Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Animal Production & Health Newsletter

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To Our Readers

As 2014 draws to a close, I want to thank you all for your cooperation, loyalty and support to the Animal Production and Health Subprogramme of the Joint FAO/IAEA Division. This was indeed a difficult year, with food insecurity, food safety issues, production failures and famine, with price increases threatening the stability and sustainability of food and agriculture, and the ever increasing zoonotic disease threats. Having said this, the Joint FAO/IAEA Division and its associated programmes celebrated this year its 50th anniversary concomitant with the renovation, modernization and expansion of its laboratories. We hope the next 50 years will be even more successful.

In this newsletter, I want to discuss shortly the effects of climate variations, food security and the expansion of animal and zoonotic diseases within the sphere of what the Animal Production and Health Subprogramme can contribute. My take home message would be:

- Globalization and climate change are causing an unprecedented worldwide impact on emerging and re-emerging animal and zoonotic diseases.
- Vector borne diseases are now spreading to previously non-endemic and cooler areas.

A dramatically increased incidence in deadly infectious and zoonotic diseases in wildlife, livestock, and people may be the most immediate serious consequence of global warming, food security or food shortage.

Globalization and climate change have had a worldwide impact on emerging and re-emerging animal and zoonotic diseases. Climate change is disrupting natural ecosystems by providing more suitable environments for infectious diseases allowing disease-causing bacteria, viruses, and fungi to move into new areas

Animal Production and Health Section.

where they may harm wildlife and domestic species, as well as humans. Diseases that were previously limited only to tropical areas are now spreading to other previously cooler areas e.g. Rift Valley fever. Pathogens that were restricted by seasonal weather patterns can invade new areas and find new susceptible species as the climate warms and/or the winters get milder. There is evidence that the increasing occurrence of tropical infectious diseases in the mid latitudes is linked to either global warming or food security. Vector borne diseases are particularly affected by weather patterns and long-term climatic factors strongly influence the incidence of outbreaks. Most of these diseases are caused by insects and their population dynamics are dependent on the prevailing weather conditions, specifically temperature and humidity. Climate change influences local weather conditions and therefore has a significant impact on the presence of vectors and their geographical distribution.

Important zoonotic diseases such as avian influenza, Lyme disease and Rift Valley fever are likely to spread due to global warming. Avian influenza viruses occur naturally in wild birds, though often with no dire consequences, however, highly pathogenic strains of the disease (e.g. H5N1) is a major concern because it can affect humans. This is mainly because severe winter conditions and droughts, occasioned by climate change can disrupt the normal migration pathways of wild birds and thereby bring both wild and domestic bird populations into greater contact at remaining water sources. The role of tick vectors in diseases like babesiosis in animals and Lyme disease in humans, of mosquitoes in the transmission of viruses (Rift Valley fever, Dengue fever) and parasites (Malaria) and of midges in the spread of African horse sickness or Bluetongue are all well-known, but, the geographical distribution of these diseases is expanding as changes in climate continue. The dreadful impact of these diseases on health and the economy affects entire animal and human populations but the poorest communities are the most disadvantaged. The increased incidence in deadly infectious diseases in wildlife and livestock, and their threat (often) to people may be one of the most important immediate consequences of global warming.

The world needs to act effectively to ensure that the various procedures required preventing and controlling emerging and re-emerging diseases are fully enabled and in synergy with the continuous development, evaluation and validation of new techniques for their early, rapid, sensitive and accurate diagnosis (as first-line and as confirmation). The Animal Production and Health Section tries to keep at the forefront of developing, evaluating and validating early and rapid diagnostic techniques that are simple to use, inexpensive and can be applied in a "laboratory and extension" environment. Most of this work has been done by the application of nuclear, nuclear associated and nuclear-related technologies. Amongst these technologies are the use of $^{13/14}C$, ^{125}I, ^{3}H, ^{32}P, ^{35}S to label protein and nucleic acid molecules for specific and sensitive detection, monitoring, and characterization of harmful pathogens that have made a critical contribution towards the development of ELISA, PCR, real time PCR and sequencing platforms. The Section also ensures the deployment and widespread use of applicable technologies in countries most at risk from climatically influenced infectious diseases. This technical support and guidance to countries (which test to use, when and for what purpose, equipment needs, staff training and proficiency, and quality management) played a vital role in building developing countries' capacities during the worldwide Rinderpest eradication campaign and the recent outbreaks of avian influenza and Rift Valley fever.

The objective of this project is to strengthen animal and human disease diagnostic capacities in countries that are considered as "hot spot zones" for emerging and re-emerging transboundary infectious diseases.

Please see further details of past, present and future activities in this issue of our newsletter. Please also note that more information is presented on our website and I strongly encourage you all to visit it and to let us know of your ideas, comments, concerns or questions. We thank all those who have responded to our request to update the details of their contact and mailing addresses, and urge others to do so by informing Roswitha at R.Reiter@iaea.org or Svetlana at S.Piedra-Cordero@iaea.org.

Finally, I wish you and your families all the best in the year ahead.

Gerrit Viljoen,
Head, Animal Production and Health Section

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The Animal Production and Health Laboratory, Seibersdorf, is a collaborating Centre for ELISA and molecular technologies in animal disease diagnosis for the OIE

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50th Anniversary of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture

The occasion of the 50th anniversary of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture has again been an exceedingly productive year. In addition to our ongoing activities reported extensively in this volume, we have taken this opportunity to highlight several examples of tangible, sustainable results derived out of this unique partnership – beneficial to both our parent organizations and to our Member States – and to share these with our many stakeholders around the world and at the celebratory ceremony of this partnership.

New communication materials outlining successes in the area of nuclear techniques:

- http://www-naweb.iaea.org/nafa/resources-nafa/IAEAsuccessStories-2014.pdf
- http://www-naweb.iaea.org/nafa/resources-nafa/ProgBrochure-2014.pdf
- http://www-naweb.iaea.org/nafa/resources-nafa/LabBrochure-2014.pdf

We have also updated our website and urge you especially to check out our News section at http://www-naweb.iaea.org/nafa/news/index-ss.html.

On 29 September 2014, a ceremony was held in Seibersdorf to mark the 50th Anniversary of the Joint FAO/IAEA Division as well as the ground-breaking for the renovation of the IAEA's nuclear sciences and applications laboratories at Seibersdorf – including the FAO/IAEA Agriculture & Biotechnology Laboratories. This ceremony was honoured by the presence of the president and members of the IAEA Board of Governors, the IAEA DG and senior management, a representative of the FAO Director General, Ms Maria Helena Semedo (Deputy Director General – Coordinator of Natural Resources), and, believe it or not, all the former directors of the Joint Division since its inception in 1964. Achievement awards in mutation breeding were presented during the IAEA General Conference on 24 September 2014 by IAEA Director General Yukiya Amano. The awards were devised by the Joint FAO/IAEA Division to celebrate worldwide successes in this field and to promote the development of further sustainable crop varieties. The awards honour teams of scientists that have contributed substantively to global food security and sustainable agricultural development by using radiation to breed improved crop varieties.

The enormous contributions of the Joint FAO/IAEA Division and its numerous stakeholders worldwide to meet the changing needs of Member States through the peaceful uses of nuclear technologies are today clearly demonstrated in the shared goals of our two parent organizations and in the five strategic objectives of the FAO: to help eliminate hunger, food insecurity and malnutrition; to make agriculture, forestry and fisheries more productive and sustainable; to reduce rural poverty; to enable inclusive and efficient agricultural and food systems; and to increase the resilience of livelihood to disaster.

It is our fervent hope that, with the continued support and dedication of our numerous stakeholders worldwide, the Joint Division will also in the future be able to provide excellent examples of the enormous contributions that peaceful nuclear technology can make to sustainable agricultural development. With this in mind, it is our unequivocal pleasure to take this opportunity to thank each and every one of you for your dedicated support to the Joint Division during the past fifty years and to embrace your continued support in the decades ahead.

1DG Amano and DDG Semedo cut a 50th anniversary cake.

Background info:

Established on 1 October 1964, the FAO and IAEA created the Joint FAO/IAEA Division as a strategic partnership in order to mobilize the talents and resources of both organizations and hence to broaden cooperation between their Member States in the peaceful application of nuclear science and technology in a safe and effective manner to provide their communities with more, better and safer food and agricultural produce while sustaining natural resources.

Fifty years later, this FAO/IAEA partnership still remains unique, with its key strengths based on interagency cooperation within the United Nations family. It is a tangible joint organizational entity with a fusion of complementary mandates, common targets, a joint programme, co-funding and coordinated management. It entails close cooperation, greater efficiency and shared approaches, and geared to demand-driven and results-based services to its Members and to the international community at large.

Nuclear applications provide added value to conventional approaches in addressing a range of agricultural problems

and issues, including food safety, animal production and health, crop improvement, insect pest control and sustainable use of finite natural resources. Over the past 50 years, this partnership has brought countless successes with distinct socio-economic impact at country, regional and global levels in Member States.

During the past 50 years the mission of the Joint Division has proactively evolved to embrace the adaptation to and mitigation of climate change and the adverse effects of globalisation, to increase biodiversity and to further contribute to agricultural development and global food security. Today, both FAO and IAEA strive to mobilize commitment and concerted action towards meeting the Millennium Development Goals and the Sustainable Development Goals through appropriate use of nuclear and related technologies for sustainable agriculture and food security.

Strong synergies and benefits of this relationship include:

- Strengthened mandates of FAO and IAEA through the unique partnership;
- Facilitated cooperation and increased efficiency;
- Privileged access for Member States to invaluable knowledge;
- Institutional links with key stakeholders at local, regional and global levels;
- Platform for cooperation with other international organizations;
- Increased mobilization of resources and fund-raising capacity in food and agriculture;
- Fortified capacity for technology development and transfer to Member States through the joint laboratories.

ReNuAL

Breaking Ground on the Future Nuclear Applications Laboratories

On 29 September, IAEA Director General Yukiya Amano was joined in Seibersdorf by representatives of Member States and the Food and Agriculture Organization of the United Nations (FAO), as well as IAEA staff members, to break ground on the Renovation of the Nuclear Applications Laboratories (ReNuAL) project, and to celebrate the 50th anniversary of the FAO/IAEA Joint Division of Nuclear Techniques in Food and Agriculture. There were over 200 participants, with 48 Member States represented.

ReNuAL is an initiative to modernize the eight laboratories in Seibersdorf that belong to the IAEA's Department of Nuclear Sciences and Applications. The project calls for the construction of a new Insect Pest Control Laboratory (IPCL) to replace the existing IPCL, and a new Flexible Modular Laboratory (FML) to house three additional laboratories, by the end of 2017.

Participants join DG in the groundbreaking

DG Amano was joined for this event by IAEA Board of Governors Chair Ms Marta Ziakova, and FAO Deputy Director General and Coordinator for Natural Resources Ms Maria Helen Semedo, who each delivered remarks in support of ReNuAL and the achievements of the Joint Division.

In his remarks, DG Amano said, "Our symbolic groundbreaking today marks the start of the implementation of the ReNuAL project. I am confident that with the active support of Member States, by 2017, we will have a cluster of modern, well-equipped laboratories here in Seibersdorf that we can all be proud of."

Moving from Planning to Construction

In July, an architectural and engineering firm was contracted to develop the conceptual designs for the Insect Pest Control Laboratory and the Flexible Modular Laboratory, and to update the master plan for the Seibersdorf site. This plan will guide the development to be carried out in the frame of ReNuAL and other related initiatives on the site.

Initial rendering of the new Insect Pest Control Laboratory.

The conceptual design for the IPCL has been completed, and will be completed for the FML by the end of November. Planning for the latter is more complex as it will house multiple laboratories and is being designed to allow laboratory space to be more easily adapted to

different activities and needs, and to be modular to make any future expansion more cost effective.

Renovation of the Nuclear Applications Laboratories

The IPCL will house laboratory sub-groups dealing with plant pests, livestock pests, human disease vectors and genetics/microbiology. The FML is designed to house laboratories with similar activities to maximize synergies, for example, through the sharing of equipment and certain types of laboratory space. For this reason, the FML will house the Food and Environmental Protection Laboratory, the Soil, Water Management and Crop Nutrition Laboratory, and the Terrestrial Environment Laboratory.

Initial rendering of the new Flexible Modular Laboratory (FML).

The purpose of the conceptual designs is to provide the basic layout and structure of the new buildings, and in doing so to provide a greater degree of certainty regarding the costs of construction.

Upon completion of the conceptual designs, the detailed designs will be developed. These will build further on the conceptual designs and add greater detail by making more concrete decisions on smaller elements of the two buildings, such as the number, size and type of windows, and the number and type of light fixtures to be used.

With these designs and cost estimates, a tender for construction can then be issued, and it is estimated that construction will begin sometime in mid-2015.

Building Momentum in Resource Mobilization

As was reported to the 59th General Conference in September, ReNuAL has so far raised approximately €860 000 in cash and funding for cost-free experts. These funds and experts have been used to support the initial planning for the project and are now supporting the design work that is being carried out.

Also during the General Conference, China announced the in-kind donation of an irradiator that can potentially serve the needs of several laboratories: the Animal Production and Health Laboratory, the Insect Pest Control Laboratory and the Plant Breeding and Genetics Laboratory.

In the resolution related to ReNuAL that was passed by the General Conference, Member States expressed strong support for the project and requested its further development and implementation. Included in this was a specific request for the Secretariat to prepare thematic packages that would separate the various elements of the project into somewhat smaller components that would enable Member States to support specific programmatic areas according to their own interests and priorities.

The Secretariat will develop these packages once more detailed cost information from the conceptual designs of the Insect Pest Control Laboratory and Flexible Modular Laboratory is fully available.

Seeking Biosafety Level 3 Laboratory Capabilities

A number of Member States have expressed support for the establishment by the Agency of biosafety level 3 capabilities that would enable the Animal Production and Health Laboratory to respond to emerging challenges related to transboundary animal diseases. These capabilities are one of the group of project elements now defined as ReNuAL Plus (ReNuAL+), which was introduced by DG Amano in September to ensure that needs additional to those identified under ReNuAL can be addressed – provided the necessary extrabudgetary resources are available.

