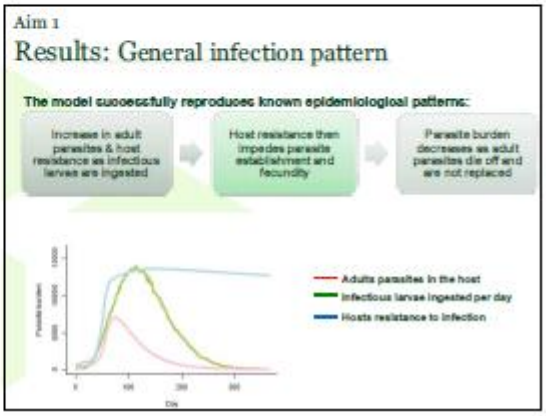
APPENDIX 5: EXPLORING INTERACTIONS BETWEEN CLIMATE CHANGE AND LIVESTOCK PARASITES – DR NAOMI FOX (SRUC, UK)









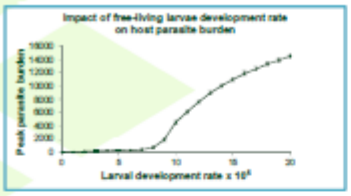


Aim 1:

Results from simple model

SRUC

Higher temperatures → increased development rate → higher parasite burden



Climate change can lead to sudden increases in parasite risk

Aim 1

Transmission is a complex systems

SRUC

- Macro-parasite transmission is influenced by:
  - Host behaviour
  - Spatial effects
  - Larvae survival
  - Larvae development
  - The hosts immune response

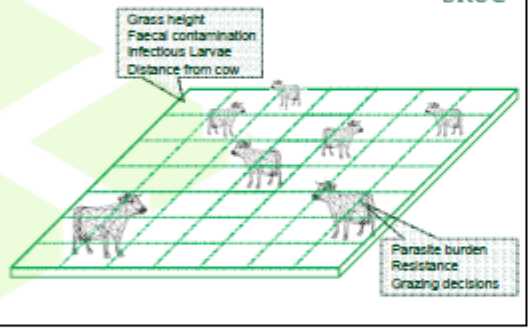
Climate change will impact on many stages of the transmission process.

There is a need to incorporate wider elements of transmission to test the robustness of results to farm-level processes.

Aim 1

Methods: the model development

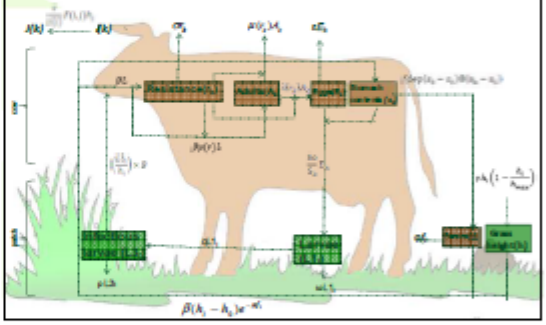
SRUC



Aim 1

Methods: model development

SRUC

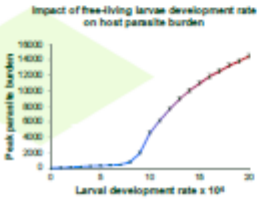


Aim 1

Results from complex model

SRUC

Higher temperatures → increased development rate → higher parasite burden

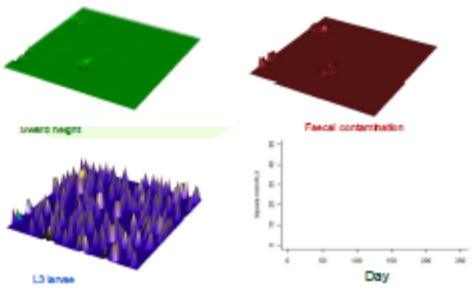


Findings are robust to inclusion of complex farm-level processes

Aim 1

Results: Spatial heterogeneity and resource use

SRUC

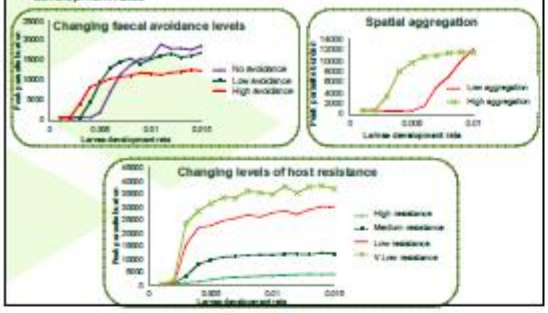


Aim 1

Influence of other factors

SRUC

Farm-level factors influence outbreak intensity for different larval development rates



Aim 2

Parasites and climate change

SRUC

Bottom-up, process-based models, showing how increased temperatures can influence parasite intensity

Aim 2

Determine if parasitism has an effect on methane emissions in finishing lambs

Aim 2

Methods

SRUC

Quantify the methane production from parasitized and non-parasitized finishing lambs

- 3 treatments
  - Non-parasitized controls, ad-lib fed
  - Parasitized (*T.circumcinta*), ad-lib fed
  - Restricted fed non-parasitized controls (80% of controls)
- 72 parasite naïve lambs:
  - 3 lambs per group,
  - 8 groups per treatment
- Quantify methane output at peak parasitism burden

Aim 2

Methods

SRUC

- In methane chamber for 3 days (2 day of data)
  - Methane Output (CH_4)
  - Carbon Dioxide (CO_2)
  - Hydrogen gas (H_2)
- Additional measures
  - Body Weight (BW) (pre- and post chamber)
  - Feed Intake (pre & during)
  - Faecal egg count (pre- and post chamber)
  - Blood serum – pepsinogen (pre- and post chamber)

Summary

SRUC

- Parasite burdens affect GHG production
- Parasitism will also affect productivity and time on farm
- Models predict that changing temperatures could have a dramatic impact on parasite burdens
- Theoretical and experimental models can increase understanding of the two-way interactions between parasites and climate change

Acknowledgements

SRUC

- SRUC receives support from the Scottish Government

Thanks to:

