GLOBAL RESEARCH ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES

Animal Health and Greenhouse Gas Emissions Intensity Network Second Annual Workshop

Crowne Plaza Hotel, Montpellier, France

15th March 2015

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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 Gases which brings together researchers from across the world to investigate links and synergies between efforts to reduce livestock disease and Greenhouse Gas (GHG) emissions intensity reductions. The second annual workshop of the Network was held on the 15th March 2015 in the margins of the Climate-Smart Agriculture Conference in Montpellier, France.

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. Participants addressed data needs and potential data sources required to consider the relationship between animal health and GHG emissions intensity, and identified the wide range of expertise required for this, as well as potential research areas and funding sources for the Network. The workshop was attended by 18 participants representing 11 countries.

The discussion sessions identified that it is important to consider temporal and spatial issues, trade-offs and farmer interpretation when looking at data requirements. A wide range of expertise relevant to the Network were identified within the themes of animal health, GHG research and social science. It was agreed that data managers and systems analysts hold a key role in bringing together the data and expertise from the different disciplines. STAR-IDAZ and FACCE-JPI provide potential funding sources for the development of the Network. The workshop identified some potential work areas for the Network such as assessing the economic and carbon costs due to an epidemic arising from climate change.

This report is a summary of key discussions, action points and outcomes from the workshop and is aimed towards all Network members and researchers/research funders interested in the links between animal health and GHG mitigation.

LIST OF ABBREVIATIONS

AOB	Any Other Business
AVTRW	Association of Veterinary Teaching and Research
BSAS	British Society of Animal Science
BVD	Bovine Virus Diarrhoea
CAP	Common Agricultural Policy
CSA	Climate Smart Agriculture
DG Agri	Directorate-General for Agriculture and Rural Development
DFID	UK Government Department for International Development
Defra	UK Government Department for Environment, Food and Rural Affairs
EC	European Commission
ERA-NET	European Research Area Net
EU	European Union
EPIZONE	International network of veterinary research institutes working on epizootic diseases
FACCE-JPI	Agriculture, Food Security and Climate Change Joint Programming Initiative
FAO	Food and Agriculture Organisation of the United Nations
GASL	Global Agenda for Sustainable Livestock
GHG	Greenhouse Gas
GMO	Genetically Modified Organism
GRA	Global Research Alliance on Agricultural Greenhouse gases
IMNANA	Innovative Metrics and Methods for Agriculture and Nutrition actions
INRA	The French National Institute for Agricultural Research
IPCC	International Panel on Climate Change
LCA	Life Cycle Analysis
LCIRAH	Leverhulme Centre for Integrative Research on Agriculture and Health
LEAP	Livestock Environmental Assessment and Performance Partnership
LRG	Livestock Research Group
MACC	Marginal Abatement Cost Curve
MACSUR	Modelling European Agriculture with Climate Change for Food Security
NEAT	Networking to enhance the use of economics in animal health education, research and policy-making in Europe and beyond
NGO	Non-Governmental Organisation
PPRV	Peste des petits ruminants virus
RDP	Rural Development Programme
SCAR	Standing Committee on Agricultural Research
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	Sustainable Animal Production ERA-NET
SVEPM	Society for Veterinary Epidemiology and Preventative 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 a real opportunity for interested researchers to collaborate and for research funders to co-ordinate their efforts.

The Network will 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 from animalhealthnetwork@adas.co.uk.

2 SUMMARY AND OUTCOMES OF THE SECOND ANNUAL NETWORK WORKSHOP

2.1 Overview of the workshop

The second annual Network workshop was held on the 15th March 2015 at Crowne Plaza Hotel, Montpellier, France, in the margins of the Conference on Climate-Smart Agriculture (CSA) 2015 (http://csa2015.cirad.fr/). This international workshop brought together researchers in animal health, veterinary science, GHG research, social science and economics, amongst other fields. It was attended by 18 participants representing 11 countries: Colombia, France, Germany, Italy, Nepal, The Netherlands, Norway, Spain, Sri Lanka, UK, and USA (see Appendix 1 for the list of participants).

The workshop objectives were to; bring together researchers from different disciplines; discuss Network activities and objectives; share information on existing research and generate ideas for future collaborative work; discuss links between the Network and other relevant initiatives; and identify data needs and expertise required to address the issue of Animal Health and GHG emissions intensity.

The workshop was chaired by the Lead Network Co-ordinator Professor Ilias Kyriazakis (Newcastle University, UK) and discussion sessions were facilitated by Professor Alistair Stott (SRUC, UK) and Mike Roper (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 related 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), Networking to enhance the use of economics in animal health education, research and policy-making in Europe and beyond (NEAT) and the Global Agenda for Sustainable Livestock (GASL). A morning session was dedicated to presentations from these initiatives including identifying potential opportunities for collaboration. The workshop also involved dedicated discussion sessions where participants addressed the important question of what data and expertise are required to address the issue of animal health and GHG emissions intensity and progress the Network.

The workshop achieved the following outcomes:

- Update on Network activities and progress since the 2014 annual workshop
- Scientific presentations by researchers from Norway, UK and The Netherlands
- Further developed links with STAR-IDAZ, FACCE-JPI, MACSUR, NEAT and GASL and identified potential collaborative opportunities
- Identified data sources and key considerations when approaching data needs
- Identified expertise and research disciplines required for the Network
- Suggested potential work areas and funding sources for the Network.

The workshop agenda is provided in Appendix 2 and photos 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 recent activities – Professor Ilias Kyriazakis (Newcastle University, UK)

The Animal Health & GHG Emissions Intensity Network is one of 7 networks established under the LRG of the GRA. The scope of the GRA is to increase agricultural production with lower emissions, improve global cooperation in research, and work with farmers and partners to provide knowledge (further information is available at www.globalresearchalliance.org).

Network Coordinator Professor Ilias Kyriazakis provided an introduction to the Network including details on the Network Coordinators, Champions and Secretariat, and a summary of the first annual Network workshop held in the margins of the Society for Veterinary Epidemiology and Preventive Medicine (SVEPM) conference on 25th March 2014. Progress since the last meeting included:

- Promotion of the Network leading to increased membership; the Network now has 58 members from 17 countries
- The Network now has more 'Network Champions'
- The first regional Network workshop focussed on Africa; held alongside a STAR-IDAZ regional meeting in Ethiopia
- Engagement with FACCE-JPI via the exploratory workshop on animal disease and GHG mitigation, in Madrid (May 2014) and further discussions on funding opportunities

- The Network has ensured links with other organisations to avoid duplication of effort e.g. developing links with MACSUR phase 2 and GASL via presenting at respective meetings in October 2014.