The process for licensing and constructing such a facility is complex and can take three to five years. For this reason, the Secretariat has been reviewing various options for obtaining biosafety level 3 capabilities. These include their establishment in Seibersdorf, or possibly at a facility in Mödling belonging to the Austrian Agency for Health and Food Safety (AGES in German). This facility already has biosafety level 3 capabilities and the associated infrastructure that is required, and therefore can potentially support the capabilities sought by the Agency.

The IAEA, the Government of Austria and senior AGES staff are in consultations to review the options available for the establishment of these capabilities. These consultations will continue in the coming months. Provided a mutually agreeable solution can be identified, the estimated resource requirements for obtaining the capabilities required by the IAEA will be determined and communicated to Member States.

AGES facility in Mödling

Forthcoming Events

Regional training course on Isotope and Geochemical Applications in Flood Risk Mitigation (RAS/5/069)

Technical Officers: Ivancho Naletoski, Gerrit Viljoen

The training course will take place from 12 to 16 January 2015 in Thailand. The purpose of the training course is to provide basic knowledge of isotope hydrology techniques and their applications along with geochemical and hydrogeological techniques for understanding surface water and groundwater interactions, groundwater dynamics/dating, and investigations for water resources assessment and management in flood plains and flood risk mitigation. It is expected that trained personnel from participating Member States will be able to apply isotope and geochemical techniques in water resources assessment and management in flood plains and flood risk mitigation.

National training course on Artificial Insemination in Small Ruminants (BKF/5/014)

Technical Officer: Mohammed Shamsuddin

The training course will be held from 26 January to 6 February 2015 in Ouagadougou, Burkina Faso.

The training shall accomplish the following objectives: a clear understanding of the science of male and female reproductive physiology and the practices of artificial insemination (AI) in small ruminants; develop working skills in participants on collection, evaluation and preservation of semen and practice of AI in small ruminants; application of AI for breed development in sheep and goats.

Twenty local participants are expected to participate at this course. The training will be carried out by Mr Naceur Slimane, Tunisia.

National training course on Serological and Molecular Techniques for the Diagnosis of Transbounday Animal Diseases (ERI/5/009)

Technical Officer: Mohammed Shamsuddin

The training course will take place in Eritrea from 10 to 20 February 2015. The purpose of the training course is to improve skills on modern techniques used for transboundary animal disease diagnosis in a team of scientists/researchers of National Animal and Plant Health Laboratory in Asmara. Twenty local participants are expected to attend the training lead by Mr Georg Mair from the Veterinary University of Vienna.

Consultants meeting on Application of Nuclear and Genetic Tools for Animal Selection to Improve Productivity

Technical Officer: Mohammed Shamsuddin

The consultants meeting planned to take place from 9 to 13 March 2015.

The purpose of the consultants meeting is to discuss the applications of genomics in farm animal species, the impact that molecular technology can have on genetic improvement of livestock, and the genetic diversity in local cattle, sheep and goat breeds. It is expected that the results of the meeting will be the basis for the implementation of a new Coordinated Research Project in the near future.

Lack of quality breeding males from local breeds to implement genetic improvement programs is a major limitation for increasing productivity in small holder systems. The fundamental reason is the absence of infrastructural facilities for performance recording and lack of efficient progeny testing schemes to meet the demands for genetically superior breeding bulls. Genomic selection is a promising tool to identify genetically superior animals based on genomic breeding values estimated from a reference population. This approach is also more advantageous as it reduces the generation interval and results in faster genetic gain per annum. Radiation hybrid mapping based genomic selection is a promising alternative tool to identify genetically superior animals, utilizing genomic breeding values estimated from a reference population. Additionally, DNA based technologies for early pregnancy diagnosis will help improve breeding efficiency in females and speed-up dissemination of genetically selected advantageous traits.

Development of a Plan for a Vaccination Trial for Brucellosis Using Irradiated Rev-1 Vaccine in Sheep and Goats (SUD/5/036)

Technical Officer: Ivancho Naletoski

The expert mission will take place from 16 to 20 March 2015 at JOVAC, Jordan.

Vaccination with live attenuated vaccines against brucellosis, induce significant T-cell response, thus

causing solid and durable protection of the vaccinated animals. However, there are still two major concerns in vaccination campaigns: 1) the interference of the serological response after vaccination, which omits the discrimination of vaccinated from naturally infected animals and 2) the public health concerns, because the vaccines can, to some extent be virulent for humans.

Recent scientific evidence has shown that gamma rays, adjusted to specific doses, can damage the brucella in a way to disable their capacity to multiply, by simultaneous maintenance of their metabolic activity. In such status, the bacteria can mimic the actual host cell infection of the live bacteria and induce a T-cell response, whereas the public health concerns will be significantly reduced or lost. Additionally, it has been shown that the use of protective substances during the process of irradiation of the live vaccine strains may significantly improve the thermo-stability of the vaccines and extend the shelf-life of the products in tropical conditions. Therefore, the use of metabolically active but non-replicating Rev-1 strain, produced using gamma irradiation may offer an alternative to the conventional vaccination approaches and improve the overall performance of the vaccination campaigns.

Brucellosis is a disease of significant animal and public health concern in Sudan. Moreover, it affects the country economy in a way that a substantial portion of the animals grown for export are returned to the country due to the presence of the disease.

The technical cooperation project SUD/5/036 aims to upgrade the capacity of the Veterinary Research Institute (VRI) in Khartoum, Sudan, in the advanced serological and molecular tools for detection of infectious diseases of animals, as well the vaccine production facility within the VRI.

Upon request of the counterparts, the APHS under the technical cooperation project SUD/5/036 has initiated a planning meeting for a vaccine trial using the irradiated Rev-1 strain. For this purpose, one expert mission from Purdue University, College of Veterinary Medicine, West Lafayette USA has been initiated, as well as two scientific visits of the counterparts from VRI. The meeting will be held at the vaccine production facilities of JOVAC (Jordan) who is expected to produce the irradiated vaccine strains. The trial will be performed at VRI under supervision of an international expert.

Technical meeting with Directors of Veterinary Laboratories Participating in the Project to Strengthen Snimal Disease Diagnostic Capacities in Selected Asian Countries supported by PUI

Technical Officers: Gerrit Viljoen, Charles Lamien

The first coordination meeting will take place from 23 to 25 March 2015 in Vienna, Austria.

Since 2011, the IAEA has been receiving support from the USA, South Africa and Japan to strengthen animal disease diagnostic capacities in selected Sub-Saharan African countries. In 2014, the PUI support by US and Japan was extended to selected Asian countries, namely: Bangladesh, Mongolia, Myanmar, Nepal, Lao People's Democratic Republic and Pakistan. This support will be provided through regional laboratory networks supported by the FAO and the IAEA, a strategy which proved highly efficient during the global rinderpest eradication campaign. During this first coordination meeting, veterinary laboratory directors of targeted Asian laboratories will meet to discuss their work plan, activities of common interest and define the priority diseases to target.

Technical meeting with Directors of Veterinary Laboratories Participating in the Project to Strengthen Animal Disease Diagnostic capacities in selected sub-Saharan Countries Supported by ARF and PUI

Technical Officers: Gerrit Viljoen, Charles Lamien

The second coordination meeting will take place from 16 to 18 June 2015 at the VIC, Vienna, Austria.

The objective of this second coordination meeting for African veterinary laboratories supported by IAEA through the South African Renaissance Fund (ARF) and the USA and Japan supported-PUI projects is to discuss results of the 2014 activities, draw lessons learned from past experiences and advise on future plans.

Past Events

Research coordination meeting on the Use of Diagnostic and Control Technologies to Control African Swine Fever

Technical Officer: Hermann Unger

The first research coordination meeting of the new coordinated research project in support of the early and rapid diagnosis and control of African swine fever (ASF) was held from 7 to 11 July 2014 in Vienna, Austria.

The purpose of the meeting was to present different approaches of the selected research contract holders and discuss the technical inputs with the research agreement holders for an optimal performance. The main topics addressed: improved diagnostics and their development and validation; collection of field isolates and the whole genome sequencing of important strains; implementation of sanitary measures to control ASF in outbreak situations.

Participants from six African and five European countries and China took part in this meeting to hear the different problems faced with the disease and the approaches taken for counteraction. There are clearly two different scenarios where in the African context wild boars and ticks play a part in maintaining endemicity while in Europe, trade with contaminated pork and their products play a major role. Such, in the absence of a vaccine, different approaches to curb transmission will apply. As any infected animal can be regarded as a potential shedder, their elimination is crucial. As the detection of ASF diseased animals is not generally a problem, it might become a challenge in non-infected areas as the serology might be inhibited by an antigen-antibody complex build up. The first task in the CRP is to evaluate this potential risk utilizing commercially available tests. As a next challenge, the most suitable molecular detection system should be evaluated to make disease identification more cost-effective and widely available. Other scopes in the context of this CRP are collection and isolation of new ASF viruses and their sequencing; epidemiological studies on the prevalence of ASF in the MS; experimental immunisation trials with focus on the African pig species; development of a panel of cellular immune markers to evaluate the success of a vaccine.

The project will run for five years and during the course it will be possible for institutions, working actively on ASF and being involved in control initiatives, to apply for ‘membership’.

Regional training course on Genetic Characterization of Indigenous Livestock Breeds Using DNA Markers (RAS/5/063)

Technical Officers: M. Garcia Podesta, K. Periasamy

The training course was conducted from 11 to 22 August 2014 at the Seibersdorf Laboratories, Austria, as part of the regional technical cooperation project (RAS/5/063) on ‘Improving the reproductive and productive performance of local small ruminants by implementing reliable artificial insemination programmes.

The aim of the course was to enhance knowledge and capacity building of participants on breed survey and monitoring, animal identification, DNA marker techniques and genomic tools for characterization and improvement of indigenous livestock breeds. The course consisted of lectures and practical training on the following topics:

a) Role of livestock biodiversity in ensuring sustainable livestock production and global food security;

b) Breed survey, sampling methods, biometry, production environment descriptors and phenotypic characterization of indigenous livestock;

c) DNA marker tools and recent advances in characterization of farm animal genetic diversity; d) Automated genotyping of nuclear DNA markers for genetic characterization of livestock;

e) Competitive allele specific polymerase chain reaction for genotyping single nucleotide polymorphic markers;

f) Advanced technologies for sequencing livestock genomes;

g) Application of high throughput single nucleotide polymorphism (SNP) genotyping methodologies in animal breeding; and

h) Analysis of genotype and sequence data to evaluate genetic variability in livestock.

The course was attended by 14 participants from Iraq, Oman, Jordan, Syrian Arab Republic, and Yemen. The Course Director, Mr K. Periasamy (IAEA), Dr A. Sharma (National Bureau of Animal Genetic Resources, India), Dr P. Burger (University of Veterinary Medicine, Vienna, Austria), Dr R. Negrini (Universita Cattolica del Sacro Cuore, Italy), and IAEA staff R. Pichler, R. Kangethe, S.T. Bharani, C. Lamien, J. Achenbach, A. Wade, and Yu Daojin lectured and conducted the laboratory work.

Training course on the Diagnosis of Transboundary Animal Disease: Pathogen Typing Using Molecular Techniques

Technical Officers: Adama Diallo, Charles Lamien

This training took take place from 25 August to 5 September 2014 at the National Veterinary Institute, Debre Zeit, Ethiopia.

The purpose of this training was to provide practical knowledge on different techniques used for virus typing and subtyping and general knowledge on the epidemiology and control strategies for peste des petits ruminants (PPR), capripox disease (CaP), Newcastle disease (ND) and highly pathogenic avian influenza (HPAI).

The first week was dedicated to capripox virus (CaPV) and peste des petits ruminants virus (PPRV) detection and consisted of lectures and practicals based on the principles of the different techniques used for virus typing and subtyping and also on general knowledge of the epidemiology and control strategies. Additionally, participants were taught the relevant bioinformatics methods to type PPRV and CaPVs based on the nucleic acid data information.

The second week of this training course covered methodologies used for subtyping and pathotyping avian influenza virus (AIV) and Newcastle disease virus (NDV) and their control strategies.

The theoretical and practical trainings were delivered by lecturers from the Friedrich-Loeffler-Institut (FLI) (Germany), AU-PANVAC and National Veterinary Institute (NVI) (Ethiopia), and a technical officer of the Animal Production and Health Subprogramme.

Twenty veterinary diagnostic laboratory scientists from 14 Sub-Saharan African countries (Botswana, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Democratic Republic of Congo, Ethiopia, Kenya, Mali, Mozambique, Namibia, Senegal, United Republic of Tanzania and Zambia), participated in the training.

Regional (AFRA) training course on Livestock Data Collection and Analysis for Breeding Improvement (RAF/5/068)

Technical Officer: Hermann Unger

The training course took place from 1 to 5 September 2014 in Sidi Thabet, Tunisia.

Sixteen participants from nine member countries gathered at the Veterinary University, Sidi Thabet, for this training course. The lecturers, Dr N. Slimane and Dr Mollel recapitulated breeding physiology and artificial insemination before starting with pregnancy diagnosis via ultrasound and RIA progesterone testing. A good discussion followed on national breeding policies for cattle development, considering climate factors, production goals and AI service inputs and requirements to achieve long term results. In order to get feedback for important issues hampering breeding policies in Africa, a questionnaire was handed out for gap analysis. Unisono, the lack of breeding data and tools to collect and analyse them was seen as the major drawback in establishing proper herd book management.

Training course on the Diagnosis of Transboundary Animal Diseases: Practical Approaches for Introducing New Assays for Routine Use in Veterinary Diagnostics Laboratories

Technical Officer: Charles Lamien

The training was held from 15 to 26 September 2014 at Seibersdorf Laboratories, Austria.

The purpose of this course was to reinforce the participant's knowledge on the set up and routine use of molecular assays for the early detection of transboundary animal diseases (TADs). More specifically, practical steps in introducing new assays for routine use in a laboratory were demonstrated.

The introduction of a new test is usually based on the customer end-user need, demand for improving existing assays, or addressing new needs. Additionally, this can be done as part of a contingency preparation plan within a country under the threat of specific TADs.