- Glenn Marion (BioSS)
- Piran White (University of York)
- Mike Hutchings (SRUC)
- Ross Davidson (SRUC)
- Jos Houdijk (SRUC)
- Lesley Smith (SRUC)
- Spiridoula Athanasiadou (SRUC)

APPENDIX 6: THE INFLUENCE OF BOVINE TUBERCULOSIS ON GHG EMISSIONS INTENSITY IN WALES – DR ADRIAN WILLIAMS (CRANFIELD UNIVERSITY, UK)

Greenhouse Gas Emissions (GHGE) from bovine tuberculosis (bTB) in Wales

- Methods * Welsh cattle population * bTB in Wales *
- Impacts of bTB in GHGE and its elimination * Conclusions

Adrian Williams [1]

Paul Upton [2] Alison Prosser [2]

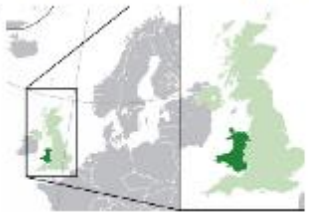
[1] Cranfield University, [2] APHA, Animal & Plant Health Agency

www.cranfield.ac.uk

Caveat: some reanalysis may occur, so please regard these as provisional

Why?

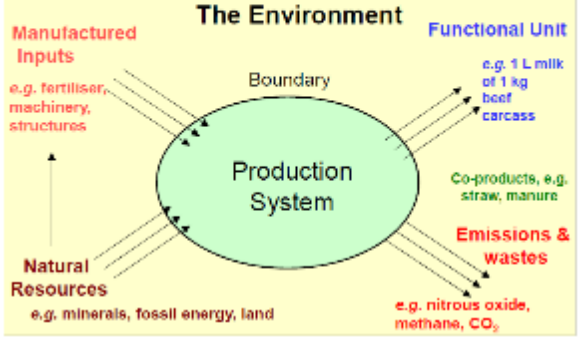
- Aim to eradicate bTB
- WG wanted to know the effect of current policies on GHGE
- Rates falling



Methods and data

1. **Life Cycle Assessment and GHGE**
2. Cattle population in Wales numbers
3. Prevalence of bTB
4. Impacts of bTB

The LCA Concept: to farm gate



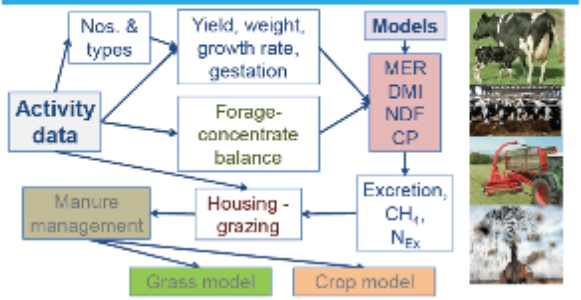
Actual functional units used

1. Beef: 1 kg expected carcass at the farm gate
   Liveweight * Killing out proportion (KoP)
2. Milk: 1 kg EFCM chilled raw milk at the farm gate

Notes

- No post farm processing involved, but most GHGE come from primary production
- All beef carcasses assumed to be of equal "value"

Systems modelling approach for LCA inputs (feed and manure)



Impacts on individual cattle

- Mortality
  - Annual and lifetime rates
  - Unavoidable vs. managed
  - Prematurely culled cattle
- Morbidity
  - Reduced milk yield
    - Growth rate?
  - Increased MER & partitioning
  - Compromised welfare

- Reduced productivity
- Inefficient production: higher overheads
- Higher GHG emissions per unit output

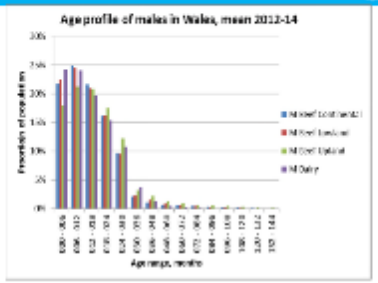
Measureable effects

- Time from confirmation to slaughter
  - Loss of milk produced
  - Beef -assume same?
- Carcass downgrades
- Culling rates
  - Reduced age at slaughter
  - Reduced average breeding population age

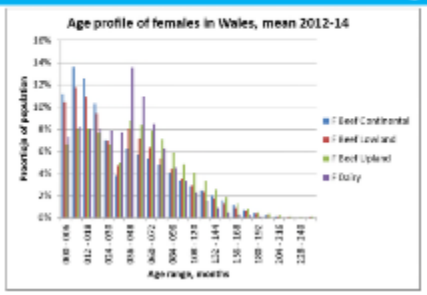
Methods and data

1. Life Cycle Assessment and GHGE
2. Cattle population in Wales
3. Prevalence of bTB
4. Impacts of bTB

Overall population profiles of male cattle in Wales (mean 2012-14)



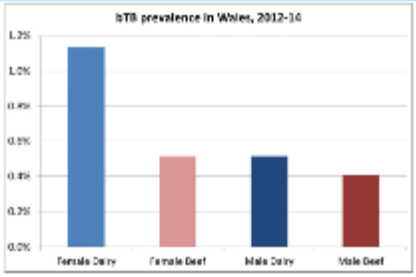
Overall population profiles of female cattle in Wales (mean 2012-14)



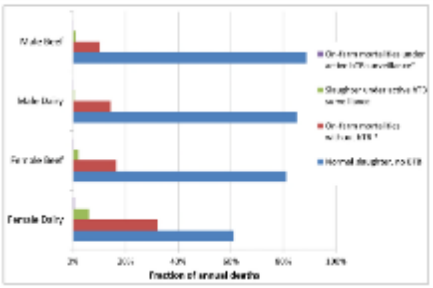
Methods and data

1. Life Cycle Assessment and GHGE
2. Cattle population in Wales
3. Prevalence of bTB
4. Impacts of bTB

Prevalence of bTB in Wales, Mean 2012-2014



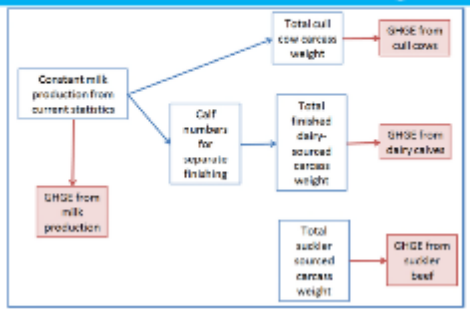
Summary of annual cattle deaths in Wales