Information on the Network was recently presented by Network Champion Professor Wim van der Poel (Wageningen, The Netherlands) at the GRA Mediterranean Engagement workshop in Tunisia, March 2015 which has resulted in interest in joining the Network from countries in that region.

Upcoming Network events include a dedicated Network session at the Joint British Society of Animal Science (BSAS) and Association of Veterinary Teaching and Research Work (AVTRW) meeting in the UK (April, 2015) which aims to increase Network participation by epidemiologists, a joint workshop with MACSUR on 25th June 2015, a Joint LRG Networks workshop on 26th June 2015, and a Network session at the LatinoAmerican Association of Animal Production Congress (November 2015).

Updates on the Network are provided in the UK Agri-Science & Innovation newsletter available at http://globalresearchalliance.org/country/united-kingdom/. The report of the African regional workshop can be downloaded at http://globalresearchalliance.org/updates-tags-key/animal-health-greenhouse-gas-emissions-intensity-network/.

Current Networks Champions are from the UK and the Netherlands. Researchers from other countries are invited to nominate themselves or others as Network Champions. Network membership is biased towards Europe so there is a drive to attract/increase input from other regions of the world.

2.2.2 Scientific presentations

2.2.2.1 Modelling the Impact of Controlling Endemic Cattle Diseases and Conditions on GHG Emissions (Defra project AC0120) – Professor Ilias Kyriazakis (Newcastle University, UK)

Professor Ilias Kyriazakis opened the session on scientific presentations with an overview of the Defra funded research on modelling the impact of controlling endemic cattle diseases and conditions on GHG emissions, which produced an animal health Marginal Abatement Cost Curve (MACC). The work has provided a 'proof of concept' that interventions intended to improve 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 land use change where land 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.

John Elliott (ADAS UK Ltd), who led the work, presented a paper on this research to the Agricultural Economics Society in April 2014, where a workshop on the economics of animal health in the context of GHG's took place.

2.2.2.2 Modelling the impact of diseases on GHG emissions in dairy cows – Dr Şeyda Özkan (Norwegian University of Life Sciences)

Thirty percent of emissions from animal production in Norway are associated with the dairy sector. The study presented here, which is being carried out as part of MACSUR, looks at the impact of diseases on GHG emissions in dairy cows in Norway with a focus on production losses due to diseases (which in turn would increase GHG emissions). This study uses data on animal health (e.g. heat problems, mastitis, abortion) from Bioforsk (http://www.bioforsk.no/ikbViewer/page/en/home)

project Environmilk. The initial analysis has focused on the impact of mastitis on gross margins using Herd Simulator Simherd (a commercially available web-based advisory, which offers dairy farmers the possibility to estimate the economic impact of alternative management strategies in their herds). Holos (Nor) (an excel-based calculator based on IPCC standards) was used to provide results on GHG emissions produced. The modelling showed reduction in methane emissions as a result of reduction in mastitis occurrence. Future aims are to calibrate Simherd with actual farm data which offers the opportunity to compare organic and conventional farming methods.

Comments and discussion

- Legislation in Norway means that there is a good source of data on animal health. Whilst the project currently only uses data from Environmilk, this wider data will be utilised in the future.

2.2.2.3 Quantifying the GHG mitigation effects of parasites in cattle and sheep – Dr Michael Macleod (SRUC, UK)

Network Champion Dr Michael Macleod described two research approaches (modelling and experimental) to quantifying the impact of animal health on GHGs. The presentation also discussed wider issues, including an example of policy that could be used to achieve mitigation through animal health, and mentioned the value of MACCs. MACCs provide an interface between research and policy as they communicate a complex issue in an easy to access format, and are therefore very useful to policy makers. Whilst one specific animal health MACC has been developed (see 2.2.2.1), the general MACCs don't tend to include animal health measures. Animal health measures are currently being considered for inclusion in the UK MACC for the fourth and fifth carbon budget periods (2027 and 2032).

The first research approach described was the modelling work to quantify the effects of intervening against trypanosomosis, which has been presented at previous Network meetings. Trypanosomosis is an important disease (of cattle and sheep) in Africa and other research has shown economic benefits of removing the disease. Results have shown an increase in emissions from disease removal but a bigger increase in production of meat and milk; therefore a net reduction in emissions per unit of output (i.e. emissions intensity). A link between productivity and emissions intensity was shown and there was a bigger mitigation effect in the more productive cattle systems. A follow up project is being carried out in West Africa to look at whether feed availability would act as a constraint if the disease was removed.

The second research approach described was an experimental approach to investigating disease impacts on GHGs. Carried out by Network Champion Jos Houdijk (SRUC, UK) the research aimed to assess the impact of ewe parasitism on methane intensity of lamb production. The results showed that parasitism reduced productivity (as ewes require longer feeding) and increased methane output during the production lifecycle. Parasitism also reduced feed value leading to increased methane yield per kg of dry matter intake.

The presentation then covered examples of policy that could be used to achieve mitigation via improved health, and challenges posed by current GHG targets and metrics, with the aim to inform the discussion sessions later in the workshop. Researchers need to consider what they need to do to make analysis convincing enough to influence policy (e.g. confidently predicting GHG effect of animal health) and where the best place to start to demonstrate the GHG benefits is (which location, species, systems, diseases, treatments, policies).

One potential way of getting the policy communities interested is to show ways that existing policies and funds can be used to improve animal health and GHGs. For example, through the Rural Development Programme (RDP) which aims to achieve a range of policy objectives. A European Commission (EC) project developed 25 fiches (short documents) on how climate change mitigation and adaptation could be integrated into RDPs. One fiche covered improving animal health through training events on awareness and health planning. Information provided in the fiche covered an explanation of how health could be improved, likely favourable conditions, and main cost elements. This will hopefully have helped to get animal health & GHGs on the policy radar in Europe. The project report and technical guide are available at (http://bookshop.europa.eu/en/mainstreaming-climate-change-into-rural-development-policy-post-2013-pbML0614002/).

There are also considerations regarding agricultural GHG inventory reporting. Capturing mitigation measures in GHG inventory reporting could provide more policy incentive to implement animal health mitigation. However a limitation is that emissions intensity changes are not reflected in reporting methods. Furthermore report methods don't reflect changes happening outside of a country.

The presentation also highlighted a need to consider the animal health effects of some mitigation measures.

