Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Animal Production & Health Newsletter

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To Our Readers

Dear Colleagues,

This year went particularly fast with many unexpected and emergency food security challenges and it was indeed an asking period for the Animal Production and Health Subprogramme. We have some remarkable achievements but also some gaps, such as improved communication and collaboration, where we need to improve our support to Member States. As 2015 draws to a close, we are completing our activities and contributions to the 2014-2015 IAEA and FAO programmes of work and budget, and finalizing our tasks and products and services for the next biennium. We hope that our programme will continue to be relevant to the needs of our Member States.

FAO/IAEA Agriculture & Biotechnology Laboratories.

The contribution of the Animal Production and Health Subprogramme to the current highly pathogenic avian influenza H5N1 emergency in western Africa comes to mind. On 16 January 2015, Nigeria confirmed the re-emergence of the deadly highly pathogenic avian influenza H5N1 strain (HPAI-H5N1) to the World Organisation for Animal Health (OIE). The disease spread rapidly reaching 18 of the 37 states in the country, decimating affecting poultry farms and live bird markets. This marked the first occurrence of HPAI H5N1 in the West Africa region since the last epidemic in 2006–2008. Since then (from January to June 2015), other countries in the region, namely Benin, Burkina Faso, Niger, Cote d'Ivoire, Togo and Ghana, officially reported outbreaks of the disease. This was unprecedented as previously only Egypt and Nigeria reported limited presence of the disease. The scale and spread, and potential threat to human lives formed the basis of Member States' concerns and therefore an urgent request for assistance was made for support and action. Globally, outbreaks of HPAI H5N1 have killed millions of birds and forced the culling of several hundreds of millions more in recent years. Added to this, about 60% of all humans infected with this deadly virus died. Early and rapid diagnosis is key to stop the spread of avian influenza and to control the disease at its outbreak source. This requires direct support and guidance to national veterinary laboratories in the region to meet this challenge (i.e. to hit the ground running). Upon requests by Member States in the African Region, the IAEA and FAO immediately reacted to the situation by taking advantage of the FAO animal health response and support mechanism, the Joint FAO/IAEA Division's VETLAB Network of veterinary diagnostic laboratories and the IAEA TC Programme's responsiveness to unforeseen needs of Member States. Expert missions were fielded by sending FAO and IAEA staff together with outside avian influenza experts to address the diagnostic needs in Cote d'Ivoire, Niger, Ghana, Nigeria, Togo, Senegal, Mali, Burkina Faso and others in the region. These missions proved to be very successful in the rapid diagnosis, action and declaration of the disease.

As part of the emergency response, the Joint Division's Animal Production and Health Section collaborated closely with the FAO Animal Health Service. Provision was made

for a diagnostic toolbox, kits (containing all the necessary reagents and consumables), essential equipment, validated guidance and standard operating procedures and on-line support to backstop the expert missions to countries in western Africa.

In addition, all IAEA and FAO staff was and still is available on-line to address any questions arising from this outbreak. Further, in parallel to the one-on-one expert support in country, a refresher training course was organized in September 2015 to provide training on the early and rapid diagnosis of HPAI H5N1 to 24 participants from 11 Member States in Africa (Benin, Burkina Faso, Cameroon, Chad, Cote d'Ivoire, Central African Republic, Ghana, Burundi, Mali, Niger, Zimbabwe, Senegal and Togo). Two more refresher HPAI H5N1 training courses are being planned for 2016 to address the topic in other areas. The actions of the relevant staff from the Animal Production and Health Subprogramme (together with staff from the IAEA Technical Cooperation Department) to support Member States to fight the threats of zoonotic diseases, culminated in receiving the 'IAEA 2015 Superior Achievement Team Award'. We hope that we can serve our Member States with the same enthusiasm in future, and I want to thank all our counterparts and other interested parties for their continued support and care.

Training course participants and staff.

Both past and future activities are described in detail in this newsletter and are also accessible at our website (http://www-naweb.iaea.org/nafa/aph/index.html); I thus need not mention them in this section. Please contact us if you have any further ideas, comments, concerns or questions. As discussed in previous newsletters, the Animal Production and Health Subprogramme will continue to move progressively forward and in pace with developments within the livestock field to optimally serve our Member States.