During the first week, the main steps involved in the introduction of new assays in veterinary diagnostic laboratories were taught. The participants received theoretical and practical training on:

- the collection of information of disease progression in order to identify the main threat (OIE, WHO, Promed) for which an assay needs to be in place;
- the screening of web resources to collect information on disease detection methods;
- the adaptation of research protocols for use at the bench;
- real time nucleic acid amplification assay design and evaluation;
- nucleic acid multiplex amplification and genotyping techniques.

To routinely use assay protocols in a quality ensured manner; scientists must undertake several steps including the validation and use of quality controls and maintain a consistent performance of the assay.

For the second week, the trainees received theoretical and practical training for a sustainable implementation of molecular assays for routine use. This included the use of PCR controls, PCR assay validation, verification and performance monitoring.

The theoretical and practical trainings were delivered by experts from the World Organization for Animal Health (OIE) (Paris, France), FAO (Rome, Italy), CODA/CERVA (Brussels, Belgium), and the Animal Production and Health Subprogramme.

Fifteen veterinary diagnostic laboratory scientists from 14 sub-Saharan African countries (Botswana, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Democratic Republic of the Congo, Ethiopia, Kenya, Mali, Mozambique, Namibia, Senegal, United Republic of Tanzania and Zambia) participated in the training.

The acquired knowledge will allow the participants to make a significant contribution to their local and regional TADs control programs.

Workshop for TAD Vaccine Selection Criteria and technologies Markers (RAS/5/060)

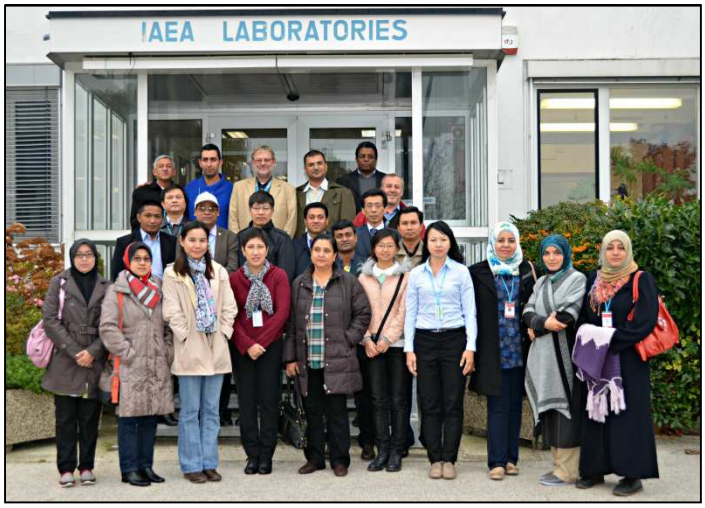
Technical Officer: Hermann Unger

The training course took place from 28 to 31 October at Seibersdorf Laboratories, Austria.

This workshop aimed at presenting and discussing procedures for typing foot and mouth disease and influenza viruses and how to select the best protecting vaccines. Dr Timm Harder (Friedrich Loeffler Institute, Germany) went through the history of flu viruses and their genetic development/mutations as well as their adaptation to different hosts. This was followed by depicting the diagnostic algorithm for identification of an influenza virus by its 'classical pathway', virus isolation in eggs, typing by antisera and pathotyping by experimental animal studies. The molecular pathway analysis is much quicker, but might lack information on the pathogenicity, as sequencing of the cleavage site is only a surrogate parameter. Flu vaccinology is always a battle to induce a broad immunity and not creating escape mutants due to a very good matching. The most used current technique for vaccine selection, the hemagglutination inhibition assay, was later practiced by the participants.

FMD control was presented by Dr Tekleghiorghis (Central Veterinary Laboratory, Eritrea) who had just finished his PhD on FMD typing and vaccine matching. After a review on FMD virology and serology the different approaches to type match vaccines were discussed, it became evident that whatever method was used, the need of highly specific reagents (antibodies) was crucial and that despite the current molecular approaches, perfect typing is still not possible. A new type O specific c-ELISA kit holds promise to do rapid typing (if the other serotype kits are released). For vaccine matching, a regional approach is more likely to bring a solution, requiring MS to produce antisera against the vaccines and exchange them together with the corresponding virus information.

The workshop was very well appreciated by the 25 participants from Asia and the Arab peninsula.



Participants and lecturers of the training course.

IMED

Technical Officer: William Dundon

The conference took place from 31 October to 3 November 2014 at Hotel Hilton, Vienna, Austria.

For the 5th year the International Society for Infectious disease organized the IMED meeting in Vienna, Austria. Over 700 participants from more than 100 countries participated in the 4 day meeting. They included scientists, clinicians and policy makers who came together to present new knowledge and discuss how to detect, discover, understand, prevent and respond to outbreaks of emerging pathogens. Given the current situation in Western Africa, the Ebola outbreak was given special attention with many presentations describing the challenges associated with combating this devastating disease. There were several moving accounts from individuals with first-hand experience treating patients and/or diagnosing disease in Liberia, Sierra Leone and Guinea. Other zoonotic diseases like MERs-CoV, influenza and rabies were discussed in detail. The situation of West Nile fever in the European Union was given a full session as were Emerging Viral Threats and Surveillance and Modelling of Emerging Infectious Diseases.

On 2 November a session dedicated to FAO was organized and colleagues from FAO Headquaters in Rome gave talks

on the Progressive Control Pathway (PCP) for Transboundary Disease, Global Animal Disease Surveillance and Health Information Tools, Good Emergency Management Practice (GEMP) and Tools Supporting Laboratory Capacities and Information Sharing. The Technical Officer gave a talk entitled Research Tools Supporting Livestock Development and Food Security; Peste des Petits Ruminants as a Working Example. The talk presented the current status of research based efforts within the Joint FAO/IAEA Division and discussed (1) the development of novel serological diagnostic tools for the identification of PPRV (2) cell lines for the improved isolation of PPRV from diagnostic samples (3) multiplex assays for the detection of respiratory disease in small ruminants including PPRV (4) full genome sequencing by standard and NGS techniques and (5) the monitoring of PPRV circulation within MS through molecular epidemiological approaches.

Task Force meeting of the Technical Cooperation Project RAS5/069

Technical Officer: Ivancho Naletoski

The meeting was held from 11 to 14 November 2014 at the VIC, Vienna Austria.

The task-force meeting on the development of guidance on nuclear techniques for flood mitigation was organized under the umbrella of the Technical Cooperation Project RAS/5/069: Complementing Conventional Approaches with Nuclear Techniques towards Flood Risk Mitigation and Post-Flood Rehabilitation Efforts in Asia. Six international experts from China, India, New Zealand, Pakistan, USA and Viet Nam were invited to support the discussions on the four involved sectors of agriculture (soil and water management, plant breeding and animal production).

The guidelines were developed to support Member States in understanding the multi sectorial approaches in mitigating the impacts of floods on animal and plant breeding and the environment, as well as to be able to facilitate solutions by national and regional stakeholders in MS in order to: i) characterize the inter dependencies of soil and water conditions and agriculture systems during the pre-flooding period in order to identify areas and systems at risk of flooding and develop post flood response strategies, and ii) quantify how floods affected the distribution of water, soil, animal and plant agriculture during the post-flood period, and continuously improve upon local area knowledge of flood mitigation.

The recommended strategic goals for the pre-flooding, design and development phase were to: i) identify and bring together stakeholders, ii) map areas, soil, water and agriculture production systems at risk and iii) to develop strategies for pre-flood mitigation, response and recovery.

For the post flood implementation phase, the recommended strategic goals were: i) to quantify the changes of the soil-water redistribution and quality, resulting from a flooding event and ii) to adapt agricultural land and animal management practices to the changes in soil-water redistribution and quality.

The experts have recommended that nuclear and nuclear related techniques are available to characterize the surface-subsurface water components, identify water flow paths in agricultural watershed, characterize soil and pollutant movements caused by floods, diagnose animal diseases, assess feed and food quality, ensure public health and food safety, support the animal reproduction and to accelerate the development of flood tolerant crop varieties.

Experts developing guidelines during the RAS/5/069 task force-meeting at the IAEA Headquarters in Vienna.

Additionally, they concluded that the nuclear and nuclear related technologies have advantages over other techniques by being able to: i) develop integrated approaches in managing water, soil, crops and livestock, ii) complement conventional techniques in understanding soil-water-crops-animal systems, iii) be applied cost effectively to large areas and large populations of livestock and are unique tools to fingerprint water, soil and pollutants.

Training course on Application of Immunoassay Techniques for Reproductive Hormone Analyses in Ruminants (THA/5/053)

Technical Officer: Mohammed Shamsuddin

The national training course was held from 11 to 20 November 2014 at the Bureau of Biotechnology in Livestock Production (BBLP) of the Department of Livestock Development (DLD), Thailand.

The objectives of the training course were to provide (a) knowledge on the oestrous cycle in cattle and buffaloes, its hormonal regulation, and applications of

progesterone measurement for monitoring reproduction, early diagnosis of non-pregnancy and improvement of AI services; and (b) hands-on practical training on RIA and ELISA techniques to measure progesterone in milk and serum.

Hands-on training.

The lectures and discussions focused on relevant aspects of reproductive physiology in cattle and buffaloes, applications of hormone assays, field sample collection, processing and storage, theory and validation of immunoassays, interpretation of assay results, safety and handling of radioactive materials, radiation protection, and waste disposal. The practical training included preparation of standards in milk and serum, conduct of ELISA and RIA for milk and serum using the solid-phase technique, and data processing by manual and computer-based methods.

Training course participants and attendees.

The participants were laboratory technicians, researchers, veterinarians and animal scientists from the BBLP and a regional centre of the DLD in Thailand. The Course Director was Mr Nussara Vadhanakul of the BBLP, and the resource persons were Mr Oswin Perera from Sri Lanka and Mr Totti Tjiptosumirat from Indonesia.

National training course on Operation and Utilization of NIRS for Feed Analysis (ERI/5/009)

Technical Officer: Mohammed Shamsuddin

The training course was held from 1 to 5 December 2014 in Asmara Eritrea.

The objective or the course was to develop skills in scientists and researchers on the operation and use of NIRS machine for feed analysis.

Ten local participants attended this course and were trained by Mr Bernard Lecler, Belgium.

Second Workshop under the FP7 Project 'Linking Epidemiology and Laboratory Research on Transboundary Animal Diseases and Zoonoses – LinkTads'

Technical Officer: Ivancho Naletoski

The workshop was held on 17 October 2014 in Shanghai, China.

The LinkTads project was approved for financing by the FP7 Programme of the EU Commission during 2014 and is coordinated by the FAO Headquarters in Rome. The overall objectives of the project are to facilitate the exchange of knowledge, the collaboration and the joint development between EU and Chinese animal health institutions in order to ensure better global animal health, improve rural livelihoods and ensure access to animal protein to the population.

The specific objectives of LinkTADs include following activities: i) to identify the priority areas, where joint actions are needed, ii) to link the research carried out by the European and the Chinese research programmes, iii) to ensure a wide-range networking of scientific communities and stakeholders, iv) to provide a long term vision and achieve coordinated planning on future common research, v) to contribute to the international policies of the EU, vi) to improve the research capacity of organizations by supporting young researchers through exchange programmes and training and vii) share the results and methodologies within and outside the consortium.

In order to integrate the different activity areas, the project is divided in 8 working packages (WPs) and includes: 1) Management and coordination, 2) Analysis of animal health and food security research, 3) Animal Health Science (Epidemiology), 4) Animal Health Science

(Laboratories), 5) Supporting policy dialogue, 6) Platform development, 7) Exchanges and capacity building and 8) Dissemination and sustainability).

The Animal Production and Health Section of the Joint FAO/IAEA Division is the coordinating the WP 4 together with the Harbin Veterinary Research Institute of the Chinese Academy of Agriculture Sciences.

The second Workshop under the WP 4 of LinkTads, aimed on Vaccine and Diagnostic Technology Development on Transboundary Animal Diseases and Zoonoses, was held in Shanghai on October 17, 2014. Forty five participants, including scientists, experts and students from 19 institutions from China and Europe attended the workshop. Eighteen delegates have presented their research progress, covering the following diseases: i) Transboundary animal diseases (TADs), ii) African swine fever (ASF), iii) pseudorabies, iv) porcine reproductive and respiratory syndrome (PRRS), v) blue tongue disease and other vector-borne diseases, as well as zoonoses, such as rabies, Japanese encephalitis, brucellosis and tuberculosis.

Among others, four experts, not members of the LinkTads consortium, were invited and presented lectures on the above mentioned topics: Dr Linda Dixon from the BBSRC-Pirbright Institute, United Kingdom, Dr José Manuel Sanchez-Vizcaino from Facultad de Veterinaria, Universidad Complutense de Madrid, Spain, Dr Jose Maria Blasco from the Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA), Zaragoza, Spain and Dr Alessio Lorusso from the Istituto Zooprofilattico Sperimentale dell' Abruzzo e Molise, Teramo, Italy.

Stories

El Salvador developed improved feeding and cooling techniques that enhance productivity and welfare of dairy cows

El Salvador is on the Pacific coast of Central America. The country has a tropical climate with two distinct seasons, rainy and dry, six months each. A once traditional extensive cattle rearing community has recently turned to a dairy industry, which has been evolving as an important agricultural activity in the country. A vibrant private sector has been growing rapidly with medium to large-scale investments made in the industry. Dairy cattle are mostly Holstein and are fed on napier grass (Pennisetum purpureum) or sorghum. Additional energy and protein requirements of the cattle are met with the supplementation of maize and soybean meal. But these practices are expensive, thus increase milk production cost and decrease farmers' profit margins.

The International Atomic Energy Agency (IAEA) has been supporting the Faculty of Agriculture at the Universidad de El Salvador (UES) through the Technical Cooperation (TC) programme, which has helped UES develop a skilled research team. The team has developed technologies that have demonstrated clear benefits on the dairy productivity and on the environment.

Jack bean (Canavalia ensiformis) and vigna (Vigna sinensis) are two leguminous forages being evaluated and promoted by the IAEA TC project team. These forages yield up to 5.9 tons dry matter (DM) per hectare with 20% crude protein. Leguminous forages require less chemical fertilizers than do sorghums and thus reduce forage production cost by 50% and help protect nature.