Comments and discussion

- Expressing emissions intensity: Per unit of animal protein or milk yield is common in Europe and North America however this intensity expression can be inappropriate for systems in Africa and Asia because the milk or meat is a by-product e.g. the cattle might be kept for fertiliser or fuel purposes. In the trypanosomosis study it was acknowledged that livestock perform lots of other functions and some GHG emissions were allocated to draft. Per unit of protein is a useful measure as long as we realise it's not giving the whole picture.
- Certain mitigation measures offer large gains for farmers but they are still not implemented. Therefore we need to consider what mitigation measures can be easily taken up by farmers. Integration of what farmers do and policy is important. An emissions intensity focus is required in order to deliver progress.
- Defra now tries to include animal health mitigation in MACCs in the context of carbon budgets. Some gains from animal health are very cost effective (e.g. certain vaccination programs) whilst others are extremely costly (e.g. animal housing improvements).

2.2.2.4 New emerging infectious diseases in livestock related to climate change – Wim van der Poel (Wageningen University, The Netherlands)

Network Champion Professor Wim van der Poel presented research on the impacts of climate change on animal health; the converse of the previous scientific presentations. Increasing temperatures resulting from global warming are affecting abundance of animal species and climate change is likely to affect the transmission of viruses by vectors or introduced reservoir/host species.

Schmallenberg virus, a vector borne disease, which spread across Europe was first detected in sheep in the Netherlands in 2011. There are very reliable data in the Netherlands as farms notified malformations in new borne calves and lambs. The Netherlands has carried out a lot of research into vector diseases particularly testing culicoides (biting midges) which were transmitting the disease. Current work is looking at the effect of temperature increase and climate change on culicoides. Higher temperatures seem to be linked to increased transmission by culicoides; they seem to be penetrating higher altitudes, they have a quickening life cycle, and can cover a large distance helped by wind.

There is ongoing work to collect more information on culicoides. Akabane virus has been explained more extensively and was used in the study as Schmallenberg virus has similar characteristics.

The second example provided was on Avian Influenza H5N8 which was introduced by migratory birds. A number of wildfowl were carrying the influenza via flyways in northern Europe. Climate change effects patterns of waterfowl migration, and can potentially alter waterfowl habitats and behaviour.

Professor van de Poel coordinates the EPIZONE network and invited delegates to visit www.epizone-eu.net.

Comments and discussion

- There are few pathogens that have been eradicated as a result of climate change, most change region. We need to be aware that the zones where pathogens are endemic will change as eradication is unlikely.
- In answer to the question on whether anyone is taking GHG emissions of exotic disease incursions into account (e.g. the carbon footprint of the risk of an incursion arising), there are a number of things to consider: the risk of the incursion, the effect, what can we do to prevent incursion. EPIZONE is looking at how rapidly a disease can be detected and how quickly we can react with vaccination.
- A suggested activity of the Network was to assess the economic and carbon costs due to an epidemic resulting from climate change. This is part of the decision making process of policy makers, and affects the amount of effort and costs put into controls. Professor Ilias Kyriazakis is aware of papers on this topic and will share the details.
- PPRV infestation is very high in Asian countries. In Northern Europe PPRV is not much of a problem, so there is not much research into it. Within EPIZONE, the aim is to put diagnostics and vaccines in place. This is an important problem in Mediterranean regions and GHG emissions should be assessed. Professor van der Poel identified that he is interested in working with other countries on this topic.

2.2.3 Presentations from initiatives with which the Network is developing links

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

STAR-IDAZ is an EU funded coordination and support action that began in February 2011 and ended in January 2015. This is a global initiative to increase the coordination of research programmes at international level aimed at research funders and programme managers. The research community is brought in under the priority disease and cross cutting issue networks. There are 24 partners in 18 countries. Defra coordinate STAR-IDAZ and the European network, and regional groups/networks are coordinated by other organisations. Objectives include strengthening linkages to reduce duplication, coordinating research activities, maximising use of expertise and accelerating coordinated development of control methods (which will be a focus of activity in the next phase of STAR-IDAZ).

Activities in phase 1 have included the development of a strategic research agenda (http://www.star-idaz.net/?page_id=70), and a database of research outputs and publications (which can be searched by animal groups and diseases etc.), as well as a database of research organisations, institutes, researchers, funders, programmes and facilities. Information on facilities, capacity and expertise across Europe were collected via a survey which asked questions on current work, major challenges, major threats, and opportunities for collaboration. The outcomes of this were used to develop priorities.

STAR-IDAZ support other networks (e.g. the network on influenza research) and aims to support and maintain links with the Animal Health & GHG Emissions Intensity Network. An online login area on the STAR-IDAZ website has been allocated for use by the Network. This is a secure area for access by Network members only, including a calendar, option to create new folders and share documents, and send messages and hold discussions.

The aim of the next phase of STAR-IDAZ (a 6-year project which has not yet been approved) is to deliver 200 new and improved disease control tools (e.g. vaccines, diagnostics, therapies, immune and genome enable tools). The focus will be on supporting disease networks and ensuring that these progress via funding meetings, and performing detailed gap analysis/ literature reviews. All STAR-IDAZ partners and funders will agree to align research programmes to enable funding.

The STAR-IDAZ goal, similarly to the Animal Health & GHG Emissions Intensity Network, is 'to improve and protect animal health'. There is an opportunity that the Network could become one of the networks that STAR-IDAZ supports which would enable it to continue and potentially have work funded.

2.2.3.2 Agriculture, Food Security and Climate Change Joint Programming Initiative (FACCE-JPI) – Heather McKhann (INRA)

Heather McKhann of the FACCE-JPI Secretariat provided an overview of the initiative and potential opportunities for collaboration with the Network. There are 21 countries participating in the FACCE-JPI with the EC, SCAR and recently DG-Agri as observers. FACCE-JPI was established in 2010 and has a strategic research agenda and implementation plan. One of the exploratory actions within the implementation plan is on animal health/disease and GHG mitigation.

The co-fund instrument is the new incarnation of ERA-NETs under Horizon 2020. Most involve a single jointly funded call by EC and Member States along with additional self-funded activities such as network meetings, knowledge hubs, conferences. FACCE-JPI has been closely involved with two ERA-NET co-funds which are under development: an ERA-NET on monitoring and mitigation of agricultural and forestry GHGs (led by Ireland) and an ERA-NET on Sustainable Animal Production (SusAn) (led by Germany). The scope of the ERA-NETs are currently being developed and animal health is being taken into account but is not a main focus. FACCE-JPI is currently updating its strategic research agenda and implementation plan.

One opportunity for the Animal Health & GHG Emissions Intensity Network is with regard to the additional activities at the intersection of these two ERA-NETs. For example the Network could become a Knowledge Hub, which is a networking instrument developed by FACCE-JPI involving networking of existing research, capacity building and bringing together research communities. Other non-European countries would be welcome to cooperate e.g. the proposed Knowledge Hub could be global.