Concerning news from the APH Subprogramme, we want to welcome our new staff member, Viskam Wijewardana. He is an immunologist from Sri Lanka and joined the Section in August 2015 to expand our work related to vaccines, diagnostics and disease pathogenesis. Before joining IAEA, he worked as a Senior Lecturer in Laboratory Medical Sciences at the University of Peradeniya, Sri Lanka. Viskam has also worked as a post-doctoral research fellow at the University of Pittsburgh, USA and Osaka Prefecture University, Japan in the areas of Viral and Cancer Immunology. He has obtained his degree in veterinary medicine from University of Peradeniya and PhD from Osaka Prefecture University. We hope that he will have a pleasant and productive time with the Animal Production and Health Subprogramme.

Finally, I wish you all and your families a happy, healthy and safe 2016.

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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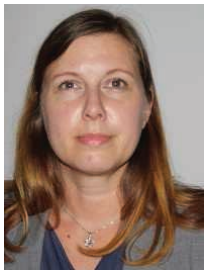
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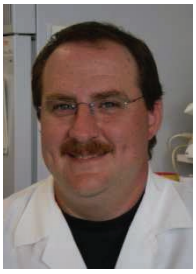
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Forthcoming Events

Technical Workshop: Remediation of Radioactive Contamination in Agriculture

The workshop will take place 17–18 October 2016 at IAEA Headquarters, Vienna.

Breaking news – just as this Newsletter was being finalized, the National Agriculture and Food Research Organization (NARO) of Japan and the Joint Division initiated a joint project to hold a Technical Workshop: "Remediation of Radioactive Contamination in Agriculture". A two day meeting at the IAEA in Vienna is being planned for 17 and 18 October 2016. Recovery from the Great East Japan Earthquake and the Fukushima Daiichi Nuclear Power Plant accident is an important cornerstone of NARO's R&D mission and it has been contributing to the development of decontamination technologies for farmland soil, and radionuclide transfer-control technologies for agricultural production. It is envisaged that the Technical Workshop will also include results of agricultural remediation activities from areas affected by the accident at the Chernobyl Power Plant. This year marks the 5th and 30th anniversary of both events respectively and there is considerable interest from our member countries on limiting the impact of radio caesium on agricultural production. We will announce more details on the Joint Divisions website in due course.

International Symposium on the Role of Agriculture Biotechnologies in Sustainable Food Systems and Nutrition

Technical Officer at APH: Gerrit Viljoen

The Symposium will take place from 15 to 17 February 2016 at FAO Headquarters, Rome, Italy.

The international symposium will explore how the application of science and technology, particularly agricultural biotechnologies, can benefit smallholders in developing sustainable food systems and improving nutrition in the context of climate change.

The symposium takes a multisectoral approach, covering crop, livestock, forestry and fishery sectors. It also aims to cover the wide spectrum of available biotechnologies, including microbial food fermentation, tissue culture in plants, reproductive technologies in livestock, use of molecular markers, genetic modification and other technologies.

The symposium takes place over two and a half days, with keynote speakers addressing the plenary sessions on 15 and 16 February. A high-level ministerial segment will take place on 16 February. Three parallel sessions will also be held each day and the symposium will close on 17 February 2016 with a final plenary session where outcomes from the parallel sessions will be reported.

The target audience for the symposium includes representatives of governments, intergovernmental organizations and of non-state actors, including civil society, private sector, research/academic institutions and cooperatives/producer organizations.

For more information please refer to the web page http://www.fao.org/about/meetings/agribiotechs-symposium/en/.

First Research Coordination Meeting on the veterinary diagnostic laboratory network ("VETLAB Network") to prevent and control Transboundary animal diseases (TADs)

Technical Officers: Ivancho Naletoski, Charles Lamien

The training course will take place in the second quarter 2016 in Vienna, Austria.

The Committee for Coordinated Research Activities (CCRA) of IAEA has recently approved the new project proposal of the Animal Production and Health Subprogramme entitled 'Early detection of transboundary animal diseases (TADs) to facilitate prevention and control through a Veterinary Diagnostic Laboratory Network (VETLAB Network).

The project targets to establish 5 outputs: i) to develop and validate a set of internationally acceptable standards for the serological diagnostic techniques for priority diseases; ii) to develop and validate a set of internationally acceptable standards for the molecular diagnostic techniques for priority diseases; iii) to develop molecular procedures for simultaneous detection of multiple pathogens (multi-pathogen detection panels) for selected syndromic diseases of animals; iv) to develop a procedure for easy access, free-of-charge genetic sequencing services for the pathogens of priority diseases and v) to establish an information platform for integrated information collection, geo-visualization, analysis and decision making among the partners of the VETLAB Network. The project will integrate the research activities of 10 research contract holders, 3 technical contract holders and several agreement

holders, who will be responsible for the implementation of the project tasks.