Methods and data

1. Life Cycle Assessment and GHGE
2. Cattle population in Wales
3. Prevalence of bTB
4. **Impacts of bTB**

Routes for milk and beef production and their GHG emissions in constant output scenario



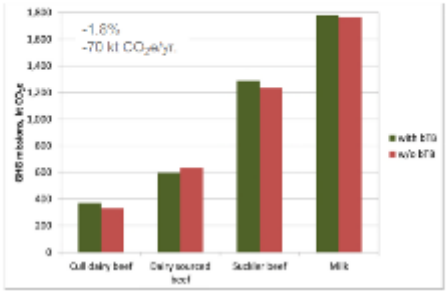
Scenario 1: The dairy sector

Dairy cows numbers	-0.29%
GHGE, per unit milk	-0.94%
Total GHGE from milk	-0.94%
Cull cow carcass per unit milk	-8.5%
GHGE per unit cull cow carcass	-2.5%
Cull cow carcass output, kt	-8.5%
GHGE of cull cow carcass	-11%

Scenario 2: Suckler beef to balance total carcass output

Suckler breeding population	-1.90%
Suckler beef production	-1.90%
GHGE per unit suckler beef	-2.20%
GHGE from suckler beef	-4.10%

Effects on annual GHG emissions of eliminating bTB from Wales by output

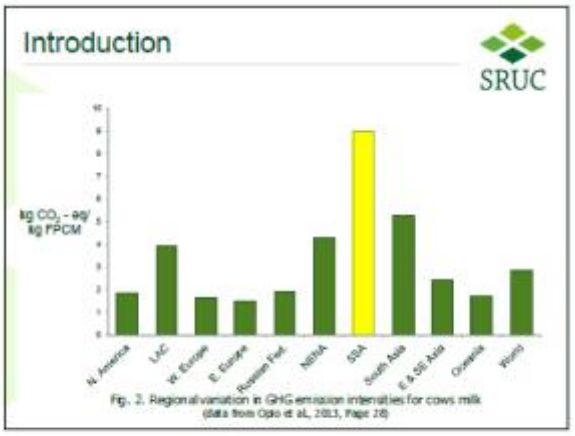


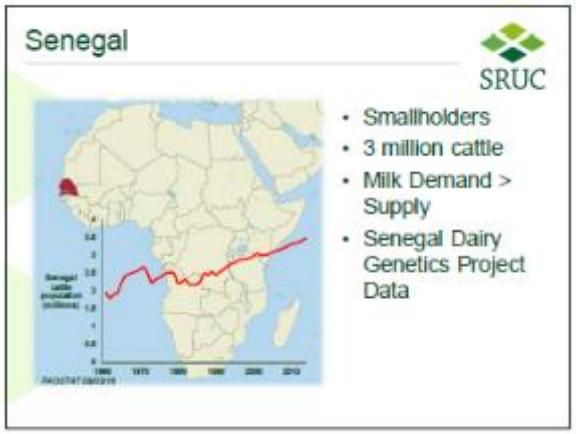
Concluding discussion

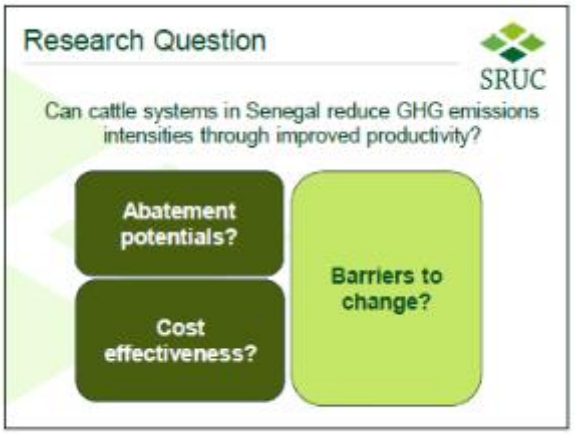
- Relatively small impact on GHGE
  - <2% of current and 70 kt CO_2e, but low prevalence now
- Lower suckler
  - Economic and social impacts much higher
- Culls enter food chain
  - Before end of 30 month rule, very different
- Real farmer behaviour?
  - bTB free Wales: export potential?
- Synergy with other conditions?
- High on-farm mortalities: bigger opportunity?
- **Caveat: some reanalysis may occur, so these are provisional**

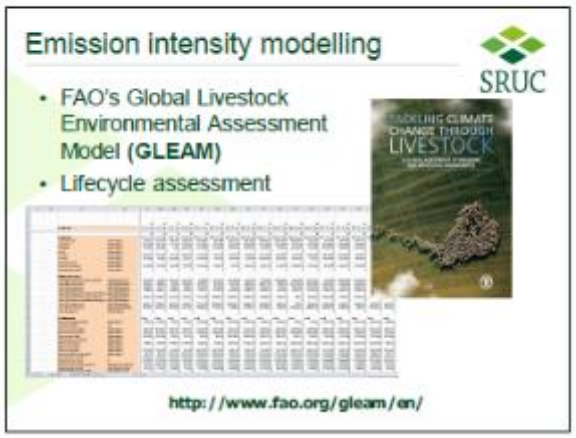
Many thanks for funding from Llywodraeth Cymru Welsh Government

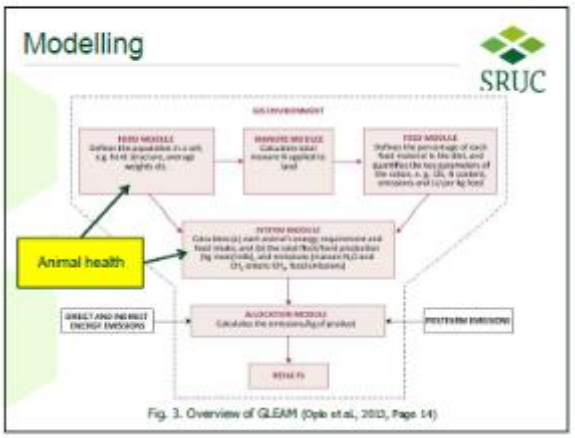
APPENDIX 7: CAN IMPROVED PRODUCTIVITY REDUCE THE CARBON FOOTPRINT OF CATTLE SYSTEMS IN DEVELOPING REGIONS? – MR GARETH SALMON (SRUC, UK)