2.2.3.3 Modelling European Agriculture with Climate Change for Food Security (MACSUR) - Dr Şeyda Özkan (Norwegian University of Life Sciences, Norway)

MACSUR is a Knowledge Hub of FACCE-JPI in which 18 countries and 71 institutes are participating. There are 3 hubs; LiveM, CropM and TradeM. LiveM brings together a diverse community of modellers (e.g. in animal health/diseases, grasslands, farm-scale) with the aim to build capacity of grassland and livestock modelling and make progress through workshops and other networking activities.

Examples of delivery in Phase 1 of LiveM include model evaluation protocols, a modelling conference and contribution to the regional pilot study by animal health modellers. Phase 2 includes two tasks directly relevant to the Animal Health & GHG Emissions Intensity Network; one on impacts of climate change on animal health, disease and productivity and the other on the impacts of impaired health, disease and productivity on GHG emissions.

There are clear opportunities for links between the two initiatives including shared workshops, strengthening links between experimental researchers and modellers, co-authorship of papers, ensuring complementarity and relevance of activities, and increasing capacity to support policy. The joint workshop taking place on 25th June 2015 at the University of Reading, UK, will further progress interactions.

2.2.3.4 Networking to enhance the use of economics in animal health education, research and policy-making in Europe and beyond (NEAT) – Elizabeth Jackson (Royal Veterinary College (RVC), UK)

This was the first Network workshop at which NEAT has been represented which is excellent progress as one of the GRA objectives for the Network is to link specifically with social scientists and economists.

NEAT focusses on supporting animal health professionals to develop skills in economics. Its objectives are; 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; development of curricula, course contents, teaching and training materials for undergraduate, postgraduate and established professionals; dissemination of curricula, course contents, teaching and training materials; and evaluation of the delivery of teaching and training materials. NEAT has 6 partners from Academia, research institutes, public/government agencies plus others (such as NGOs). Achievements include a literature and reference repository (available on the website) to determine the use of economics in animal health, development of teaching material, and a survey to identify the educational needs and gaps for the use of economics in animal health.

The website (http://www.neat-network.eu) provides an excellent resource to share knowledge and Dr Jackson invited workshop delegates to become a 'NEAT friend' to receive regular blogs on their activities. Network members were also invited to write blogs and share information via this medium.

NEAT endeavours to ensure that economics work is delivered properly. More animal health economists are needed and NEAT wants to increase the number of young people moving into this area of the animal health profession.

Comments and discussion

- One main problem in using the information gathered is communicating it in different languages. Partners translate the information as an in-kind contribution e.g. Slovenia have translated a recent literature review. There is no money in NEAT for document translation.
- The veterinary curriculum is very full and economics and GHGs are examples of topics with competition for space, how can NEAT and the Animal Health Network make space for these issues? Dr Jackson responded that NEAT is looking to all animal health professionals, not just vets, and that she would like the ethos and thinking of NEAT to help 'spring clean' economics in curricula to promote that economics isn't overcomplicated and is needed to address world issues.

2.2.3.5 Global Agenda for Sustainable Livestock (GASL) – Dr Anne Mottet (FAO, Italy)

FAO is the Secretariat to GASL, which is now embracing the topic of animal health by making it part of the agenda for action and practice change.

Dr Mottet set the scene by describing three key issues concerning the livestock sector namely; livestock and equity, livestock and natural resources, and livestock and public health/animal health. In the future there will be an increased requirement for animal products with more people in cities (e.g. with increased access to refrigeration) and higher income driving up the consumption of agricultural products. Demand for products is stable in Europe and North America whilst it is expected that growth in demand will take place mainly in developing countries particularly East Asia, South East Asia, and Africa. One in four people rely (partly or entirely) on livestock which includes industry, and crop systems requiring manure, and FAO estimates that half are livestock keepers with low income. However most growth does not benefit small holders as it is taking place in large scale production units. Livestock use up significant natural resources; they take up 30% of world land area, and contribute to GHG emissions, and impact water resource, biodiversity (positive and negative) and habitat loss. Regarding livestock and health, 62% of pathogens are from animal origin, large sums of money are associated with animal health issues (e.g. 6 major zoonotic epidemics cost >$80 billion), and there are evident links between animal products and human health.

GASL started in 2010 and includes partners from international to local organisations including public sector, private sector, research, social movements, donors, international organisations and NGOs. Focus areas have been set up on closing the efficiency gap; restoring value to grasslands; and Waste to Worth. Stakeholders from the sector meet at least once a year, bringing together organisations that previously didn't communicate, to discuss a joint vision of sustainable development of the livestock sector and gain consensus on major issues. GASL achievements include a resource efficiency matrix, LEAP partnership guidelines for the industry on how to account for GHGs in livestock subsectors, and the Manure Management Knowledge Kiosk. GASL is seen as the livestock sustainability forum at global level. Post-2015 GASL will be a key implementation mechanism of the Sustainable Development Goals.

Comments and discussion

- Where would the Animal Health Network sit within GASL? Animal health would be addressed as a separate issue rather than within another group.
- What is the funding model? GASL is funded by the Swiss Government with New Zealand, Dutch and French Governments also contributing. Funds are limited to secretariat activities and organising/convening events. GASL is a platform and does not have a budget to fund projects. Partners attend meetings at their own expense and partners can agree to fund projects that are of interest.
- How are language barriers being addressed? Global meeting are held in English with simultaneous translation. Regional meetings can be held in Spanish, French or other relevant language when possible. Language is not seen as a barrier but rather representing communities. Integrating social movement and community based organisations was a big challenge in the first years of GASL. A dedicated meeting was organised with these groups during which they decided on the best mechanism for them to be represented. More organisations have yet to join the GASL but this workshop provided a good start. Workshop information (including program, presentations and main outputs) is available at http://www.livestockdialogue.org/events/events/others/civil-society-dialogue-ahmedabad-india-27-29-september-2013/en/.

- Does the agenda link livestock sustainability with crop production (particularly as most farmers in Nepal are still subsistence)? GASL has a mandate to ensure that livestock is included in other sustainability initiatives (e.g. CSA), and considers trade-offs and synergies, in particular in crop-livestock systems.
- There are links with SusAn ERA-NET.

2.3 Overview of Discussion Sessions

2.3.1 Session 1: What data are required to address the issue of animal health and GHG emissions intensity?

Professor Alistair Stott (SRUC) led this discussion session to investigate what kind of data the network needs to generate and use, where the data will come from, and how we will obtain it. Reflecting on the morning's presentations, there are numerous networks and sources of data including experimental data sources (e.g. Jos Houdijk's work at SRUC), commercial data sources (e.g. the Environmilk data being used in Norway) and modelling activities that generate data (e.g. those under MACSUR).