The first research coordination meeting (RCM) of the project is planned for the second quarter of and will aim at determining the technical solutions, such as priority diseases, priority diagnostic techniques, organization of the sequencing services and the components of the information platform. The conclusions and recommendations of the RCM will be used to upgrade and fine-tune the project workplan. Upon finalization, the project outputs will be disseminated to other Member States of IAEA and FAO through the Technical Cooperation Programme, the capacity building component of IAEA.

Coordination Meeting with Directors of Veterinary Laboratories in Africa and Asia that are Supported by the African Renaissance Fund and the Peaceful Uses Initiative

Technical Officer: Charles Lamien

The technical meeting will take place in the second quarter 2016 in Vienna, Austria.

Since 2011, IAEA has received support from the USA, South Africa and Japan to strengthen animal disease diagnostic capacities in selected sub-Saharan African countries. Two coordination meetings of that project were held in February 2014 and June 2015. A new proposal for PUI support of similar activities in Asia was granted in 2014 and the first coordination meeting with directors of Asian veterinary laboratories was held in 2015. During the two separate meetings for Africa and Asia, it was agreed that a joint coordination meeting will be held in 2016 with both African and Asian veterinary laboratory directors to promote the interaction between the two regions which are facing several common transboundary animal diseases. This will allow the sharing of knowledge, experience and create opportunities for collaboration.

Relying on regional laboratory networks, as those supported by FAO and the IAEA during the global rinderpest eradication campaign, has proven to be a highly efficient approach. It is anticipated that these directors of targeted African and Asian laboratories will meet at least once a year to discuss past activities and plan for the coming years. The meeting will allow both Asian and African laboratories members of the VETLAB network, which are supported through ARF and PUI, to review the work plans, share their experience, knowledge and identify areas of common interest for enhancing their capacity to better contribute to their respective national and regional TADs control strategies.

Second Research Coordination Meeting on the Early and Rapid Diagnosis and Control of African Swine Fever (ASF)

Technical Officer: Hermann Unger

The research coordination meeting (RCM) of the D3.20.21 coordinated research project (CRP) on Early and rapid diagnosis and control of TADs – second phase- African swine fever will take place from 20 to 24 June 2016 in Lusaka, Zambia.

In the course of the coordinated research project, the different existing ELISA tests for ASF were evaluated in the 6 participating laboratories with positive and negative samples locally collected. The results will be discussed during this meeting and recommendations for their application will be defined. Currently, molecular diagnostics, specifically PCR, direct PCR and qPCR, are under investigation and the results will be discussed during this meeting as well. The aim of this meeting is to develop a report on the assessment of the diagnostic tools for ASF diagnosis.

At this meeting, the work plans of the research contract holders as well as the protocols and cooperative activities designed to help in the design of clinical studies for prevention or control of ASF infections will be discussed.

Third Research Coordination Meeting on the 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 Officers: Ivancho Naletoski, Gerrit Viljoen

The third RCM will take place in the third quarter 2016 in Bulgaria.

All project contract holders of the CRP D3.20.30 on the Use of stable isotopes to trace bird migrations and molecular nuclear techniques to investigate the epidemiology and ecology of the highly pathogenic avian influenza, will be invited to attend the meeting. They will discuss the results obtained from the three main project components: the detection of avian influenza virus in sampled migratory birds, stable isotope ratios in the feather samples as indicators for the long range migration of wild waterfowl and the results of the DNA barcoding of fecal and feather samples, used as a tool for non-invasive determination of the bird species.

As of September 2016, the research contract holders have collected approximately 3000 fecal samples and 1900 feather samples of wild migratory waterfowl. The fecal samples have been partly tested in the counterparts' laboratories and partly sent to the laboratory in Seibersdorf (positive samples) for further shipment / analysis at the avian influenza reference laboratory of Animal and Plant Health Agency (APHA) in Weybridge, UK. The feather samples (n=678) have been submitted to the University of Saskatchewan, Canada, for determination of the stable isotope profiles. The DNA barcoding of the feather samples is planned to begin in December 2015 and will be performed at the IAEA Laboratories in Seibersdorf. The CRP will be active until the end of 2017. The samples collected during 2016 and 2017 will be processed according to the existing work plan.