Canavalia and Vigna forages increased the protein content of the formulated diet when mixed with sorghum either fresh or as silage. The addition of 2.4 kg (DM) legumes in cows' diet increased their milk production from 19 to 22 kg per cow per day. Additionally, feeding cost decreased and farmers profit margin increased compared with cattle fed with sorghum forage and concentrates. In separate field trials, the addition of legumes in cattle feed not only sustained higher milk production but also demonstrated increased feed digestibility and reduced faeces volume and nitrogen excretion into nature.

A low cost cooling system involving coconut leaves shades, water mist and fanning has been developed for cows. The technology is being adopted by dairy farmers. The cooling system provides better comfort to cows which results in increased DM intake and digestibility and higher milk yield as compared with production in conventional farms.

These technologies are now taken to private farmers, cooperatives and smallholders to promote good practices for cultivation of leguminous forage for feeding dairy cows. This system based on legumes not only economically benefits dairy farmers but also help to a better crop rotation, less use of chemical fertilizers due to nitrogen fixation by legumes to soil, and contributes to more sustainable production systems.

Scientists and researchers of Universidad de El Salvador conducted demonstration projects in five private and cooperative dairy farms, and has optimised the production system of leguminous forages. These activities led to further cooperation between the UES and farmers to positively change cattle feeding strategies that improve production, increase profit, support food security and protect the environment in El Salvador.

Eritrean veterinarian graduate under an IAEA PhD programme

Managing veterinary affairs, field services or diagnostic laboratories requires a wealth of knowledge and training. For countries like Eritrea this can be a major challenge, as the number of trained veterinarians in government services is already low and post graduate training depends on external resources and opportunities.

During the course of an IAEA Technical Cooperation Project in Eritrea in 2005, it became clear that the lack of technical staff with up-to-date knowledge on transboundary and zoonotic animal diseases was a limitation that would affect the strengthening of the national animal disease diagnostic laboratory and the implementation of a number of advanced techniques, and therefore the success of the project. Despite all these limitations the Head of the Animal and Plant Health Laboratory in Asmara, Mr Tesfaalem Tekleghiorghis managed, with support from the TC project, to get serology diagnostics running and established molecular diagnostic tests after a training in South Africa. By doing this, the laboratory was able to diagnose contagious bovine pleuropneumonia (CBPP) in the country and to establish a brucellosis and tuberculosis control programme for semi intensive dairy farms.

During a quality control training course in 2006 at IAEA Seibersdorf laboratories a follow-up TC project was discussed, including the importance of further training. In this context a PhD training programme was explored targeting foot and mouth disease (FMD), a major challenge to livestock producers in Eritrea, as the focus of his major topic of research. After contacts with Dr Aldo Dekker and Prof Rob Moormann (Central Veterinary Institute, part of Wageningen UR, Lelystad, The Netherlands), the training and research programme was developed and funding was allocated through the national TC project. As the IAEA is only supporting 'sandwich training programmes' it was decided to do half a year field work followed by six months research. The training eventually started in early 2009 in Lelystad at the Central Veterinary institute which is part of Wageningen UR, in the Netherlands. Part of the training was also supported by the FMD project financed by the Dutch Ministry of Economic Affairs.

The planned three years were passing fast and due to various logistical problems it was not possible to publish the required scientific peer reviewed papers. To finish the work, various individuals and institutions in Eritrea and

the Netherlands supported his final research activities while others added funding from shipping samples until he finally printed his thesis. Dr Tekleghiorghis successfully defended his thesis on 9 October 2014 in Utrecht University, and celebrated his promotion in Utrecht.

His work on FMD typing and vaccine matching will certainly have an impact on the next generation of testing procedures. Consequently he was invited to the IAEA regional workshop on vaccine matching and serotyping in September to train 25 participants from the Asian region in the latest techniques. It is expected that Dr Tekleghiorghis will soon be able to transfer his findings into the field and thus improve the control of FMD in Eritrea and of course the region.

Scientific achievements:

The research work started out with an analysis of the role that animal husbandry, trade and wildlife have on the transmission of FMD virus and provided a scientific basis for different FMD control measures in Africa. Next, two surveillance studies on FMD were carried out to know the level of sero-prevalence and identify the serotypes in cattle in Eritrea. To study FMDV vaccine matching the best serological test method to determine cross-reactions was evaluated and the inherent variability of the r1-value addressed. Although cross-reactions were observed in post vaccination and/or infection sera, in most cases, the highest VNT titre was found with the serotype used for vaccination and/or infection, suggesting that the criterion of using the highest response only is generally valid. Serum samples from cattle vaccinated with 10 different FMDV serotype A strain vaccines were analysed using three serological test methods (virus neutralization test, neutralization index test and the liquid phase blocking ELISA). Finally the formulation of FMD vaccines was investigated by using different adjuvants, antigen composition, antigen payload and administration routes. Unfortunately none of the FMD vaccine formulations showed any influence on the breadth of the antibody response in cattle.

A very important result though was the finding that the r1-value was an inaccurate indicator of cross-protection in contrast to the VNT titres against the field isolates. The latter also takes into account the vaccine quality, as a low titre induced by a good matching strain might not protect, whereas a very high titre against a poor matching strain could protect. Therefore, quality control of FMD vaccines is also essential.

The thesis can be downloaded under:

http://www.narcis.nl/search/Language/NL/coll/publication/uquery/tekleghiorghis/genre/doctoralthesis

Enhancing animal production and disease control in Uganda

Technical cooperation project UGA/5/032: Improving Animal Production and Productivity through Advanced Animal Disease Control and Animal Production Measures

The challenge:

Over 70% of the total population of Uganda is engaged in agriculture. Livestock is a major component, but growth in this sector needs improvement, mainly due to diseases and parasites that affect national herds and flocks.

Uganda is land locked and borders 5 livestock keeping countries with a high interaction with the Ugandan herd. This scenario creates a potential risk for disease exchange for both animal diseases and zoonoses. Efficient border control of animal diseases is required for disease control, which requires fast disease identification at border areas.

District Veterinary Officer at the border district laboratory in Arua, Uganda.

The project:

Uganda has worked with the IAEA's technical cooperation (TC) programme for many years. A range of projects have provided expertise to support the establishment of laboratories and to build capacity for their operation.

Through this project, the IAEA assisted Uganda through capacity building of staff and by providing equipment for the established mini mobile laboratories at border posts for fast and efficient diagnosis and control of animal diseases, using nuclear techniques. In addition, mapping of the stock

routes and animal check points were initiated to improve the planning and implementation of animal and transboundary animal diseases (TADs) control in Uganda.

The impact:

At the National Animal Disease Diagnostics and Epidemiology Centre (NADDEC), TC projects have supported the establishment of a molecular diagnostic laboratory, which provides services for the rapid diagnosis of TADs. Nutrition laboratory centres have also been established that are able to be used for residue analysis in livestock and livestock products, and to promote production, productivity and marketing of livestock. Eighty per cent (up from 30%) of reported animal disease outbreaks are now investigated and diagnosed at NADDEC. Border post and mobile laboratories have been created to control disease incursions from five neighbouring countries. With this infrastructure in place, animal disease control has improved with accurate and timely diagnosis. Uganda is now serving as a fellowship training portal for Africa.

In addition, two artificial insemination (AI) centres have been renovated and made operational in Uganda, in Njeru and Ruhengere, with 168 inseminations occurring in the first half of 2014. The centres bring AI services nearer to farmers, and will have a direct impact on improving livestock productivity and farmer livelihood. It is estimated that farmers' access to AI services will increase by 10%.

http://www.iaea.org/technicalcooperation/Pub/Suc-stories/Agric-food.html

Preventing Brucellosis in Bosnia and Herzegovina

Technical cooperation project BOH/5/001: Reducing the Incidence of Brucellosis in Animals and Humans by Surveillance and Control

The challenge:

The economy of Bosnia and Herzegovina depends significantly on agriculture, which provides employment for approximately 20% of the country's workforce and contributes 10% of the total GDP of the country. The national animal population is estimated to be 458 000 cattle, 1 125 000 sheep and goats and 529 000 pigs. However, the prevalence of transboundary animal diseases (TADs) in Bosnia and Herzegovina has increased due to a lack of consistency in the country's disease control strategies. Zoonotic TADs, which can easily be transmitted to humans, are of particular concern. Lack of proper control measures for brucellosis in Bosnia and Herzegovina, for example, led to the sudden spread of the disease among the human population, reaching a peak of approximately 1000 cases in 2008.

The project:

As the primary source of brucellosis is farm animals, especially sheep and goats, early disease detection using nuclear-related diagnostic platforms, as well as the upgrade of epidemiological strategies, became a priority for the State Veterinary Office and the entire veterinary service. An IAEA technical cooperation project supported the upgrade of laboratory capacities and the implementation of standardized protocols. A strategically important epidemiological team, competent to design and enforce scientifically justified epidemiological models for the control of brucellosis and other TADs in the country, was designated and trained.

The impact:

As a result of the project, a disease control strategy based on quantitative epidemiology methods was developed and implemented to enhance Bosnia and Herzegovina's disease surveillance and control system. Today, samples collected under the established surveillance strategy are submitted to regional screening laboratories, and samples from animal flocks that test positive are further processed at two reference laboratories. The surveillance results are reported to the competent authorities for further action, such as the removal of diseased animals. The new system has improved the capacity of the State Veterinary Service to detect, control or eradicate brucellosis and has established a model for other TADs. A network of advanced epidemiological units has been set up, and standard and harmonized laboratory techniques and diagnostic protocols are being implemented.

As a result of the TC project, Bosnia and Herzegovina is now better able to ensure the safety of its livestock and population.

http://www.iaea.org/technicalcooperation/Pub/Suc-stories/Agric-food.html

These stories as well as other articles are also available under 'Highlights' on our Homepage
http://www-naweb.iaea.org/nafa/aph/index.html

Coordinated Research Projects

Project Number	Ongoing CRPs	Scientific Secretary
D3.10.26	Genetic variation on the control of resistance to infectious diseases in small ruminants for improving animal productivity	Mohammed Shamsuddin
D3.10.27	The use of enzymes and nuclear technologies to improve the utilization of fibrous feeds and reduce greenhouse gas emissions from livestock	Mohammed Shamsuddin
D3.20.26	The early and sensitive diagnosis and control of peste des petits ruminants (PPR)	Adama Diallo
D3.20.28	The control of foot and mouth disease (FMD)	Gerrit Viljoen
D3.20.29	The use of irradiated vaccines in the control of infectious transboundary diseases of livestock	Adama Diallo
D3.20.30	Use of stable isotopes to trace bird migrations and molecular nuclear techniques to investigate the epidemiology and ecology of the highly pathogenic avian influenza	Ivancho Naletoski
D3.20.31	Early and rapid diagnosis and control of TADs – second phase- African swine fever	Hermann Unger

Genetic variation on the control or resistance to infectious diseases in small ruminants for improving animal productivity

Technical Officer: Mohammed Shamsuddin

A coordinated research project (CRP) referred to above (D3.10.26) has been running since 2010. The CRP was designed to characterize phenotypes of sheep and goats related to resistance to gastrointestinal (GI) parasites and identify genes responsible for variations in phenotypes. The project has been implemented in 14 countries as research contract holders (RCH). Two major research trials (i.e. artificial challenge and field trial) were designed for recording phenotypic data focusing on parasite burden and sampling blood for DNA analysis during the first RCM (Vienna, 21–25 February 2011). RCHs of Argentina, Brazil, Eritrea, Ethiopia, Indonesia and the Islamic Republic of Iran have been working with sheep breeds. RCHs of Bangladesh, Burkina Faso, China, Mexico, Nigeria and Sri Lanka have been working with goat breeds and TCH of Pakistan has been studying both sheep and goat breeds.

All RCHs have completed the artificial challenge trial and presented the data during the Second RCM held in Bogor, Indonesia (11–15 February 2013). Based on preliminary results, there are clear indications of genetic variations in resistance to parasites in sheep and goats, however, advanced and detailed statistical analysis involving bioinformatics data are still being processed. This will lead to the submission of at least one manuscript per RCH for publication in a peer reviewed journal by the end of 2014. The research team in Argentina has already initiated a breeding programme where rams have been selected for parasite resistance. On the other hand, two RCs were terminated based on poor results. In addition to the research trials, a Radiation Hybrid panel for goats (Capra hircus) was constructed as a resource for rapid and large-scale physical mapping of the goat genome to facilitate the resolution of the genetic and physical distances prior to designing strategies for positional candidate cloning of the gene(s) that are involved in economically important traits. Later in a second step, the whole-genome Radiation Hybrid Map (RH Map) was developed. This is used during the second phase of the CRP for the genetic characterization of goat breeds, for conducting comparative genomics that are necessary to utilize the genotype-phenotype associations, for evaluating candidate genes for the identification of genetic markers associated to infectious disease resistance and for the development of analytical tools for molecular diagnostics and assisted breeding.

RCHs have already started or nearly completed the field trial that involves studying sheep and goat breeds for resistance to natural infections with GI parasites. DNA has been extracted from blood samples and most of the RCHs have sent an aliquot to the IAEA's Animal Production and Health Laboratory (APHL) in Seibersdorf for genotyping. Single Nucleotide Polymorphism based DNA markers were

discovered in different candidate genes at Seibersdorf laboratory. Part of the DNA samples collected from resistant/susceptible sheep and goat breeds by the RCHs during artificial challenge trials were genotyped. Several RCH have already published their data. The project is progressing according to the work plan. The CRP will end in 2015.

The use of enzymes and nuclear technologies to improve the utilization of fibrous feeds and reduce greenhouse gas emissions from livestock

Technical Officers: Mohammed Shamsuddin, Gerrit Viljoen

The CRP referred to above has been implemented since 2010 and involved 11 RCHs. The CRP aims at improving efficiency of utilizing locally available feed resources including tree and shrub leaves, agro-industrial by-products and other lesser-known and/or new plants adapted to the harsh conditions or capable of growing in poor, marginal and degraded soils. The first RCM was held in Lethbridge, Alberta, Canada, from 7 to 11 February 2011 and work plans were finalized to conduct the research work in two phases.