Modelling – Abatement potentials

Beyond the Model…

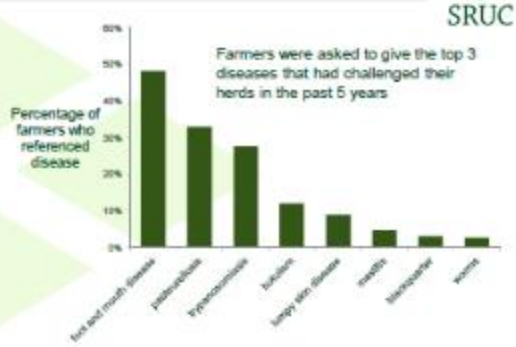
Barriers to change

- Sociocultural
- Financial
- Infrastructure
- Policy
- Markets

Sampling

- 220 smallholder cattle farmers
- Monthly records 2013-2015

Health challenges



Management

Disease	Manageable?	Methods
Foot and mouth disease	?	isolation; ring vaccination
Pasteurellosis	✓	prompt chemotherapy; vaccination
Trypanosomiasis	✓	herding strategies; vector control; breed choice; prophylactic drugs
Botulism	?	correct diet; immunization
Lumpy skin disease	✓	antibiotics; vaccinations; slaughter policy
Mastitis	✓	antibiotics; fly repellents; hygiene
Blackquarter	?	penicillin; vaccination
Worms	✓	anthelmintic treatment

Productivity influence

Disease	Milk yield	Body weight/ Growth rate	Mortality (Pre-natal, Neo-natal, calves, cows)
Foot and mouth disease	↓	↓	↑
Pasteurellosis	↓	↓	↑
Trypanosomiasis	↓	↓	↑
Botulism	Generally rapidly fatal		↑
Lumpy skin disease	↓	↓	↑
Mastitis	↓	↓	↑
Blackquarter	Generally rapidly fatal		↑
Worms	↓	↓	↑

BUT…by how much…?

Disease incidence levels

SRUC

1. % herds with disease

How many households in sample have treated in past year?

2. % of herd with disease

How many animals in the herd have been treated?

BUT…not all diseases are treated and not all HH treat

The challenge continues…

SRUC

Going forward:

- Trip to Senegal
- Dakar Vet School
- ILRI
- CIRAD (West Africa)

Thank you & Questions

SRUC

Acknowledgments:
Michael Macleod (SRUC)
Karen Marshall & Tim Robinson (ILRI)
CCAFS funding
ILRI data

ILRI

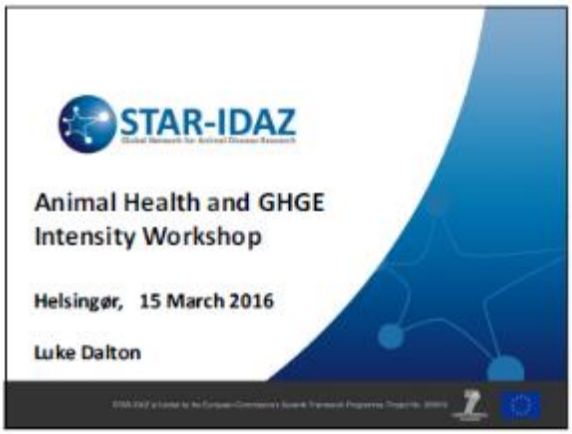
References

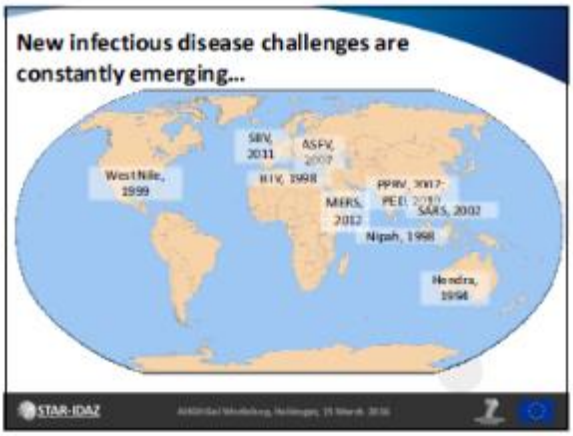
Gerber, P., Vellinga, T., Opio, C. & Steinfeld, H. (2011) Productivity gains and greenhouse gas emissions intensity in dairy systems. Livestock Science 139(1), pp. 100–108.

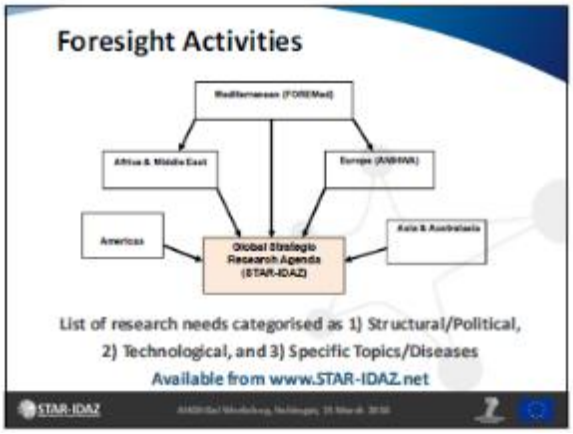
Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. & Tempio, G. (2013) Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities. Rome: Food and Agriculture Organization of the United Nations (FAO).