In summary, key considerations when addressing data requirements are:

- There are different levels of data aggregation (animal to national level) and data requirements depend on the question being investigated
- Geospatial and temporal issues need to be taken into account
- Indirect effects of a disease such as the disruption they can cause to wider economic activity or influences they may have on food markets and hence the prices farmers receive for their produce whether their livestock suffer directly from the disease or not. Such effects are often considerably greater than the direct ones but tend to get neglected for want of the data and/or modelling systems their analysis requires. Trade-offs with other goods and services need to be considered. For example, investment in animal health to improve GHG emissions intensity may divert resources from other activities which might also improve the environment and/or bring alternative benefits. As with the consideration of indirect effects of a disease, these issues demand that the systems boundary be spread wider than is usual in disease focused studies with an associated expansion in the data demands.
- An understanding of input-output relationships is required. To resolve trade-offs it is necessary to understand the relationships between the factors and products of production concerned. In principle this leads to an optimal (Pareto) point where no improvements can be made to one aspect of the system without detriment to another. Again, data and modelling requirements are greatly increased over simple comparisons between one alternative and the status quo. However, various analytical frameworks are available and have been applied in animal health economics (see for example, Rich et al., 2013). They have the advantage of providing a sound baseline from which to make meaningful comparisons between alternative interventions without the need to assume their independence (as is the case in a MACC for example).
- Knowledge exchange and consideration of how interpreted data are returned to the farmer.

Details on the topics discussed are provided hereafter.

2.3.1.1 Level of data required

The level of data required needs to be considered, as whole country data could lead to oversimplifications. The different levels to be considered are animal, herd, farm, regional and national. Improving health can reduce emissions at herd level (e.g. lower replacement, more productive animals). Upscaling from the animal to the herd level is critical.

Data requirements will vary depending on the question being investigated and this offers an alternative approach to asking 'what data do we have?' e.g. crude data may be suitable for looking at costs of a measure at a national level, whereas finer grained, more robust data would be required when developing practical measures.

2.3.1.2 Temporal and geospatial considerations

Temporal issues need to be taken into account such as considering the long-term consequential effects of a disease on the time it takes a business to recover. Epidemiological models finish when the disease has been eradicated but the economic implications continue, particularly with regard to restrictions on trade. One option, currently adopted at SRUC, is to use economic models (e.g. partial equilibrium models) and expert economists to determine how long it would take markets to recover from a perturbation within a part of the economy affected by a disease. This will vary between diseases, economies, and regions. Indirect effects have the biggest financial implication and therefore must be considered.

Inter-temporal issues are also important, such as considering how long a disease takes to work through the system and the wider context of the effects of a disease at farm level. Within a modelling framework, how do you find a benchmark in which to measure the relationship between animal disease and GHG emissions?

Regarding geospatial considerations, a potential activity for the Network would be to map the location of key diseases (endemic and exotic) and then relate that back to GHG emissions and identify where gains will be made. This would be beneficial to government policy. Additionally it would be beneficial to link epidemiology with activity data to identify where the best returns will be for different countries in terms of reducing GHG emissions.

2.3.1.3 Trade-offs

Often MACCs provide a high level view and can identify priority areas and enable identification of cost-effective actions. However, they only provide information on one impact (GHG emissions) and so need to be supplemented with information on the wider impacts of actions (e.g. in terms of animal welfare, human health or other environmental impacts). From a policy perspective, Defra is approaching this by using a MACC to identify where the big gains are (which diseases, which areas) and where progress can be made. This method is different to that used for exotic diseases which requires risk analysis into how much investment is put into managing a risk.

The group discussed the role of agricultural engineering and innovation in managing animal welfare and health. Dr Jackson asked how waste is being factored in managing herd health e.g. new technologies and innovations in bedding that can reduce emissions associated with disposal. Dr Macleod identified that one option is to benchmark against a best practice farm and see how high welfare/health animals perform compared with a normal herd. Bedding has implications for animal health regarding hygiene, and the trade-off may be a requirement for increased expenditure to purchase bedding. There are wider implications on how manure is handled and potential impact on a farm's carbon footprint.

Disease spread can be affected by stocking rate, for example, in Scotland there are large areas of low productivity land and situations in which farmers keep stock in one small area. This scenario would have different implications to a farmer that distributes their livestock across the entire farm. This topic is not well researched which is potentially due to lack of relevant data. However, it has important implications if (modelling) assumptions of even distribution of livestock in time and/or space have health/welfare significance and are not justified in practice. For example, housing and high stocking rates associated with greater intensification of agriculture may be justified in terms of economic efficiency, environment or food security, but could present unacceptable risks to animal health and welfare unless factored into a more heterogeneous model that captures these trade-offs.

Input-output relationships need to be considered e.g. the relationship between input of more straw and output of piglet mortality and sow welfare; at what point do you stop putting in extra straw as the benefit to welfare/mortality is marginal? It is important to understand this relationship to understand the right trade-off in a situation. An analogy regarding the GHG issue is; how much do you push biosecurity to get a BVD reduction? Sometimes there is a private cost compared to a significant public gain. Spotting these trade-offs is require with intervention for societal good, potentially requiring compensation to farmers.

2.3.1.4 Farmer uptake and Knowledge exchange (KE)

Farmers don't always uptake the win-win options and will not always implement the most economically beneficial scenario as other barriers may exist, such as psychological barriers. A previous study identified that peer group perceptions may be a barrier (e.g. introducing a measure may imply previous bad farming standards). We should be 'picking the low hanging fruit' (undertaking the quick easy actions) before worrying about trade-offs, and therefore find out what data policy makers need to push the farmers to deliver. The people implementing the science and taking the message to farmers are very important. There are data available but it is important to consider knowledge transfer methods to the farmers to inform better decision-making.

Knowledge exchange is key and there is an important role in how data is interpreted and communicated to the farmer. For example, the distribution of costs at farm level of many endemic diseases of livestock is skewed. Most farmers therefore experience costs of these diseases that are below the mean values often used as the basis for KE aimed at encouraging behavioural change. These figures can undermine the credibility of communicators with their farmer audience. They appear to them to be exaggerated. However, although most farmers experience costs below the mean, this is counter balanced by a few outbreaks that are extremely severe. The consequences of such extreme outbreaks for the farm business concerned can be very serious. In other words, using the data to explain the importance of animal health as a risk management tool may be more effective than using the same data in the context of average cost benefit. More broadly, effort is required in developing community action and there are lessons to be learnt from collaborative action examples in Scandinavian countries.

Knowledge exchange should also be evaluated in the context of communication. The way modelling results are communicated to the research community is different, for example, from the way they are communicated to policy makers or farmers who require less scientific information.