Most of the RCHs published data generated during the first phase of the CRP. The first phase had three major activities. In the first activity, commercial fibrolytic enzymes were screened in vitro to identify 2 to 4 best-bet candidates and their optimal dosages for further evaluation in animal trials. All enzyme candidates were assayed locally by each RCH for enzyme activity using standardized methodology before starting the in vitro research which focused on batch culture incubations of the forage substrates in buffered rumen fluid plus enzymes to determine effects on 24 and 48 h dry matter (DM) and neutral detergent fibre (NDF) degradation. Additionally, the teams surveyed for and collected samples of fibrous feed materials available and/or used on smallholder farms for chemical compositional analysis of feed ingredients. The second activity was the evaluation of fibrolytic enzyme activity using the different fibrous feed materials available in the region, including endoglucanase, exoglucanase, cellulase and xylanase activity. The third activity was to conduct initial in vitro batch cultures to identify enzyme candidates and optimum dose rates for the forages of interest using DM and NDF degradation followed by more detailed in vitro batch cultures or continuous culture incubations to measure other variables of interest such as digestibility, kinetics of digestion, methane production, microbial protein synthesis, rate of gas production including methane, volatile fatty acid production and concentrations, microbial ecology of the rumen, etc.

The activities of the second phase were planned during the second RCM in Vienna, from 13 to 17 May 2013. The activities focus on in vivo evaluation of best-bet candidate fibrolytic enzymes to determine effects on animal productivity, the critical enzymatic activities, optimal enzyme application method and to establish possible mode of action. In vivo trials with the best-bet candidate fibrolytic enzymes are in progress to determine effects on animal productivity including effects of enzyme on methane production. The project is progressing according to the work-plan. The CRP will end in 2015.

The control of foot and mouth disease (FMD)

Technical Officer: Gerrit Viljoen

The FMD CRP investigates vaccine matching procedures, vaccine potency testing methods and guidelines, and procedures by which an FMD vaccine's ability to induce production of protective antibodies in cattle without the need for animal challenge experiments can be evaluated.

The first research coordination meeting (RCM) of the coordinated research project (CRP) on The Control of Foot and Mouth Disease, FAO, Rome, Italy, from 10 to 14 January 2011, was held in collaboration with FAO and EU-FMD. It was attended by all but one research contract holders and agreement holders, as well as several observers from EU-FMD and FAO and foot and mouth disease (FMD) vaccine and diagnostic manufacturers and producers. Discussions were focused on: (1) the status of FMD in the participating counterpart's respective countries (e.g. FMD free vs. FMD free zone with or without vaccination vs. FMD endemic) with respect to the risks and threats, (2) what is currently being done in terms of vaccine matching, (3) what criteria are being used to choose FMD vaccines and how they are being applied, (4) how is vaccine potency being determined and utilized, (5) how are post-vaccination monitoring and surveillance being performed, (6) the status of counterpart's vaccine laboratory quality assurance and FMD laboratory analysis and diagnoses (i.e. their analysis and/or diagnostic laboratory proficiencies and capacities both for routine testing and research, laboratory infrastructure and procedures). The work plans of all the research contract holders (RCH) and the agreement holders (AH) were developed and discussed, and all the agreement holders will supervise (based on their respective expertise) identified aspects of the work plans.

Foot and mouth disease is one of the most important livestock diseases known to man due to its high infection rate (ease of spread) and its effect on the limitation of livestock movement and trade. An outbreak of FMD can

have a devastating effect on a country's food security with direct impact on national and international trade. The confirmatory diagnosis of FMD and its effective control through prophylactic, quarantine or slaughter procedures are therefore of paramount importance as they have financial and trade implications. Vaccination with inactivated FMD virus is undertaken to control FMD in endemic countries or countries at risk. Vaccines, whilst widely available but which should match (i.e. should be of homologous serotype and strain isolate) with virulent FMD viruses circulating in the region of vaccine use, are of variable quality, not from the homologous outbreak serotype/strain isolate, and are often stored under inadequate temperature conditions and therefore might be not as effective in the field as determined in animal experiments. Due to insufficient knowledge on vaccine strength and antigenic match (antigenic cartography) between vaccine strain and outbreak virus, it is often not possible to pinpoint the weakness of the vaccination strategy and to take action on this weakness. Vaccine effectiveness can be determined by animal challenge, but this is both costly and difficult. In vitro systems have been developed in different countries since the 1980s, but these are not standardized for international use. Many countries now produce FMD vaccines but often without proper consideration of their effectiveness.

In many developing countries, vaccination will continue to be an essential component for the progressive control of FMD. Maximizing the effectiveness of current vaccines and supporting research to improve the effectiveness and quality of those and or new vaccines will be critical. Countries using locally produced vaccines need to assure trade partners that they are using quality assured vaccines in order to overcome the restrictive effects of endemic FMD. The provision of internationally accepted guidelines for quality assurance and alternatives to the present need for animal challenge vaccine trials would be a significant step forward. It is likely that control and eventual eradication in endemic areas with a low level resource base (much of Africa, parts of Asia and Latin America) will require the use of quality assured vaccine preparations, correct vaccine formulations (i.e. homologous strain or isolate vaccine to protect against outbreak, new generation vaccines with a broader protection base (i.e. cross protection between different strains and isolates) or alternative formulations of existing vaccines).

All the counterparts developed their work plans such that, individually and or collectively, they worked towards creating solutions set by the objectives of the FMD CRP.

It is important to:

- establish methods and develop internationally agreed protocols for measuring the potency of FMD vaccines using in vitro methods;
- establish guidelines for optimum population vaccination intervals based on in vitro measurements of potency and duration of the antibody response to structural proteins, after the vaccination of cattle and small ruminants with commercially available FMD vaccines, and including the evaluation of reduced dose options such as intradermal administration of FMD vaccine;
- establish protocols and guidelines for application and interpretation of vaccine matching methods (antigenic cartography) to identify the extent of expected cross-protection of type A or SAT viruses;
- provide further global coordination of current research into FMD vaccines for use in endemic settings and to cooperate with other FMD institutions such as EU-FMD and PANAFTOSA;
- evaluate and standardize:
  - Virus neutralization (VN) tests
  - Early and rapid lateral flow and dip-site technologies and their application and use
  - Antigenic cartography (at IAH and OVI) in relation to virus neutralization tests (VN).

The second RCM took place from 8 to 12 April 2013 at FAO Headquarters in Rome, Italy. The final RCM will take place from 6 to 10 July 2015.

The use of irradiated vaccines in the control of infectious transboundary diseases of livestock

Technical Officer: Adama Diallo

Vaccination has been one of the greatest achievements of mankind in enabling the eradication of serious, life-threatening diseases of man and his domesticated livestock. Many of the vaccines used today rely on technologies developed over 100 years ago involving some form of attenuation, i.e. the use of an alternative or mutant strain of a pathogenic organism that has reduced virulence whilst maintaining immunogenicity, or inactivation, where chemical or physical methods are used to kill virulent pathogenic strains. In general, attenuated vaccines are more efficient than vaccines that are killed by chemical procedures that might denature the immunogenic antigens, making them less efficient in inducing good protective immune response. Irradiation of pathogens may be an alternative to chemical inactivation of the pathogen for developing efficient vaccines.

This IAEA CRP aims at developing vaccines for the control of some animal diseases through the irradiation of pathogens, irradiation in a way to obtain an organism not able to multiply anymore while maintaining the ability to synthesize proteins that will trigger the immune system in the host to provide a good protection against an infection. The objective of the first phase of the project was to identify the most efficient dose of irradiation to obtain such a product. For that objective the effect of different doses of irradiation was evaluated on the capacity of irradiated

pathogens on their capacity of biosynthesis and growth in vitro or in vivo. Those studies allowed the determination of a range of efficient doses for each of the pathogens. In most cases, the effect of the irradiation was evaluated on the growth of the pathogen in vitro and then in mice or rabbits, non–natural hosts of those pathogens. Good results have been obtained with some cases such as, Theleria annulata and Fasciola gigantica. In those cases the evaluation in the natural host remains to be carried out. This test was already carried out in the case of the fish parasite Ichthyophthirius multifilis and the ruminant gastro-intestinal parasite Haemonchus contortus. The results are very promising.

The third and final RCM took place from 23 to 26 June 2014 in Vienna, Austria.

Use of stable isotopes to trace bird migrations and molecular nuclear techniques to investigate the epidemiology and ecology of the highly pathogenic avian influenza

Technical Officer: Ivancho Naletoski

Among several important issues in the epidemiology of the highly pathogenic avian influenza (HPAI) that need attention is the role that wild water fowl (WWF) populations might play in the dissemination of infection. Tracing the movements of WWF in relation to where they originated as well as their stopover points during their migration between breeding and non-breeding grounds is a particularly challenging task.

It is necessary to utilize methods that can be used on a larger scale and not biased to initial capture location if we are to fully comprehend the role of migratory birds in the spread of avian influenza. A suitable technique that has already been used to trace migrants is based on the stable isotope (SI) signatures of the tissues of birds, especially those in feathers. Of most interest are deuterium (δD) ratios in tissues that reflect those in surface (lakes, rivers, oceans) and ground waters. Since hydrogen isotope composition of environmental water varies spatially across the globe in a predictable manner, and its presence relayed to feathers, δD analyses of feathers provide a way of linking SI data on water isoscapes with those in the feathers.

Faecal samples will be used for the detection of AI viruses with extraction and analysis of somatic DNA to detect the bird species. These two techniques will be used to link the AI carrier status and the carrier species without even capturing the birds, and may thus be used as a non-invasive platform to generate important epidemiological information on migration pathways (obtained by SIA) and the transmission of the virus to a certain geographical area. Faecal samples should be collected randomly at the same sites where feathers are collected. Samples will undergo two test procedures:

(a) DNA barcoding (species identification), adapted at the Avian Disease Laboratory, College of Veterinary Medicine, Konkuk University, South Korea. The technique is based on detection of a short gene sequence from a standardized region of the genome as a diagnostic 'biomarker' for species. The target sequence has been the 648-bp region of the mitochondrial gene, cytochrome C oxidase I (COI), already optimized as a DNA barcode for the identification of bird species. The optimization of a DNA barcoding technique for faecal samples has been performed by comparing DNA from the faecal samples with the DNA from tissue samples (muscle, feather, and blood) from already known bird species (domestic poultry and WWF), collected from live bird markets, the Conservation Genome Resource Bank for Korean Wildlife and from the Seoul Grand Park Zoo. The results of bird species identification, using COI gene sequences from tissues matched the faecal samples of the same individuals.

(b) Detection of the AIV in the faecal samples using optimized protocol in five phases: i) detection of M gene to detect the presence of influenza A viruses using PCR technique (positive samples should be inoculated in SPF eggs for virus isolation), ii) positive samples should be tested using H5 or H7 protocol on PCR, iii) H5 and H7 positive samples should undergo molecular pathotyping (cleavage site sequencing), iv) M gene positive, H5 and H7 negative, should be further typed in order to differentiate the subtype using conventional (HI-test) and/or molecular methods, v) positive samples and a portion of negatives will be tested using loop mediated isothermal amplification (LAMP) protocol.

The main pathway of AIV transmission is faecal contamination. Natural water reservoirs are the media where WWF faeces are excreted in the water, contaminating it randomly. However, the survival of the AIV in natural water reservoirs depends on numerous environmental, physical and chemical influences, as well as on the period between excretion by an infected and infection of a healthy WWF. Testing of natural water reservoirs will generate information on the level of (eventual) contamination and the risk of AIV transmission via these media at different geographical and environmental conditions. Water samples should be collected from different points of each selected area, in an amount of approximately 500 ml per sample. Each sample should be tested for the presence of AIV, using PCR with previous concentration of the virus. Using a standardized protocol it is possible to quantitatively evaluate the level of contamination based on a comparison with a known titrated virus isolate.

Of great epidemiological interest would be the potential application of the same technology to trace short-range

migration in wildlife carriers, in order to determine their role in transmission of animal and/or human pathogens.

Seven research contract holders from Bulgaria, China, Egypt, Nepal, Russian Federation, Tajikistan and Turkey, two agreement holders from Germany, and three technical contract holders from Canada, Republic of Korea and the UK are currently participating in the CRP.

The first RCM was held at the IAEA from 31 October to 2 November 2012. The second RCM was held from 5 to 9 May 2014 in Izmir, Turkey. Please see the report under Past Events.

The early and rapid diagnosis and control of TADs – second phase – African swine fever (AFS)

Technical Officers: Herman Unger, Charles Lamien

This new CRP started this year, after a successful first phase with a focus on avian influenza control, now ASF will be addressed.

ASF is a contagious viral disease of pigs transmitted directly or by ticks. It leads to acute disease with high mortality and maintains a chronic infection when survived. Wild boars are the natural reservoir in Africa. Endemic in wide parts of sub-Saharan Africa it has spread in the last 10 years to the Northern Caucasus and keeps expanding primarily to the West and North. The disease creates severe economic hardship for pig farmers and due to lack of a vaccine, culling and quarantine measures are the only tools available to control disease. As pig production is in many cases on a small scale, farmers do often lack the means and education how to fend off disease. Similarly the diagnostic tools so far available have their limitations and a number of epidemiological as well as virological issues are not understood.

The CRP will focus in its first two years on the validation of the serological and molecular diagnostic tools to allow veterinary services to come up with quality assured results. In parallel, samples from infected pigs, wild or domestic, will be collected for virus isolation. These isolates should be characterized and some of them sequenced in order to create an understanding of the genetic diversity on a spatial scale. This knowledge together with information regarding the pathology of each strain should allow some insight into the underlying patho-mechanisms and might help identify epitopes of interest for a vaccine. Finally, a number of control measures will be initiated to see how efficient they are in the context of small scale commercial production.

The first research coordination meeting took place from 7 to 11 July 2014 in Vienna, Austria.

General information applicable to all coordinated research projects

Submission of Proposals

Research contract proposal forms can be obtained from the IAEA, the National Atomic Energy Commissions, UNDP offices or by contacting the Technical Officer. The form can also be downloaded from the URL:
http://www-crp.iaea.org/html/forms.html.