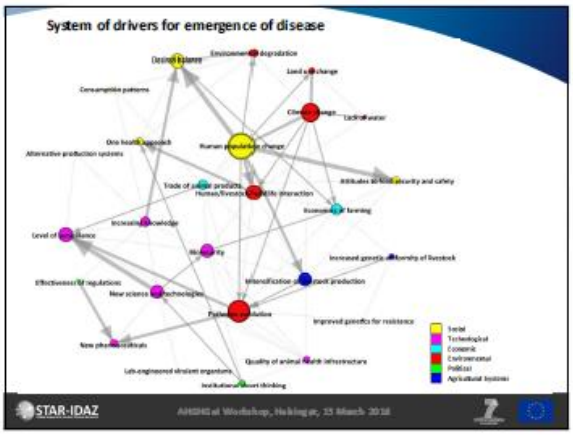
Opio, C., Gerber, P., Mottet, A., Falcucci, A., Tempio, G., MacLeod, M., Vellinga, T., Henderson, B. & Steinfeld, H. (2013). Greenhouse gas emissions from ruminant supply chains – A global life cycle assessment. Rome: Food and Agriculture Organization of the United Nations (FAO).

APPENDIX 8: GLOBAL NETWORK FOR ANIMAL DISEASE RESEARCH (STAR-IDAZ) – MR LUKE DALTON (DEFRA, UK)









Network Status Update

Established as a global network under agreed MoU

Higher level of commitment through the STAR-IDAZ International Research Consortium for Animal Health (IRC)

- 16 partners from 12 countries have signed Letter of Intent to participate
- Total budget of $2+ billion over next 5 years
- Agree to coordinate/align funding to deliver targets
- Agree to share research results

STAR-IDAZ

Objective of STAR-IDAZ IRC

To coordinate research at international level to contribute to new and improved animal health strategies for at least 30 priority diseases/infections/issues

The deliverables include :
candidate vaccines, and/or
diagnostics, and/or
therapeutics and other animal health products, and/or
procedures and/or
key scientific information/tools to support risk analysis and disease control

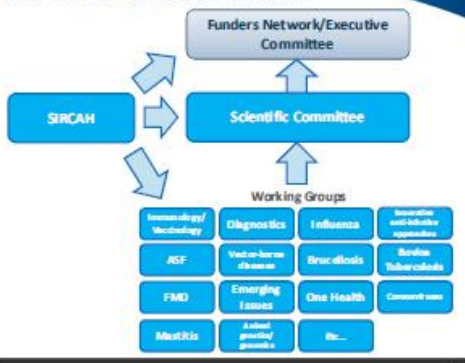
STAR-IDAZ

Priority topics identified for initial collaboration

- Immunology/vaccinology (tools and technologies)
- Diagnostics (tools and technologies)
- Innovative anti-infective approaches, including alternatives to anti-microbial agents
- Influenza
- Bovine Tuberculosis
- Foot and Mouth Disease
- Brucellosis
- African Swine Fever
- Emerging issues
- Vector-borne diseases
- Coronaviruses
- One Health (including food-borne pathogens and AMR)
- Mastitis
- Animal genetics/genomics for animal health
- Epidemiology
- Helminths
- Rabies
- Respiratory Diseases of Pigs

STAR-IDAZ

IRC Governance Structure



STAR-IDAZ

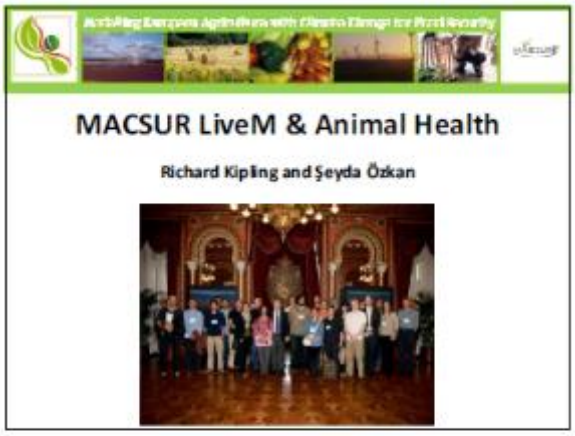
IRC – Next steps

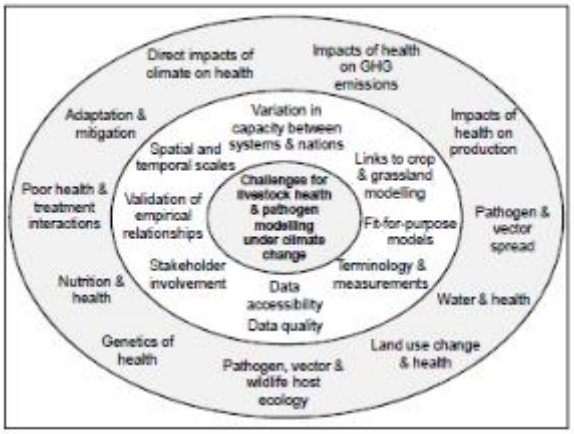
- Advocacy to enlarge membership
- Partners meet in Buenos Aires on 5 – 7 April
  - IRC Executive Committee meet
  - Review progress of existing working groups
  - Agree membership of the Scientific Committee
  - Look to expand IRC membership
  - Establish Additional Working Groups

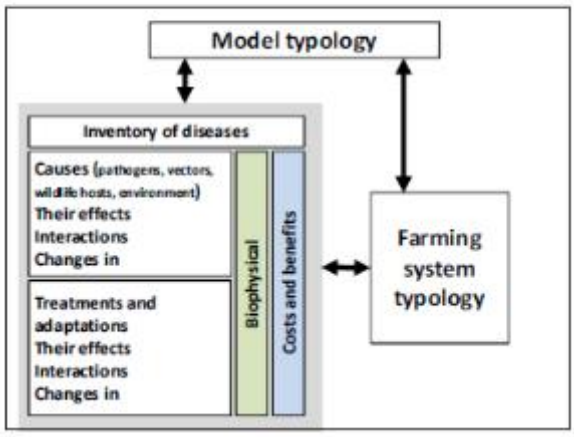
STAR-IDAZ

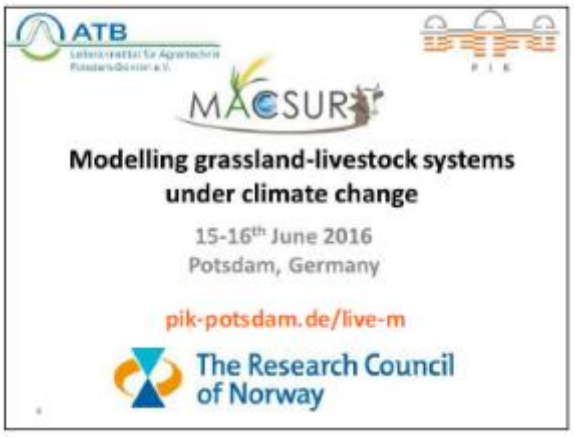

Links with AH&GHGeI
Shared goal to "improve and protect animal health"
Participation in working groups?
Links with regional networks?
WWW.STAR-IDAZ.NET
STAR-IDAZ