There is an opportunity for disease reduction through bottom-up collective action potentially mitigated by commercial veterinary practice. Farmers also need to think more collectively about the overall health of farms and groups of farmers could be marketed as more health conscious and engaging with health plans. It is likely that public money would be required at the outset.

In the next carbon budget for the UK, currently being developed by Defra, there are approximately 30 mitigation measures related to animal health. When this has been peer reviewed, Mike Roper (Defra, UK) will circulate to the Network as this could help focus attention for community action.

2.3.1.5 Data sources

Suggested potential data sources, from various countries, include Qbox, XLVets (http://www.xlvets.co.uk/) and Innovent technologies (http://itlscotland.co.uk/). Innovent technologies is collecting data on carcass composition including indices of animal health (e.g. liver condemnations for fluke). This data is then linked back to the farm and is used to benchmark performance. Other potential data sources include commercial companies (as there is a push for more open data and other actors further along the food chain e.g. slaughter housing).

Veterinary organisations would have a business interest in animal health and GHGs so inviting them to engage in the Network would probably be well received. Relevant contact are required.

There is a general lack of commercial farm data. INRA has instigated public funded data collection activities to gather sustainable informatics data and will interpret data to see what proportion of variation in sustainability metrics is due to animal health differences between farms. Commercial data would enable research into which sector is the best to target and reasons.

An information centre is being developed in the UK (via Agri-Tech funding) which aims to collect data for benchmarking to enable farmers to make improvements. The animal health/GHG axis should be included in this information centre but the mechanism for incorporation would need further consideration.

A UK project called PARABAN is collecting data from monitor farms in the UK aiming to exchange knowledge and experiences for best practice for Johnes Disease control (linking meat and milk producers, industry stakeholders, scientists and vets).

2.3.2 Session 2: What expertise are required to progress the issue of animal health and GHG emissions intensity?

Mike Roper (Defra, UK) led this discussion session to assess whether the Network is 'casting its net' wide enough and identify other research groups that need to be included in the Network. The Network addresses two central themes of animal health and GHG research that historically do not have linkages. The Networks aims to bring together researchers from these two communities and also recognises the importance of participation by social scientists.

Key messages from the session:

- The Network aims to bring together researchers in disciplines that did not previously communicate. Both animal health and GHG communities need to work together to understand each other's needs
- There are numerous disciplines relevant to the Network and whilst many are currently represented within the Network, there are others that need to be contacted and engaged
- Appropriate expertise should be brought into the Network by identifying where the Network can bring most benefit
- Both detailed scientific researchers (e.g. focussed on a specific disease) and the bigger picture (whole system approach) are required. As farmers will want a solution to fit all, the whole system approach will be key

- There is a need for an interdisciplinary approach led by researchers that brings all the information together (systems analysis and modelling)
- Data managers are required within the scope of the Network, to make data accessible to all research communities.

2.3.2.1 Research areas within the Network's remit

Table 1 shows the expertise of participants taking part in this discussion session and provides a subset of expertise present in the Network. Figure 1 shows the wide range of expertise relevant to the Network that were identified during the discussion. The Network needs to attract researchers from these disciplines. Participation of leading researchers in each discipline will be key to the progress of the Network.

Table 1: Expertise of discussion session 2 participants.

Name	Expertise
Professor Ilias Kyriazakis	Animal management
Michael Lopez Cepeda	Animal health, management and measurement of GHG emissions
Dr Johannes Bender	ERA-NET "Sustainable Animal Production" Funding
Luke Dalton	Risk analysis (communication, governance, assessment, management), foresight studies
Chandima Gajaweera	Ruminant nutrition, forage science, GHG emissions of livestock
Shiva Kumar Shrestha	Agriculturalist, sustainable agriculture
Dr Liz Jackson	Veterinary business management, farmer behaviour (qualitative and quantitative)
Dr Anne Mottet	Agronomy and livestock science, climate change and environmental LCA's, assessment and policy support
Dr Şeyda Özkan	Background in veterinary Science, modelling GHG emissions, climate variability, nutrition
Adele Hulin	Diffuse pollution from agriculture (water quality and GHG emissions), UK participation in the GRA
Dr Michael MacLeod	Agricultural GHG accounting, life cycle analysis, cost-effectiveness analysis

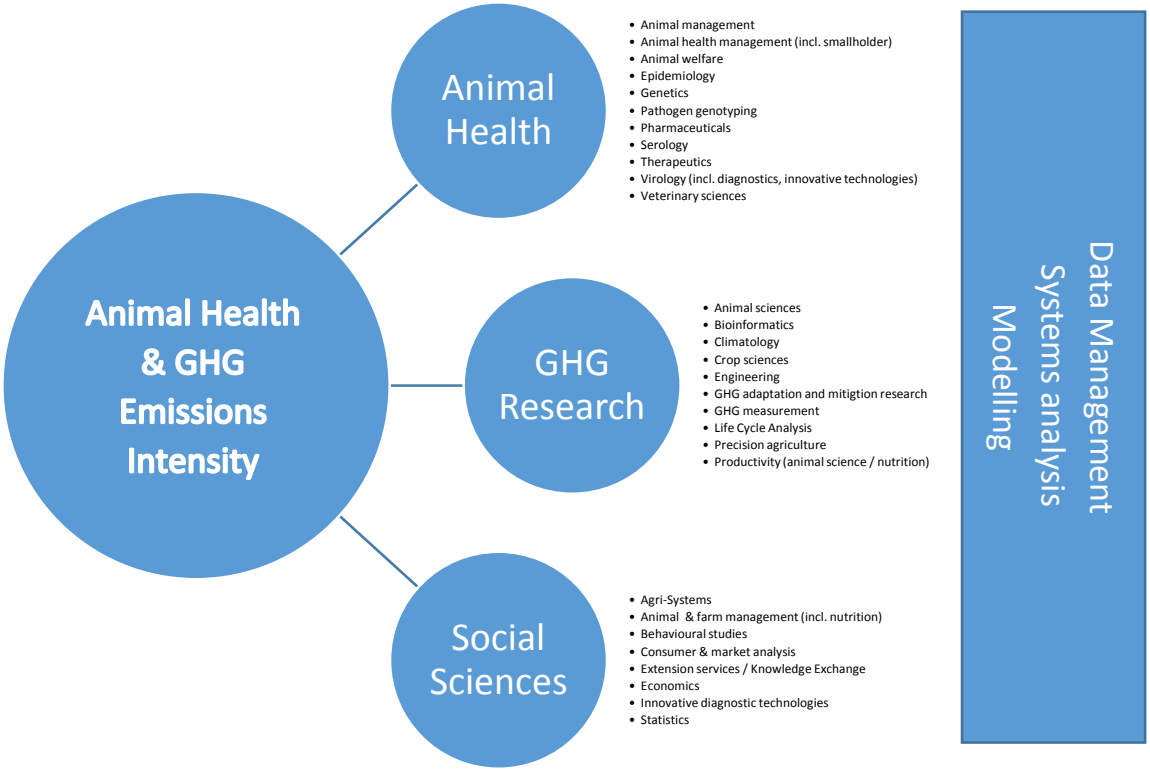


Figure 1: Research areas relevant to the Network

Further comments regarding the identified disciplines in Figure 1 are given below.