Such proposals need to be countersigned by the Head of the Institutions and sent directly to the IAEA. They do not need to be routed through other official channels unless local regulations require otherwise.

Complementary FAO/IAEA Support

IAEA has a programme of support through national Technical Cooperation (TC) projects. Such support is available to IAEA Member States and can include additional support such as equipment, specialized training through IAEA training fellowships and the provision of technical assistance through visits by IAEA experts for periods of up to one month. Full details of the TC Programme and information on how to prepare a project proposal are available at the URL http://pcmf.iaea.org/.

Activities of the Animal Production and Health Laboratory

Animal Genetics

Genetic variation on the control of resistance to internal parasites in small ruminants for improving animal productivity

Development of a real time PCR based assay to differentiate sympatric Haemonchus species infecting ruminants.

Haemonchus parasites are trichostrongyloid nematodes and one of the major parasites affecting ruminants (sheep, goat, cattle and camel) around the world. The adult worms suck blood from the abomasum of ruminant hosts and cause anaemia, oedema, diarrhoea and even death. Apart from the loss due to mortality and slow growth, the growing level of anthelmintic resistance in these parasites is a serious challenge. The level of anthelmintic resistance in different species/populations of Haemonchus varies greatly. Three different sympatric species of Haemonchus are infecting ruminants in Asia viz. H. contortus, H. placei and H. longistipes. H. contortus is predominantly a parasite of sheep and goat, H. placei infect cattle while H. longistipes is more commonly found in camels. However, all the sympatric species can be found in the abomasum of any host species either as a single infection or as multiple co-infections. The correct identification of different species/variants, as well as knowledge regarding the epidemiology and genetic characterization of the principal circulating species/variants, is essential for the establishment of sustainable control strategies. APHL initiated the development of a real time PCR (polymerase chain reaction) based assay to differentiate the three major Haemonchus species infecting ruminants in Asia.

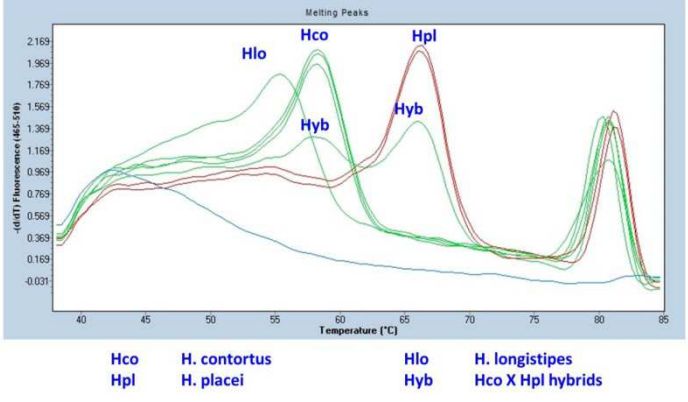


Figure 1. Melting curve analysis of PCR amplicons showing specific melting peaks for each of the three sympatric Haemonchus species.

Species specific single nucleotide polymorphic (SNP) variations within internal transcribed spacer 2 (ITS2) gene of Haemonchus parasites were utilized to develop the assay. Primers for PCR amplification of ITS2 gene and a snap back probe to detect species specific SNPs were designed. Asymmetric PCR followed by melting curve analysis of samples showed three distinct melting temperatures specific to each of the three Haemonchus species (Figure 1). The assessment of sensitivity and specificity of this assay is currently under progress.

Genetic characterization of indigenous livestock breeds

The Joint FAO/IAEA Division is supporting Member States in implementing Global Plan of Action on animal genetic resources (AnGR) through capacity building and training. APHL supported Myanmar on molecular genetic characterization of indigenous goat breeds using nuclear and extra-nuclear DNA markers.

Genetic diversity, population structure and phylogeography of Myanmar goats.

Myanmar has primarily an agriculture driven economy with a contribution of 42% to the national gross domestic product, of which livestock plays an important role providing employment and livelihood to the rural masses. Goats in Myanmar are mostly reared for meat purpose and are able to adapt well to the prevailing harsh dry conditions. Three major native goat breeds, Jade Ni, Nyaung Oo and Waithar Li are available in Myanmar, however, baseline information on the phenotypic and genetic characteristics on these goat breeds are not available. Such information is required to formulate and implement effective strategies for their genetic improvement and conservation.

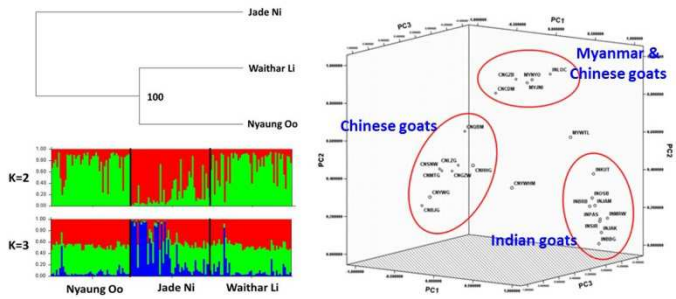


Figure 2. Genetic structure of Myanmar goat breeds based on nuclear (left) and extra nuclear (right) DNA markers.

A total of 147 goats from all three indigenous breeds were genotyped at 27 microsatellite loci. Genetic diversity in terms of allelic polymorphisms, observed and expected heterozygosities were found to be moderately high. Considerable heterozygosity deficit ranging from 5.5% to 8.2% was observed in Myanmar goat breeds. Most of the genetic variations were found within breeds and only 1.9% of the total observed variation was explained by between

breed differences. Genetic structure analyses showed complete admixture of Nyaung Oo and Waithar Li goats indicating high rate of gene flow among these populations (Figure 2). Population stratification was observed in Jade Ni with a subset of individuals clustering distinctly. Variations in mitochondrial DNA (mtDNA) control region revealed 22 distinct haplotypes belonging to two major haplogroups, A and B. Haplogroup A was found to predominate Myanmar goats similar to other goat populations in Asia. Comparative analysis of mtDNA variations indicated possible Chinese origin of the maternal haplotypic lineages of Myanmar goats.

Genetic relationship of domestic sheep breeds with primitive Asian wild Urial sheep

The geographical region extending from Eurasia to North West of Indian subcontinent is home to the wild progenitors of present day domestic sheep. Asian Urial sheep (Ovis orientalis punjabiensis) were initially proposed as the first sheep domesticate while later reports suggested them to be more primitive than Asiatic mouflons in the evolutionary scale. In continuation of Joint FAO/IAEA Division's efforts on characterization of small ruminant genetic resources of Asia and as part of the research project implemented by University of Veterinary and Animal Sciences, Pakistan (funded by world wide fund for nature), baseline information on genetic diversity of Urial sheep was generated and compared with domestic sheep breeds around the world. High levels of genetic diversity in terms of allelic diversity, observed and expected heterozygosity and inter-individual allele sharing distance was observed within the wild Urial sheep. Distribution of diversity was consistent with the history of sheep domestication and the sheep breeds originating close to Fertile Crescent (center of domestication) tend to possess higher diversity. Comparison of Urial sheep with domestic sheep breeds located near the domestication centers revealed relatively closer relationship of Urial with West Asian and East European sheep than South Asian sheep. No evidence was observed to support the hypothesis of Urial sheep as a potential wild ancestor to the Asian domestic sheep lineage.

Animal Health

Using irradiation technology to develop a potential trypanosome vaccine

Trypanosomosis, a parasite disease in mammals, remains a big hindrance to the development of livestock resources in Africa with approximately 8.7 million km^2 of Africa infested by tsetse flies, the major insect vector of the parasite on the continent. The disease puts 4.6 million cattle at risk annually with annual losses estimated to be between 1.3 and 5 billion US$. A vaccine would provide the most effective means of managing the disease in livestock. Recent advances using irradiation in developing vaccines against other parasite diseases e.g. malaria, brucellosis and toxoplasma have contributed to further research in trypanosomosis. At the Joint FAO/IAEA Agriculture and Biotechnology Laboratory in Seibersdorf, experiments have been carried out to characterize the effects of using low level irradiation doses on trypanosomes. Several assays that measure the metabolic processes and growth dynamics of irradiated parasites have shown that it is possible to produce trypanosomes with long-term in vitro viability that are non-infectious when used for inoculation in mice for in vivo studies. Mice that have been inoculated with these living but non-infectious parasites display a response when using cytokine levels as a marker of immunity. Immunization using parasites irradiated with lower levels of irradiation leads to a wider variation of cytokine response.

In order to further investigate the characteristics of irradiated parasites, whole transcript arrays that measure the expression profiles of parasites subjected to different amounts of irradiation are being designed. These arrays cover the genomes of three different trypanosome genomes; T. *brucei*, T, *evansi* and T. *congolense* and will be used to analyse irradiated parasites. Information gathered from these experiments will then be used to identify novel genes involved in parasite virulence and disease pathology. These genes will be further characterized using reverse genetics in combination with infection studies. Initial experiments using pathogenic factors previously described in literature have resulted in the production of mutant parasites that will also be used for irradiation in a bid to improve the efficiency of an irradiated vaccine. The identification and characterization of novel genes associated with pathology will provide the basis for new vaccines that present a large repertoire of antigens to the host immune system using one inoculation so as to induce protection in the mammalian host.

Peste des petits ruminants (PPR)

Full genome sequence of a lineage III PPRV from Kenya. In May 2014 tissue samples that had been collected from goats suspected of having died from peste des petits ruminants (PPR) disease in Turkana county northwestern Kenya in 2011 were sent to APHL for further characterization. The samples were processed and tested by the nucleic acid amplification test (RT-PCR for Reverse-transcription Polymerase Chain reaction,) for the presence of PPR viral RNA. The positive samples were sequenced and identified as belonging to PPRV Lineage III. The full genome using the viral RNA from one of the samples was generated and analysis revealed that the virus causing disease in Kenya in 2011 was 95.7% identical to the full genome of a virus isolated in Uganda in 2012 and that a segment of the viral fusion gene was 100% identical to that

of a virus circulating in Tanzania in 2013. These data strongly indicate transboundary movement of Lineage III viruses between Eastern Africa countries and has significant implications for surveillance and control of this important disease as it moves southwards in Africa.

Capacity Building in Member States Laboratories

Technical visit to the Central Veterinary Laboratory, Kinshasa, Democratic Republic of Congo

As part of the Peaceful Uses Initiative (PUI), African Renaissance Fund (ARF) and Identify projects the CVL in Kinshasa was visited by an expert from APHL from the 13 to 17 October 2014. The primary aims of the visit were to deliver and install a real-time PCR instrument in the laboratory that had been purchased using ARF funds and to assist in the activation of the sequencing service provided to partners under the Identify project. The real-time PCR instrument was successfully installed and tested. CVL staff members were assisted in the setting up of two real-time protocols for peste des petit ruminants (PPR) and African swine fever (ASF) using the new instrument. In addition, PCR amplicons were generated from positive samples of PPRV, ASF and rabies virus and prepared for shipment to a sequence provider in Europe.

Fellows/interns/consultants

Ms Pann Pwint Phyu from Livestock Breeding and Veterinary Department, Yangon, Myanmar was trained on Genetic characterization, population structure and phylogeography of indigenous goat breeds from Myanmar at APHL for three months (25June to 21 September 2014) under TC fellowship (MYA/13013).

Mr James Jenkins stayed at the APHL from 14 July to 23 September 2014 as intern. During his stay, he has contributed to development of bioinformatics tools for qPCR data analysis, and sequence analysis. Additionally, he has initiated work on the development of multiple pathogen detection in swine.

Ms Kadidia Tounkara joined APHL in July 2014 for a nine month internship. She is being trained on the characterization of peste des petits ruminants virus through virus gene amplification and sequencing. A new virus gene is being explored for studying the molecular epidemiology.

Mr Abel Wade from LANAVET, Garoua, Cameroon worked as consultant at APHL from 01 February 2014 to 30 September 2014 on biology and molecular biology of African swine fever (ASF). During this period, Mr Wade contributed to the characterization of ASF virus strains identified in pathological samples collected in Western and Central Africa and the molecular epidemiology study of this virus.

Prof Yu Daojin from the Fujian Agriculture and Forestry University (FAFU), China, who joined the IAEA Animal Production and Health Laboratory (APHL) in July 2013 as a cost free expert returned home in August 2014. During his stay in APHL, he focused his research activities on peste des petits ruminants. His contribution in the improvement of PPR vaccine production was highly appreciated.