APPENDIX 9: ANIMAL HEALTH AND PATHOGEN MODELLING IN MACSUR: PROGRESS AND NEXT STEPS – DR RICHARD KIPLING (ABERYSTWYTH UNIVERSITY, UK) AND DR SEYDA OZKAN (NORWEGIAN UNIVERSITY OF LIFE SCIENCES, NORWAY)









MACSUR2 plans
(Animal health and GHG emissions)

Şeyda Özkan
Research Scientist
Norwegian University of Life Sciences

Animal Health & Greenhouse Gas Emissions Intensity Network Workshop
16 March 2016
Elsinore, Denmark

Task L2.2. Impacts of impaired health, disease and productivity change on GHG emissions

Task leader: Dr Şeyda Özkan

Duration 1 June 2015-30 May 2017

Task decription

- Impacts of animal health and production on GHG emissions
- Links to task on impacts of CC on health and productivity (e.g. directly through environmental changes and indirectly through changes in disease and parasite types, risk, and severity) (L2.1).

Draft proposal 1
An assessment of current models predicting the impacts of pathogens and poor animal health on greenhouse gas emissions intensity

- Lead: Şeyda Özkan
- Improved livestock health and welfare → increased production efficiency, profitability and reduced GHG emissions intensity
- Few studies quantify the impacts of livestock ill-health on GHG emissions.
- Aim: Assess the methodologies in existing livestock climate models to predict the impact of health change (pathogens, diseases, poor health etc.) on GHG emissions & conduct modelling for a given set of input parameters.
- Not everyone has a GHG model or a calculting tool, but they can still be involved.

Contributing partners in study 1

Ş Özkan (reduction in feed intake, GHG emissions, mastitis)
A Bannink (nutrient metabolism, GHG emissions)
A Wilson (Data for Schmallenberg virus and BTV)
D Bartley (Endemic diseases, productivity)
N Wheelhouse (Bacterial diseases, reproduction efficiency)
M Macleod (Improving health and GHG emissions emissions intensities, removing trypanosomosis in East Africa)
T Robinson (Improving health and GHG emissions emissions intensities, removing trypanosomosis in East Africa)
S Østergaard (Simherd model, health changes, production, GHG emissions, economics)
I Kyriazakis (gastrointestinal parasites feed intake, feed strategies and productivity)
Jos Houtlijk (Effect of diseases on GHG emissions, sheep)
J Gulitan (prevalence of major endemic conditions of daily cattle in the UK. Impacts of diseases on GHG emissions)

Draft proposal 2
A review of current modelling on livestock pathogens and disease spread under changing climate conditions (TBD)

- Lead: TBD
- Background: Limitations in pathogen vector modelling:
- (i) relationships between the factors involved;
- (ii) a lack of parasite intensity data;
- (iii) a subsequent reliance on correlative modelling based on distribution data alone
- A range of models used to predict the impact of external factors e.g. climate on parasite intensity and spread
- Gaps remain for particular pairings of pathogen conditions and specific environmental changes
- Aim: Review the current practice on livestock pathogen and spread modelling under climate change. Assess the challenges associated with using these models; and the relationships between pathogen movements and climate conditions

Contributing partners in study 2

H Williams (disease spread)
D Leclère (evolution of disease vectors)
A Williams (disease spread)
D Sandars (disease spread)
N fox (parasitism and GHG emissions)
Ş Özkan

Draft proposal 3

Adapting to climate change is difficult but possible: a review of current trends in modelling animal disease interventions in relation to climate change and stakeholder behaviour

- Lead: TBD
- Background: Animal health issues → reduced economic performance
- Aim: (i) Review the current modelling on the impacts of animal disease interventions to reduce the GHG emissions,
- Produce an inventory of diseases used to model the impacts of direct and indirect costs on the farm first.
- Compile the intervention methods for each disease
- Combine this information with the existing modelling results on diseases and GHG emissions intensity.
- Assess farmers attitudes to adapt to such intervention methods based on the emissions produced on the farm and possible carbon policy implications.
- (ii) the uptake of such modelling results among specific stakeholders will be investigated. There may be a focus on carbon policy here e.g. implying direct cost on carbon-based emissions.

Contributing partners in study 3

B Vosough Ahmadi (Data for blue tongue, economics)
S Shrestha (productivity, economics, diseases)
J Elliott (Diseases, productivity, GHG emissions, economics, MAC curves)
I Blanco-Penedo (stakeholder, consumer etc.)
C Sipahi (animal health economics, avian influenza)
Ş Özkan (data from Norwegian dairy recording system)

Task L2.1. Impacts of climate change on animal health, production and reproduction

Task Leader: Dr Andrea Vitali

Duration: 24 Months

Aim: two position papers + one research paper

#1: State of the art on the direct impact of heat stress on livestock health and productivity across European regions with special emphasis on dairy cows

#2: Analysis of the best practices adopted to reduce the direct impacts of heat stress on livestock health and productivity (adaptation)

Aims:

Provide information that may improve the capacity of modelling the direct effect of climate change on animal health and productivity

Paper #1

- Analyse results of research studies in light of methodological variability
- Experimental design, weather variables/bioclimatic indices, parameters under study, genotype, production system, time scale and regions.