Animal health: Genetics includes animal breeding programmes specific to disease resistance. Diagnostics includes mapping genotypes of disease patterns and novel diagnostics e.g. based on animal behaviour. New innovative technologies includes technologies that assist measurement and monitoring.

GHG research (mitigation/adaptation): Crop science is needed to look at impacts on yields and feed availability. Climatology is required particularly with regard to adaptation. Engineering (such as improved bedding and housing or keeping well managed herds in a controlled environment) may be needed from a GHG mitigation perspective but the animal welfare and social perspective issues need considering. Any such activities would need to be accepted by the consumer, as would use of Genetically Modified Organisms (GMO), antibiotics etc.

Social science: Behavioural studies are needed to communicate messages to farmers and enable behaviour change. Behavioural issues should include effects of temperature, wind and precipitation on plants and animals. Economics expertise should include food chain economists and market analysts, and there is a need to consider consumer responses and acceptability of actions. Economic development is needed to improve animal health, and animal health improvements should have a positive impact on farm economics.

The Network needs to identify areas where it can provide benefit and then approach the people with the appropriate expertise.

2.3.2.2 Integration of expertise

As the animal health research area is vast, a question raised during the discussion was; do we need people who are experts in diseases or just those who deal with impacts? The answer is that we need

to draw from both the detailed scientific hypothesis testing methods and the bigger picture/systems analysis methods. There needs to be an understanding between the two different ways of thinking. Although there may initially be barriers, overcoming these would lead to effective interdisciplinary research. Both methods are needed for the animal health and GHGs topic to progress. It is advantageous that currently at FAO LCA modellers and livestock scientists are integrated.

There are many researchers addressing specific diseases, but farmers require a whole system view; farmers want solutions that address more than one of their disease challenges. Therefore researchers looking at the whole system are key (e.g. people developing the health plans) and the whole system approach may be more critical in the Network than specific disease experts. The economic paradigm also provides a bigger picture approach.

2.3.2.3 Potential to share data

Synergy between modelling diseases, and GHG monitoring & evaluation could be improved as the different research communities become aware of data held by each. However the type of data collected by the animal health and GHG communities are difficult to match. There is a requirement for these communities to work together to understand each other's needs. The challenge of upscaling field scale animal health data to regional or country level was highlighted.

Bringing together data and efficient data input methods are important to enable data mining for different purposes. For example, it was a challenge bringing together data at a national level in the UK Agricultural GHG Platform and so could be very challenging at a global level. Therefore data managers are required within the scope of the Network, to make data accessible to both communities.

Utilising data from large pharmaceutical companies that collect epidemiological and virological data could be useful to generate information on the impact of animal health on GHGs. Potentially good quality data could be obtained from this source, although it will be relevant to consider whether the data will be biased and whether the company will be happy with the outcomes from analysis of their data.

The Network should link up with AnimalChange (http://www.animalchange.eu/).

2.3.3 Funding options

A number of funding opportunities and ideas were identified at the workshop.

- The Network could become one of the disease networks funded under STAR-IDAZ phase 2.
- There is overlap with the SusAn ERA-NET and potential opportunities to influence the topics of future calls.
- FACCE-JPI Knowledge hub; the Network potentially sits within the planned SusAn and GHG ERA-NETs and could become a Knowledge Hub at the interface between the two.
- Complementary work exists between the Network and MACSUR tasks on animal health and GHG emissions. Mutual funding opportunities can be discussed e.g. Horizon 2020, Marie Curie.
- Experience with Agri-Tech strategy shows that there is a trend towards joint funding from industry and government e.g. funding specific projects to deliver a clear set of objectives which might be in response to corporate concerns but have a co-benefit of reducing GHGs. Alternative ways of thinking about gaining funding are required.
- Getting people together is an important first step to identifying research gaps, once gaps are identified there is a need for creative thinking to identify co-benefits and potential private funders, to address questions indirectly.

- Counterbalance is required as there are a lot of different disciplines. We need to identify the problem and then bring in the relevant people and funders. Researchers from a range of disciplines will be just part of the team needed to address animal health campaigns that achieve and demonstrate the range of private and public benefits available. Developments in technology will provide much of the necessary expansion in data and data analysis referred to above. For example, individual animal activity monitors that currently provide data for oestrus detection (silent herdsman) could be expanded to collect a wide range of performance data including animal health and GHG emissions. These data could be pooled with data from other sensors, then analysed and reported on by appropriate teams of people and systems to monitor and control the farm, food chain and wider regional environment to ensure sustainable development for the benefit of all concerned.
- IMNANA (Innovative Metrics and Methods for Agriculture and Nutrition actions) and LCIRAH (Leverhulme Centre for Integrative Research on Agriculture and Health). A partnership funded by DFID, whereby funding opportunities are fed in to this website. Although most deadlines have passed, the final round of funding is yet to be announced.

2.4 AOB

Benefits of the Network, particularly for researchers in less developed countries, would include sharing scientific papers. The online member's login (STAR-IDAZ) area provides a useful location for associated discussions.

All presentations are available from the Network Secretariat and will be uploaded to the Members login.

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

Actions and potential Network activities identified throughout the workshop are summarised in Appendix 4.