Technical Cooperation Projects

TC Project	Description	Technical Officer(s)
ALG/5/027	Strengthening Animal Health and Livestock Production to Improve Diagnostic and Reproductive Capacities in Animal Breeding and Support Expertise for the Feasibility Study of a Biosafety Laboratory, Level 3 (BSL3) **Objective:** To contribute to the improvement of animal health and livestock production by using nuclear and nuclear related technologies to strengthen reproductive and diagnostic capacities in animal breeding, to support expertise for the feasibility study of a biosafety laboratory.	M. Shamsuddin I. Naletoski C.E. Lamien
ANG/5/011	Monitoring Soil Fertility in Pasture Areas for Their Improvement and Maintenance **Objective:** The objective of the work is monitoring of soils in pasture areas for their improvement and maintenance.	M. Shamsuddin
BDI/0/001	Supporting Human Resource Development and Nuclear Technology Support including Radiation Safety **Objective**: To upgrade and strengthen the skills and capabilities of human resources and to provide general support within the broad spectrum of the application of nuclear science and technology, including radiation safety. To support unforeseen relevant needs of Member States.	I. Naletoski
BEN/5/007	Soil, Crop and Livestock Integration for Sustainable Agriculture Development Through the Establishment of a National Laboratory Network **Objective:** An interdisciplinary project that aims at a sustainable intensification of peri-urban agricultural production through the integration of cropping-livestock systems was developed.	M. Shamsuddin H. Unger
BKF/5/011	Improving the Health and Productivity of Small Ruminants through Efficient Animal Feeding, Identification of Genetic Markers for Breeding Programmes and Better Health and Reproductive Management **Objective:** To improve small ruminants productivity through efficient use of local plant resources in animal feeding and health, identification of genetic markers for use in breeding programmes and better health and reproductive management.	M. Shamsuddin K. Periasamy
BKF/5/014	Improving the Productivity of Small Ruminants through Diet, Health and Identification of Genetic Markers for Selection and Breeding Management **Objective**: To contribute to improving the productivity and profitability of small ruminant farms in Burkina Faso by applying genetic characterization and artificial insemination for breeding and utilizing local feed resources to improve nutrition and medicinal plants to control parasites	M. Garcia M. Shamsuddin K. Periasamy
BOT/5/008	Using Nuclear and Molecular Diagnostic Techniques for Improved Diagnosis of Animal Diseases **Objective**: To employ nuclear and molecular diagnostic techniques to improve diagnosis of animal diseases.	G. Viljoen C. Lamien
BOT/5/011	Using Nuclear and Molecular Techniques for Early and Rapid Diagnosis and Control of Transboundary Animal Diseases **Objective**: To employ nuclear molecular diagnostic techniques to improve diagnosis of transboundary animal diseases, such as foot and mouth disease, contagious bovine pleuropneumonia, avian influenza, Rift Valley fever, tuberculosis, PPR (peste des petits ruminants) and rabies.	G. Viljoen C. Lamien

TC Project	Description	Technical Officer(s)
BZE/5/006	Establishing Early and Rapid Diagnosis of Transboundary Animal Diseases to Support Food Security **Objective:** To establish an early and rapid nuclear/nuclear related serological/molecular diagnostic and control capability for transboundary animal diseases: Building capacity, strengthening of a national diagnosis and surveillance system for transboundary/zoonotic diseases.	G. Viljoen
BZE/5/007	Supporting Sustainable Capacity Building through Distance Learning for Laboratory Personnel of the National Agricultural Health Authority **Objective**: To increase and sustain the level of trained qualified staff in the laboratory, and thus the sustainability of the laboratory as a whole by providing an avenue for technical laboratory staff to pursue educational advancement while retaining their services.	G. Viljoen
CAF/5/005	Enhancing Livestock Productivity through the Improvement of Selection and Use of Artificial Insemination for Increased Meat and Milk Production **Objective:** Improve cattle productivity by implementing a reliable artificial insemination (AI) programme in the country.	M. Shamsuddin
CHD/5/004	Improving Cattle Productivity through Genetic Improvement, Including Artificial Insemination, to Contribute to Reducing Poverty and Combating Food Insecurity **Objective:** Improve the productivity of local cattle breeds by means of artificial insemination.	M. Shamsuddin
CMR/5/018	Improving Productivity of Indigenous Breeds and Animal Health **Objective:** Improved productivity of indigenous breeds and animal health.	H. Unger K. Periasamy M. Garcia Podesta
CMR/5/019	Using Nuclear Techniques to Improve Milk Production **Objective**: To improve breeding and disease control in cattle for increased milk production in Cameroon by utilising nuclear techniques.	M. Garcia Podesta M. Shamsuddin H. Unger K. Periasamy
ELS/5/011	Enhancing Livestock Productivity and Decreasing Environmental Pollution through Balanced Feeding and Proper Manure Management **Objective:** Enhance livestock productivity and decrease environment pollution through balanced feeding and proper manure management.	M. Shamsuddin H. Unger
ERI/5/009	Enhancing Small Scale Market Oriented Dairy Production and Safety for Dairy Products through Improved Feeding and Cattle Management, Higher Conception Rates and Lower Calf Mortality **Objective:** To increase dairy production through improved feeding and cattle management and higher conception rate and lower calf mortality, and improve farmers' livelihood in Eritrea.	M. Shamsuddin
ETH/5/017	Improving Livestock Productivity through Advances in Animal Health and Production **Objective:** Improvement of livestock productivity through advances in animal health and production.	A. Diallo
IVC/5/032	Establishing Epidemiological Surveillance of Peste des Petits Ruminants (PPR) and Studying Its Socio-Economic Impact on Rural Populations by Developing Diagnostic Tools and Providing Economic Data to Veterinary Services **Objective:** To develop diagnostic tools and provide economic data to assist veterinary services in developing a proper strategy to control peste des petits ruminants in Cote d'Ivoire.	H. Unger A. Diallo G. Viljoen

TC Project	Description	Technical Officer(s)
IVC/5/034	Monitoring Epidemiology of Transboundary Animal Diseases **Objective**: To contribute to the fight against peste des petits ruminants (PPR). To allow for a systematic study and characterization of the viral strains present in Côte d'Ivoire. To help improve the economic situation of small-scale farmers, who have suffered in the crisis. The results from the epidemiological study planned under the project, and of the economic study to be conducted, will be key tools in this post-crisis phase.	H. Unger A. Diallo
KAM/5/002	Using Nuclear and Molecular Techniques to Improve Animal Productivity and Control Transboundary Animal Diseases **Objective:** To improve livestock productivity for food security by integrated management of animal nutrition, reproduction and health which includes: early pregnancy diagnosis for better reproductive management, metabolic profiles in livestock for assessing nutrition.	G. Viljoen M. Garcia M. Shamsuddin
KEN/5/033	Using an Integrated Approach towards Sustainable Livestock Health and Nutrition to Improve Their Production and Productivity for Enhanced Economic Development **Objective:** To use an integrated approach to manage both livestock health and nutrition in order to improve their production and productivity for enhanced economic development.	A. Diallo M. Shamsuddin
LES/5/002	Using Nuclear and Molecular Techniques for Improving Animal Productivity and Control of Transboundary Animal Diseases to Enhance Livestock Production and Health **Objective:** To improve livestock production and health.	G.Viljoen
LES/5/003	Using Nuclear and Molecular Techniques for Improving Animal Productivity **Objective:** To improve livestock production.	G. Viljoen
MAG/5/016	Appling Nuclear Techniques to Optimize Animal Production **Objective:** To increase animal production through the improvement of animal health and control reproduction in the Amoron'i Mania region.	M. Shamsuddin I. Naletoski
MAG/5/020	Improving Stockbreeding Productivity Through the Application of Nuclear and Related Techniques for Reducing Rural Poverty **Objective:** To contribute to reducing rural poverty by improving the productivity of stockbreeding.	M. Shamsuddin I. Naletoski
MAR/5/021	Improving Smallholder Dairy Productivity through Better Nutrition by Using Locally Available Forage and Browse Species **Objective:** To contribute to the improvement of smallholder dairy productivity through better nutrition using locally available forage and browse species.	M Shamsuddin
MAU/5/004	Supporting Genetic Improvement of Local Cattle Breeds and Strengthening the Control of Cross-Border Diseases **Objective**: To increase livestock productivity by reducing disease events and improving breeding programmes and genetic resources for food security.	H. Unger M. Shamsuddin
MLI/5/025	Improving National Capacities to Characterize Serotypes of Major Animal Diseases Using Molecular Biology Techniques for the Development of a National Disease Control Strategy **Objective**: The main objective is identification of the various serotypes of the foot and mouth disease virus. The project would help the elaboration of a national strategy for control of the disease by formulating vaccines which are currently imported from Botswana.	I. Naletoski C. Lamien
MLI/5/026	Improving the Diagnosis of Livestock Diseases **Objective:** To improve animal health by implementing a control programme to tackle the major prevalent animal diseases in Mali.	I. Naletoski C. Lamien

TC Project	Description	Technical Officer(s)
MLW/5/001	Strengthening the Essential Animal Health and Veterinary Infrastructure for Disease Control and Management Services in Urban and Rural Areas **Objective:** To develop capacity and strengthen infrastructure for animal disease control and management services in urban and rural areas of Malawi.	H. Unger
MON/5/020	Improving the Health Status of Livestock by Developing a Technology to Produce the Vaccine and Diagnostic Kit for Transboundary Animal Diseases **Objective:** To improve the health status of livestock by developing a technology to produce the vaccine and diagnostic kit of transboundary animal diseases.	H. Unger G. Viljoen
MON/5/021	Improving the Productivity and Sustainability of Farms Using Nuclear Techniques in Combination with Molecular Marker Technology **Objective:** To improve the productivity and sustainability of livestock and crop integrated farms through utilization of high yield, disease resistant new wheat varieties and other cereal varieties developed by the combined application of nuclear and molecular marker.	M. Shamsuddin
MOR/5/034	Improving Veterinary Drug Residue Detection and Animal Disease Diagnosis with Nuclear and Molecular Techniques **Objective**: To establish technical expertise using nuclear and complimentary non-nuclear techniques for screening and confirmatory analysis of veterinary drug residues and related chemical contaminants in food for human consumption and diagnosis of animal diseases by molecular biology.	I. Naletoski
MOZ/5/005	Strengthening the Sustainability of the Institution to Address Animal Diseases, Prevention, Food Safety and Animal Production Problems through Nuclear and Related Techniques **Objective:** To improve the productivity and sustainability of livestock and crop integrated farms through utilization of high yield, disease resistant new wheat varieties and other cereal varieties developed by the combined application of nuclear and molecular marker.	G.Viljoen
MYA/5/022	Improving Animal Productivity through the Use of DNA-Based Technology and Artificial Insemination **Objective:** To improve livestock productivity through the selection of superior breeding stock and to improve capacity in the use of molecular and related technologies for raising the genetic quality of local and adapted livestock breeds.	M. Shamsuddin K. Periasamy
MYA/5/024	Supporting the National Foot-and-Mouth Disease Control Programme **Objective:** To increase productivity of the livestock sector by implementing sustainable strategies to control and eradicate Foot-and-Mouth Disease.	G. Viljoen
NAM/5/011	Establishing Research and Diagnostic Capacity for the Effective Control of Animal Diseases in the Northern Communal Areas and Improving Vet. Public Health Services **Objective:** To control transboundary and parasite-borne animal diseases in the Central and Northern Communal Areas (NCA) and to improve veterinary-public health.	H. Unger G. Viljoen
NEP/5/002	Improving Animal Productivity and Control of Transboundary Animal Diseases Using Nuclear and Molecular Techniques **Objective:** To improve livestock productivity for food security by integrated management of animal nutrition, reproduction and health.	G. Viljoen I. Naletoski
NER/5/016	Strengthening the Capacities of the Epidemiological Surveillance Network for Transboundary Animal Diseases of Livestock **Objective**: To contribute to ensuring food security and to reducing poverty by improving livestock productivity through mitigation of health constraints.	I. Naletoski

TC Project	Description	Technical Officer(s)
RAF/5/057	Strengthening Capacities for the Diagnosis and Control of Transboundary Animal Diseases in Africa (AFRA) **Objective**: To strengthen the diagnostic capacity of national veterinary services to monitor and control major transboundary animal diseases, particularly foot and mouth disease, peste des petits ruminants and contagious bovine pleuropneumonia.	H. Unger A. Diallo C. Lamien
RAF/5/068	Improving Livestock Productivity through Strengthened Transboundary Animal Disease Control using Nuclear Technologies to Promote Food Security (AFRA) **Objective**: To integrate livestock disease control in support of increased livestock productivity to enhance food security. To use an integrated approach while deploying available appropriate technologies to bring about sustainable improvement of livestock production among AFRA Member States. This will contribute to food security and poverty reduction, especially among small-holder farmers.	H. Unger A. Diallo C. Lamien
RAS/5/060	Supporting Early Warning, Response and Control of Transboundary Animal Diseases **Objective:** To establish a regional/national network of laboratories and training centres on early diagnosis, response and control of transboundary animal diseases and eradication programmes for zoonotic diseases.	H. Unger
RAS/5/063	Improving the Reproductive and Productive Performance of Local Small Ruminants by Implementing Reliable Artificial Insemination Programmes **Objective**: To improve small ruminants productivity by implementing reliable artificial insemination programmes.	M. Shamsuddin / M. Garcia A. Diallo K Periasamy
RAS/5/069	Complementing Conventional Approaches with Nuclear Techniques towards Flood Risk Mitigation and Post-Flood Rehabilitation Efforts in Asia **Objective**: To improve the capacity to develop resilience/adaptation of agricultural production systems to flooding events by (i) generating flood-tolerant crops using nuclear techniques, (ii) improving soil-water-nutrient management practices by isotopic techniques for flood adaptation-rehabilitation approach, (iii) optimizing use of local feed resources while protecting the environment, animal production and locally adapted animal breeds, and early and rapid diagnosis/control of trans-boundary animal/zoonatic diseases, (iv) flood management by use of isotope hydrology, comprehensive water resources assessment, including river basin and groundwater systems, for forecasting occurrence and potential extent of floods, and (v) developing strategies to exploit the potential of floodplains to absorb floodwater to the extent possible and to fulfil additional needs of drinking and irrigation through use of groundwater from floodplains.	G. Viljoen / I. Naletoski A. Diallo C. Lamien
RER/5/016	Supporting Coordinated Control of Transboundary Animal Diseases with Socioeconomic Impact and that Affect Human Health **Objective**: To reduce transboundary disease incidence in livestock and livestock products in the Euro-Asian region.	I. Naletoski A. Diallo C. Lamien
RLA/5/049	Integrated Control of Fascioliasis in Latin America (in support of National Programmes **Objective**: Integrated control of fascioliasis (in support of national programmes).	G. Viljoen I. Naletoski
SEY/5/008	Building Capacity for Diagnosis of Animal Diseases using Nuclear and related Techniques (Phase I) **Objective**: To enhance local production of livestock in order to improve local food and nutrition security by reducing the country`s dependence on importation of animal and animal products..	H. Unger G. Viljoen