Paper #2

List of the adaptation strategies used today across Europe to mitigate heat stress on livestock and assessment of their effectiveness

- Structural: e.g. housing type, cooling devices, shade facilities
- Management: e.g. type of feed and feeding strategies, wetting (or soaking) schemes, A.I. programs
- Pro-active: e.g. warning systems, genetic selection

Paper #3: Research activity

Data available: Weather, health, production, reproduction

Comparison between difference indexes e.g. THI

Analysis of the relationships between climatic conditions and animal outputs (health and productivity)

Contact us if interested

- Please contact Seyda at seyda.ozkan@nmbu.no or Andrea at mail@andreavitali.it for further discussion or involvement in the task activities.

- More info at LiveM conference in Potsdam 15-16th June 2016.
  Abstract submissions due
  18th March 2016.

APPENDIX 10: NEAT PROGRESS: NEXT STEPS IN THE ECONOMICS OF ANIMAL HEALTH – DR KEITH HOWE (ROYAL VETERINARY COLLEGE, UK)

RVC Royal Veterinary College University of London

NEAT

NEAT Progress:

Next steps in the economics of animal health

Keith Howe

Royal Veterinary College, University of London

Annual workshop of the Animal Health and Greenhouse Gas Emissions Intensity Network (AHGHGN).

15 March, 2016

Elsinore, Denmark

Lifelong Learning

NEAT

Aim of NEAT

Networking to enhance the use of economics in animal health education, research and policy-making in Europe and beyond

To strengthen and enhance the **use of economics** in animal health in higher education and professional environments

Lifelong Learning www.neat-network.eu NEAT

NEAT

NEAT's objectives & activities

Improved **organisational coordination** for those developing and delivering curricula and course content on economics for animal health professionals

Identification of **teaching and training needs** for undergraduate, postgraduate and established professionals

Lifelong Learning www.neat-network.eu NEAT

NEAT

NEAT's objectives & activities

Development of curricula, course contents, teaching and training materials for undergraduate, postgraduate and established professionals

Dissemination of curricula, course contents, teaching and training materials

Evaluation of the delivery of teaching and training materials

Lifelong Learning www.neat-network.eu NEAT

NEAT and you

NEAT

Lifelong Learning www.neat-network.eu

NEAT

NEAT in transition

Concluded at 3rd Annual Conference, Cesenatico, Italy, September 2015

Decisions to **sustain momentum** into the future are:

Lifelong Learning www.neat-network.eu NEAT

Next steps

Set up the **International Society for Economics and Social Sciences of Animal Health (ISESSAH)**

Inaugural conference 28 March 2017,Inverness, Scotland (pre-SVEPM)

www.neat-network.eu

Next steps

Continue to **refine and update curricula**

Transfer **teaching materials into book or internet** format

Strengthen **data collection, analysis, publication** by encouraging and fostering people's engagement

www.neat-network.eu

Next steps

Review existing journals which publish work in the economics of animal health (EAH)

Take decision about **potential launch of dedicated EAH journal**

Support NEAT-type initiatives for the **Americas**

Strengthen **data collection, analysis, publication** by encouraging and fostering people's engagement

www.neat-network.eu

Next steps

Build **ISESSAH website from NEAT website**, now just starting the transition

Please **keep watching NEAT website** for news of developments

Much still to do!

Meanwhile .....

www.neat-network.eu

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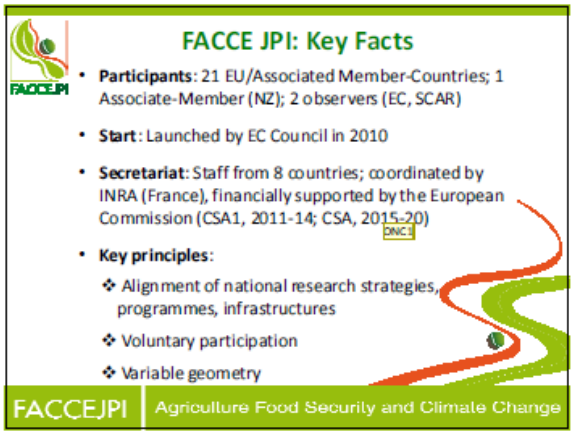
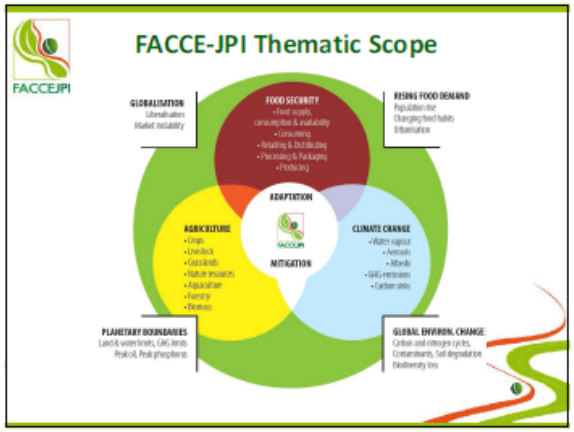
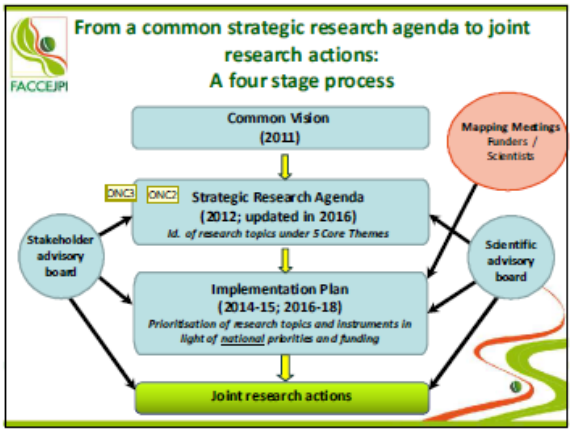
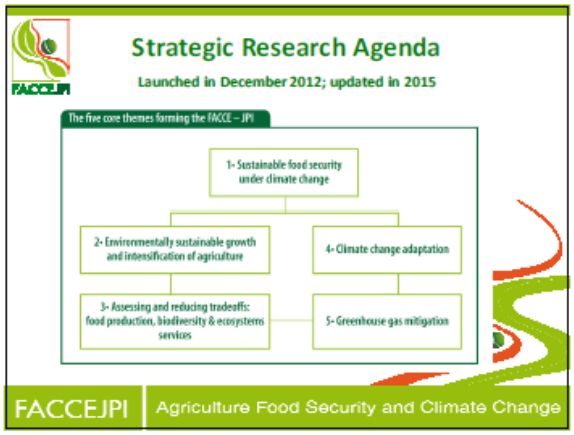
APPENDIX 11: LINKS WITH FACCE-JPI AND OPPORTUNITIES FOR COLLABORATION – DR ÓRLAITH NI CHONCUBHAIR (TEAGASC, IRELAND)