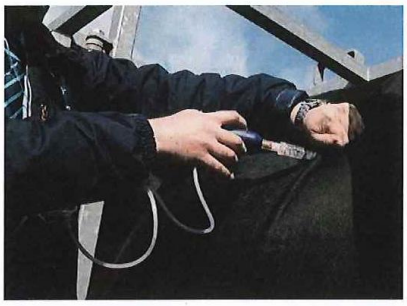
APPENDIX 1: PARTICIPANTS LIST

Research Institute	Title	Forename	Surname	Research interest/Title/Network role	Country
Federal Office for Agriculture and Food	Dr	Johannes	Bender	ERA-NET Co-fund on Sustainable Animal Production Coordinator	Germany
Defra	Mr	Luke	Dalton	STAR-IDAZ Project Manager	UK
University of Ruhuna	Mr	Chandima	Gajaweera	Lecturer – department of Animal Science, Faculty of Agriculture	Sri Lanka
ADAS UK Ltd	Ms	Adele	Hulin	Research Scientist, Network Secretariat	UK
Royal Veterinary college	Dr	Elizabeth	Jackson	Lecturer in Business	UK
Newcastle University	Prof	Ilias	Kyriazakis	Professor of Animal Health and Nutrition, Network Coordinator	UK
CORPOICA	Mr	Michael	Lopez Cepeda	Veterinarian, Professional Researcher	Colombia
SRUC	Dr	Michael	MacLeod	Researcher	UK (Scotland)
Self-Employed	Ms	Wendy Lu	McGill	Research Consultant	USA
INRA	Dr	Heather	McKhann	FACCE-JPI Secretariat	France
USC/EURAF	Dr	Maria Rosa	Mosquera Losada	Head of Crop Production Department	Spain
FAO-AGAL	Dr	Anne	Mottet	Livestock Policy Officer	Italy
Norwegian University of Life Sciences	Dr	Şeyda	Özkan	Research Scientist	Norway
Defra	Mr	Mike	Roper	Innovative and Sustainable Farming R&D Programme Manager	UK
Wageningen University	Dr	Martin	Scholten	Co-chair of GRA Livestock Research Group	The Netherlands
HELVETAS Nepal	Mr	Shiva Kumar	Shrestha	Senior Programme Officer	Nepal
SRUC	Prof	Alistair	Stott	Group Manager Future Farming Systems Research	UK (Scotland)
Wageningen University, Central Veterinary Institute	Dr	Wim	Van der Poel	Research Leader	The Netherlands

APPENDIX 2: WORKSHOP FLYER INCLUDING AGENDA

Animal Health & Greenhouse Gas Emissions Intensity Network Workshop

15th March 2015
09.30 – 16.30



The second Annual Network Workshop is being held in the margins of the **Climate-Smart Agriculture 2015 Global Science Conference** (http://csa2015.cirad.fr/) at

Crowne Plaza, Montpellier, France

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

- Bring together researchers from different disciplines;
- Discuss Network activities and objectives;
- Share information on existing research and generate ideas for future collaborative work;
- Discuss links between the Network and other relevant initiatives;
- Identify data needs and expertise required to address the issue of Animal Health and GHG emissions intensity.

Registration and further information

The workshop takes place on Sunday 15th March. It is free for you to attend but please register beforehand as spaces are limited. 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

Crowne Plaza is a 10 minute walk from Le Corum. For **venue and accommodation** information please refer to http://www.crowneplaza.com and http://csa2015.cirad.fr/information.

Registration deadline: 9th March 2015

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 information on the Network please see the report from the inaugural Network workshop which is available at http://www.globalresearchalliance.org/updates/2014/animal-health-network-dublin-workshop-report/.

Time	Agenda Item	Delegate
09.30 – 09.40	Arrive	
09.40 – 09.55	**Welcome and round table for introductions**	Ilias Kyriazakis (Network Coordinator, UK)
09.55 – 10.15	**Overview of the Network and recent activities**	Ilias Kyriazakis
10.15 – 11.45	**Scientific presentations**	
10.15 – 10.35	A modelling exercise to evaluate the impact of animal health on GHG emissions	Seyda Ozkan (Norway)
10.35 – 10.55	Quantifying the effects of removing trypanosomosis on West African cattle emissions	Michael Macleod (UK)
10.55 – 11.25	*Tea/Coffee*	
11.25 – 11.45	Emerging diseases in livestock in relation to climate change	Wim van der Poel (The Netherlands)
11.45 – 13.00	**Presentations from initiatives with which the Network is developing links**	
11.45 – 12.00	Global Network for Animal Disease Research (STAR-IDAZ)	Luke Dalton (UK)
12.00 – 12.15	Agriculture, Food Security and Climate Change Joint Programming Initiative (FACCE-JPI)	Heather McKhann (France)
12.15 – 12.30	Modelling European Agriculture with Climate Change for Food Security (MACSUR)	Seyda Ozkan
12.30 – 12.45	Networking to enhance the use of economics in animal health education, research and policy-making in Europe and beyond (NEAT)	Elizabeth Jackson (UK)
12.45 – 13.00	Global Agenda for Sustainable Livestock (GASL)	Anne Mottet (FAO, Italy)
13.00 – 14.00	*Lunch*	
14.00 – 14.45	**Discussion session 1** What data do we need to address the issue of animal health and GHG emissions intensity	Chaired by Alistair Stott (UK)
14.45 – 15.15	*Tea/Coffee*	
15.15 – 16.00	**Discussion session 2** What expertise are required to progress the issue of animal health and GHG emissions intensity	Chaired by Mike Roper (UK)
16.00 – 16.30	AOB, Summary and Close	Ilias Kyriazakis

APPENDIX 3: WORKSHOP PHOTOS

APPENDIX 4: SUMMARY OF ACTIONS AND POTENTIAL NETWORK ACTIVITIES IDENTIFIED AT THE WORKSHOP

Summary of actions identified during the workshop

1. Professor Ilias Kyriazakis to share details of papers on economic / carbon costs of epidemics.
2. Dr Anne Mottet to share the outcomes of the GASL meeting for social movement and community based organisations.
3. Mike Roper to share the peer reviewed Defra carbon budget which includes 30 mitigation measures related to animal health.
4. The Network should engage veterinary organisations who would have a business interested in animal health and GHGs. For this relevant contacts are required – Please email any leads to animalhealthnetwork@adas.co.uk.
5. The Network needs to contact and engage with research communities identified in discussion session 2 of the workshop (summarised in Figure 1) and try to make the Network attractive to the various disciplines. Participation of leading researchers in each discipline will be key to the progress of the Network.
6. Link up with AnimalChange (http://www.animalchange.eu/).
7. Network members are encouraged to write blogs and share information via NEAT and via the STAR-IDAZ shared login area (contact animalhealthnetwork@adas.co.uk for your individual login ID).
8. Egypt has recently become a member of the GRA and should be contacted to participate in this Network.
9. The animal health/GHG axis should be included in the UK Agri-Tech information centre but the mechanism for incorporation needs further consideration.

Summary of potential Network work areas/activities

1. Assess the economic and carbon costs due to an epidemic resulting from climate change. This is part of the decision making process of policy makers, and effects the amount of effort and costs put into controls.
2. Map the location of key diseases (endemic and exotic) and then relate that back to GHG emissions and identify where gains will be made.
3. Further to the above activity, link epidemiology with activity data to identify where the best returns will be for different countries in terms of reducing GHG emissions.