TC Project	Description	Technical Officer(s)
SIL/5/013	Establishing a Dual-Purpose Cattle Development Project for the Sustainable Contribution to Food Security, Poverty Alleviation and Improved Livelihoods of Communities Raising Cattle **Objective:** Sustainable contribution to food security, poverty alleviation and improved livelihoods of communities raising cattle.	M. Shamsuddin H. Unger
SRL/5/042	Applying Molecular Diagnostics to Zoonotic Diseases **Objective**: To enhance the long term epidemic preparedness by developing competence in molecular diagnosis and surveillance of zoonotic infections.	H. Unger C. Lamien
SRL/5/045	Establishing a National Centre for Nuclear Agriculture **Objective**: To develop and implement programmes on the use of nuclear technology applications in the field of agricultural soil, water and plant nutrient studies, crop variety improvement and associated management technologies.	H. Unger C. Lamien
SUD/5/036	Improving Livestock Production for Enhanced Food Security through Genetic Improvement of Indigenous Animal Breeds Using Artificial Insemination, Improved Nutrition and Adequate Animal Disease Control Measures **Objective**: To attain food security by improving livestock productivity.	N. Naletoski M. Garcia Podesta
THA/5/053	Enhancing Productivity and Control of Reproductive Diseases of Dairy Cattle and Buffaloes by Application of Nuclear-Based and Molecular Techniques **Objective**: To enhance productivity of dairy cattle and buffaloes in Thailand in order to obtain food security, poverty reduction and a good quality of life for farmers according to the national development programme for food and agriculture, with a focus on animal productivity and disease control.	G. Viljoen M Shamsuddin
TUN/5/028	Supporting Watering Strategies to Help Livestock Raised in Semiarid and Arid Regions Coping with Climate Change **Objective**: To characterize, analyse and to adjust watering strategies for livestock adopted in different production systems in the main agroecological areas of Tunisia. To enhance livestock performance, secure the sustainability of livestock-based production systems and contribute to the empowerment of livelihoods of rural communities.	M. Garcia Podesta I. Naletoski
UGA/5/032	Improving Animal Production and Productivity through Advanced Animal Disease Control and Animal Production Measures **Objective:** To improve animal production and productivity through advanced animal disease control and animal production measures.	H. Unger C. Lamien
UGA/5/035	Improving Food Safety through Surveillance of Fish Diseases **Objective**: To avail credible information about trace metals and aflatoxins in fish.	H. Unger C. Lamien
URT/5/027	Improving Livestock Production and Productivity through Sustainable Application of Nuclear and Related Techniques **Objective:** The broad objective of this project is to improve livestock production and productivity in the United Republic of Tanzania through sustainable application of various nuclear and nuclear related techniques.	M. Shamsuddin M. Garcia
URU/5/028	Improving the Diagnosis of Bacterial, Viral and Parasitic Zoonotic Diseases that Impact the National Economy and Human Health **Objective**: Improvement of the diagnosis of important zoonotic diseases (eg Newcastle Disease, Fascioliasis, Leptospirosis, Micobacterium and others).	G. Viljoen

TC Project	Description	Technical Officer(s)
YEM/5/012	Improving Diagnostic and Analytical Capabilities of the Central Veterinary Laboratory Including Residue Testing of Animal Products **Objective**: To enhance livestock productivity and quality by reducing the incidence of livestock diseases.	H. Unger
ZAI/5/021	Upgrading Laboratory Services for the Diagnosis of Animal Diseases and Building Capacity in Vaccine Production to Support the Sustainability of Food Security and Poverty Alleviation **Objective:** To support the sustainability of food security and poverty alleviation through animal diseases diagnosis and immunization.	H. Unger A. Diallo
ZAI/5/023	Upgrading Laboratory Services for Capacity Building in Fish and Aquaculture Diseases as a Contribution to Sustainable Poverty Alleviation and Sanitary Security of Food **Objective**: To enhance advanced skills in the diagnosis and investigation of fish and aquaculture diseases as a contribution to sustainable poverty alleviation and sanitary security of food.	A. Diallo H. Unger
ZAM/5/028	Improving Productivity of Dairy Animals Maintained on Smallholder Farms through Selected Breeding and Effective Disease Diagnosis and Control Using Isotopic and Nuclear Techniques **Objective:** To improve productivity of dairy animals maintained on smallholder farms in rural areas through selected breeding, effective disease diagnosis and control, improved supply of quality feeds and application of assisted animal reproduction techn.	I. Naletoski M. Garcia
ZIM/5/016	Strengthening Food Security and Safety by Advancing Technologies for the Rapid Diagnosis of Diseases of Major Economic and Zoonotic Importance and for Residue/Pesticide Control in Animals and Animal Products **Objective:** Strengthening the existing technology and capacity to rapidly diagnose diseases of major economic and zoonotic importance and enable proper and timely response to disease outbreaks.	I. Naletoski

Publications

First Complete Genome Sequence of a Lineage III Peste des Petits Ruminants Virus

Dundon W.G.**, Kihu S.M., **Settypalli T.B.,** Gitao G.C., Bebora L.C., John N.M., Oyugi J.O., Silber R., Loitsch A., **Diallo A.

Genome Announc.2014 Oct 23;2(5). e01054-14.

Peste des petits ruminants (PPR) is a highly infectious transboundary viral animal disease that affects mainly sheep, goats and small wild ruminants. Sheep and goats contribute considerably to the cash income and nutrition of small farmers in many countries so the control of PPR, with morbidity and mortality rates of 70-80%, is considered an essential element in the fight for global food security and poverty alleviation. PPR viruess have been classified into four genetic lineages based on the comparison of a sequence fragment for the N and/or F genes. Lineage four is prevalent in Asian countries while all four lineages have been found in Africa. At the time of publication, only eleven full genome sequences were available in public databases representing three of the four lineages.

In May 2011, in Turkana County Kenya, tissue samples were collected from three female goats suspected of dying of PPR. The tissue samples were transported on ice to the University of Nairobi and stored at -80°C. In May 2014 the samples were shipped to the Austrian Agency for Health and Food Safety for further characterization. The RNA from one positive lung sample was selected for genome

sequencing. At the time of publication, the genome had the highest nucleotide sequence identity (87.2%) with the lineage II virus Nigeria 76/1 (EU267274) and the lowest identify (82.5%) with the lineage IV virus Sungri/96 (KF727981).

Also at the time of publication, this was the first available complete genome of a lineage III PPRV that, in combination with data on experimental and field infections in animals, will provide a clearer understanding of the genetic influences on host specificity and viral pathogenicity and transmission of PPRV.

Full genome sequence of a peste des petits ruminants virus (PPRV) from Ghana

Dundon W.G., Adombi C., *Waqas A.,* *Otsyina H.R., Arthur C.T., Silber R., Loitsch A.,* ***Diallo A.***

Virus Genes. 2014 Aug 24. Epub ahead of print

The samples analysed in this study were collected from sheep and goats suspected of being infected with the PPRV as they were manifesting the following symptoms: fever, ocular and nasal discharges, diarrhoea and erosive lesions in the buccal mucous membrane. They were collected in Ghana between September 2009 and March 2010 and sent on dry ice to the Austrian High Security Laboratory, Vienna, for processing. They included ocular (n=7), nasal (n=10) and buccal (n=6) swabs from 6 animals and 12 tissue samples from four other animals [lung (n= 4), lymph node (n=4) and spleen (n=4)]. All samples tested by RT-PCR were positive for PPRV. One of the positive isolates (i.e. KJ676597) was chosen for full genome sequencing. This isolate (PPRV Ghana/NK1/2010) originated from the lung of a female sheep collected on the 14-01-2010 in Accra. The full genome sequence of PPRV Ghana/NK1/2010 is available from GenBank under accession number KJ466104. The sequencing of the full genome of the virus generated 15,948 bp of sequence. The organization of the genome was the same as those described previously with a 107 nt genome promoter region at the 3'end followed by the transcription units for the N, P, M, F. H and L proteins and the antigenome promoter at the 5' end.

At the time of publication, this was the first genome sequence from a PPRV isolated in Ghana and the most recent lineage II sequence available. The other sequences of lineage II viruses in Genbank were from viruses isolated in 1975 and 1976 respectively so this study provided important data on the evolution of lineage II virus over a 35 year period.

Development and validation of a 3ABC antibody ELISA in Australia for foot and mouth disease

Colling A., Morrissy C., Barr J., Meehan G., Wright L., Goff W., Gleeson L.J., van der Heide B., Riddell S., Yu M., Eagles D., Lunt R., Khounsy S., Ngo Than Long, Pham Phong Vu, Nguyen Than Phuong, Nguyen Tung, Linchongsubongkoch W., Hammond J., Johnson M., Johnson W.O., ***Unger H.****, Daniels P., Crowther J.R.*

Austr Vet J (2014) 92(6): 192-199. doi: 10.1111/avj.12190

Objective: To measure the diagnostic performance of an Australian-developed ELISA for the detection of antibodies against the non-structural proteins (NSP) 3ABC of the foot and mouth disease (FMD) virus.

Design Test development and validation study.

Methods: The diagnostic specificity was determined using 2535 sera from naïve animals and 1112 sera from vaccinated animals. Diagnostic sensitivity was calculated from the data for 995 sera from experimentally and field-infected animals from FMD-endemic countries in South East Asia. A commercial ELISA detecting antibodies against FMD virus NSP was used as the r ference test to establish relative sensitivity and specificity. Bayesian latent class analysis was performed to corroborate results. The diagnostic window and rate of detection were determined at different times using sera from cattle, sheep and pigs before and after infection, and after vaccination and subsequent infection. Repeatability and reproducibility data were established.

Results: At 35% test cut-off, the 3ABC ELISA had an overall diagnostic sensitivity of 91.5% and diagnostic specificity of 96.4%. The diagnostic sensitivity in vaccinated and subsequently infected cattle was 68.4% and diagnostic specificity in vaccinated cattle was 98.0%.

Conclusions: The 3ABC ELISA identified field and experimentally infected animals, as well as vaccinated and subsequently infected animals. Diagnostic sensitivity and specificity estimates for other FMD NSP tests are comparable with the results obtained in this study. This NSP ELISA was found to be'fit for purpose'as a screening assay at the herd level to detect viral infection and also to substantiate absence of infection.

Characterization of sheep pox virus vaccine for cattle against lumpy skin disease virus

Tuppurainen E.S.M., Pearson C.R., Bachanek-Bankowska K., Knowles N.J., Amareen S., Frost L., Henstock M.R., ***Lamien C.E., Diallo A.****, Mertens P.P.C.*

Antiviral Research (2014) 109: 1-6. doi: 10.1016/j.antiviral.2014.06.009

Lumpy skin disease is of significant economic impact for the cattle industry in Africa. The disease is currently spreading aggressively in the Near East, posing a threat of incursion to Europe and Asia. Due to cross-protection within the Capripoxvirus genus, sheep pox virus (SPPV) vaccines have been widely used for cattle against lumpy skin disease virus (LSDV). In the Middle East and the Horn of Africa these vaccines have been associated with incomplete protection and adverse reactions in cattle post-vaccination.

The present study confirms that the real identity of the commonly used Kenyan sheep and goat pox vaccine virus (KSGP) O-240 is not SPPV but is actually LSDV. The low level attenuation of this virus is likely to be not sufficient for safe use in cattle, causing clinical disease in vaccinated animals. In addition, Isiolo and Kedong goat pox strains, capable of infecting sheep, goats and cattle are identified for potential use as broad-spectrum vaccine candidates against all capripox diseases.

Scientifically achievable directives: a key driver in the control of transboundary animal diseases

Liang Q., Garcia Podesta M., Diallo A., Viljoen G.J.

Journal of Consumer Protection and Food Safety 9(Suppl): 93-100. doi: 10.1007/s00003-014-0891-y

Research can deliver answers to infinite numbers of unsolved questions and provide solutions to problems affecting humankind. Science underpins innovation and technological development, and ultimately provides benefits to humanity. Science, politics, and policy are and should be, the three legs of any country's legal and regulatory process. Unfortunately, scientists, politicians and policy-decision makers are often disconnected, because research is seen as not being applicable to a particular field or there is a lack of communication and understanding between scientists, investors and stakeholders. The route from science to policy can be complex; however, communication should be early, frequent, and consistent. Communication advocacy and a two-way knowledge sharing is paramount in order to inform policy dialogue, scientific research/advancement and provide useful tools for the future that benefit and is accepted by society.

This paper shows three successful examples of the Joint FAO/IAEA (Food and Agriculture Organization of the United Nations/International Atomic Energy Agency) Division of Nuclear Techniques in Food and Agriculture in bringing science to the end-user and decision maker, and highlights the role that policy plays in such endeavours. The first example deals with the worldwide eradication of an animal disease (rinderpest), the second with an African network of diagnostic laboratories of animal diseases in Africa, and the third with international technical support for the control of foot-and-mouth disease in Mongolia.

The results show that when approached in an open and motivated environment, unbiased science can indeed make a difference in formulating policy.

Bovine spermatozoa react to in vitro heat stress by activating the mitogen-activated protein kinase 14 signalling pathway

Rahman M.B., Vandaele L., Rijsselaere T., El-Deen M.S., Maes D., ***Shamsuddin M.****, Van Soom A.*

Reprod Fertil Dev (2014). 26(2):245-257. doi: 10.1071/RD12198

Heat stress has long been recognised as a cause of subfertility in farm animals. The objectives of the present study were to elucidate the effect of heat stress on sperm function and involvement of the mitogen-activated protein kinase (MAPK) 14 signalling pathway. Spermatozoa incubated for 4 h at a physiological temperature (38.5°C) exhibited significantly ($P<0.05$) reduced motility, plasma membrane integrity and mitochondrial potential compared with non-incubated spermatozoa; the reductions in these parameters were more severe following incubation at a hyperthermic (41°C) temperature ($P<0.01$). Percentages of fertilisation and embryo development were highly affected in spermatozoa incubated at 41°C compared with non-incubated spermatozoa ($P<0.01$). Similarly, embryo quality was adversely affected by sperm incubation at 41°C, as indicated by a higher apoptotic cell ratio in Day 7 blastocysts compared with that in the non-incubated control group (14.6% vs 6.7%, respectively; $P<0.01$). Using SB203580 (10 μgmL(-1)), a specific inhibitor of the p38 MAPK pathway, during sperm hyperthermia reduced MAPK14 activation (24.9% vs 35.6%), increased sperm motility (45.8% vs 26.5%) and reduced DNA fragmentation (16.9% vs 23.4%) compared with the untreated control group, but did not improve subsequent fertilisation and embryo development. In conclusion, heat stress significantly affects the potential of spermatozoa to penetrate oocytes, as well as subsequent embryo development and quality. Notably, the data show that the MAPK14 signalling pathway is largely involved in heat-induced sperm damage. However, further research is needed to elucidate other signalling pathways possibly involved in heat-induced sperm damage.

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