FACCE-JPI Implementation Plans: 3 types of joint actions/ instruments

- **Actions that allow to align already existing research at EU level**
  - Knowledge Hubs => Member-States' funding
  - Knowledge Network => Member-States' funding
  - Thematic Annual Programming Network => Member-States' funding
- **Actions that allow to invest jointly in new EU research**
  - FACCE-JPI ERA-NETs => Member States + EC co-funding (Horizon2020)
  - Joint calls for research proposals (some with international partners) => Member-States' funding
- **Actions that allow to explore emerging research areas**
  - Exploratory workshops => Member-States' funding

Currently: 12 joint actions (ongoing or *under development*)

CT1. Food security under CC	CT2. Sustainable intensification of agriculture	CT3. Biodiversity and ecosystem services	CT4. CC Adaptation	CT5. GHG Mitigation
Knowledge Hub on modelling the impacts climate change on food security (MACSUR)	*Knowledge Network on sustainable intensification*	Joint call with the BiodiversA ERA-NET	FACCE ERA-NET + on Climate Smart Agriculture	Multipartner call on agricultural GHG mitigation (with GRA countries)
International call on food security and land use change with the Belmont Forum	FACCE ERA-NET Cofund on Sustainable agriculture for food and non-food systems (SURPLUS)		ERA NET Cofund with the Water JPI on adapting agricultural land and water management	Exploratory Workshop on Animal health and GHG Mitigation
Exploratory Workshop on CC impacts on food safety	*Thematic Annual Programming Network on agricultural soil quality*			FACCE ERA-NET Cofund on monitoring and mitigation of agricultural GHG (ERA-GAS)

FACCE ERA-GAS

HORIZON 2020 ISIB-2015-1-12c Call for ERA-NET Cofund

Topic: Monitoring and mitigation of agricultural and forestry GHGs

- Grant Agreement negotiation completed Feb 2016
- Call Open: 4th March 2016
- Pre-Proposal Deadline: 3rd May 2016
- Full Proposal Deadline: December 2016

FACCE ERA-GAS

- Minimum of 3 partners (max. 8) from at least 3 different countries
- Led by Teagasc, Ireland
- 20 partner organisations from:
  - 12 FACCE-JPI member countries
  - 2 Other countries
- Total national/regional contribution: approx. € 9.9 M
- EU budget max: € 5 M

teagasc The Irish Agriculture and Food Development Authority

FACCE ERA-GAS Budget

Funding countries	Funders	Budget	Other partners
DE	BMEL	€1.000.000	BLE, FNR, Juelich
DK	IFD	€1.000.000	
FI	MMM	€300.000	
FR	ANR	€1.000.000	
IE	DAFM, Teagasc	€1.000.000	
IV	VIAA	€300.000	
NL	NWO	€900.000	DLO, EZ
NO	RCN	€1.000.000	
PL	NCBR	€500.000	
RO	UEFISCDI	€500.000	
SE	Formas	€1.000.000	
TR	GDAR	€250.000	
UK	DEFRA	€340.000	
NZ	MPI	€800.000	
TOTAL MS and AC		€9.090.000	

FACCE ERA-GAS

Scope of the Co-funded Call

- **Theme 1:** Improving national GHG inventories and monitoring, reporting, verification of emissions
- **Theme 2:** Refining and facilitating implementation of GHG mitigation technologies
- **Theme 3:** State of the art production systems that are:
  - profitable
  - improve food and forest biomass production
  - while reducing GHG emissions
- **Theme 4:** Assessment of policy and economic measures across the production chains

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ERA-NET on Sustainable Animal Production: SusAn

ISIB-2015-1-12e Call for ERA-NET Cofund

Topic: Sustainable livestock production, including animal health and welfare, breeding, nutrition and production systems

- Call Open: 4th Jan 2016
- Pre-Proposal Deadline: **29th March 2016**
- Full Proposal Deadline: 9th Sept 2016

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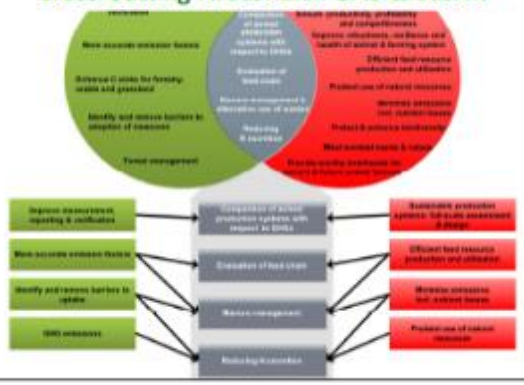
Participation & Scope

- Led by BLE, deputy INIA
- 37 partner organisations from:
  - 21 EU Member States
  - 2 Associated States
- Total national/regional contribution: approx. € 17M
- **Three Research Areas:**
  1) Economy
  2) Environment
  3) Society

  At farm, regional, national, EU and global scale

Cross-Cutting Areas: ERA-GAS & SusAn



FACCE ERA-GAS

Additional Joint Activities

- Additional joint call e.g. competitive project funding call, knowledge hub
- Exploit synergies with other ERA-NETs, funding programmes and initiatives (JCT-Agri, GRA, MACSUR…)
- ERA-NET SusAn cross-cutting areas
- Workshop to develop Implementation Plan:
  - scientific priorities
  - tools best suited
- Other additional activities (workshops, exchanges…)
- Implementation Plan expected July 2017

The Irish Agriculture and Food Development Authority

FACCEJPI

Thank you for your attention!

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Visit: www.faccejpi.com
www.eragas.eu
www.era-susan.eu

Email: facce-secretariat@paris.inra.fr

FACCE ERA-GAS

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