Past Events

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 technical meeting with directors of African veterinary laboratories that are supported by the African Renaissance Fund and the Peaceful Uses Initiative to strengthen animal disease diagnostic capacities was held at the IAEA Headquarters in Vienna, Austria, from 16 to 18 June 2015.

The following 13 partner laboratories were represented: **Botswana** (National Veterinary Laboratory, Gabarone), **Burkina Faso** (Laboratoire National d'Elevage, Ouagadougou), **Cameroon** (Laboratoire National Vétérinaire, Garoua), **Chad** (Institut de recherche en élevage pour le développement, N'Djamena), **Democratic Republic of Congo** (Laboratoire Vétérinaire de Kinshasa), **Ethiopia** (National Animal Health Diagnostic and Investigation Centre. Sebeta), **Ethiopia** (National Veterinary Institute, Debre Zeit), **Mali** (Laboratoire Central Vétérinaire, Bamako), **Mozambique** (Animal Science Directorate Central Veterinary Laboratory, Maputo), **Senegal** (Institut Sénégalais de Recherches Agricoles, Dakar), **Tanzania** (Tanzanian Veterinary Laboratory Agency, Mwanza), **Namibia** (Central Veterinary Laboratory, Windhoek), **Zambia** (Central Veterinary Research Institute, Lusaka).

Two partners from Cote d'Ivoire (Laboratoire Central vétérinaire, Bingerville) and Kenya (Central Veterinary Laboratory, Nairobi) were unable to attend the meeting. Partners updated on their progress and achievements in implementing the 2014 work plans, and also stressed the new challenges they have been facing. Some of the challenges are the re-emergence of highly pathogenic avian influenza in West Africa and the high threat of peste des petits ruminants disease for Southern African countries.

Significant achievements that occurred following the first technical meeting with the support of this project were:

- Accreditation of the NVI laboratory in Ethiopia
- Diagnostic services were provided by LANAVET, Cameroon, to Chad on African swine fever, and Gabon for several TADs
- The management of the recent HPAI outbreak by LNE in Burkina Faso
- The increase in the number of assays under accreditation by Botswana and NAHDIC Ethiopia.

The respective laboratories highlighted the significant contributions of this project particularly in bringing together several laboratories of Africa and share their experience and knowledge. For instance, the partners from Burkina Faso shared their experience and challenges on HPAI crisis management at both the laboratory and field levels, which was found very useful by the participants from countries that are not yet affected. Similarly, NAHDIC shared their experience in setting up a cost-effective biosafety level 3 laboratory, which is affordable for many other laboratories of the network. From the partners' presentations it was evident that all these countries shared many common TADs of major concern which included peste des petits ruminants, African swine fever, Capripox disease, foot and mouth disease, avian influenza, Newcastle disease, rabies, and CBPP.

Training course on the Early Detection of Animal Diseases in Post Flooding Environment, with Emphasis on Water Borne and Vector Borne Diseases (Project RAS/5/069)

Technical Officer: Ivancho Naletoski

The training course was held from 15 to 26 June 2015 at the IAEA Laboratories in Seibersdorf, Austria.

The first coordination meeting of the Technical Cooperation (TC) project RAS/5/069 – 'Complementing Conventional Approaches with Nuclear Techniques towards Flood Risk Mitigation and Post-Flood Rehabilitation Efforts in Asia' was held during June 2014. The overall objective of the coordination meeting was to adjust the project activities to contribute to the improvement of the capacity of participating Member States to develop strategies/guidelines for resilience/adaptation of agricultural production systems to flooding events by integrated strategies, based on nuclear and nuclear related techniques.

Twenty three participants from 13 Member States (MSs) of the Asian region (Bangladesh, Cambodia, China, Indonesia, Lao P.D.R., Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam) participated in the course. Four international experts were invited to cover the topics of the course: i) Leptospirosis; ii) Bluetongue and West Nile fever; iii) Clostridial infections of animals and iv) Disease mapping and modelling using geo information/visualization tools (GIS).

The training course covered a wide range of theoretical and practical aspects of the diagnosis and control of the targeted diseases. The trainees had an opportunity to practically use and evaluate nuclear derived techniques, such as the Enzyme Linked Immunosorbent Assay (ELISA) and the Polymerase Chain Reaction (PCR) in early detection of animal diseases.

Leptospirosis was covered with an indirect ELISA for detection of antibodies against the disease (indirect evidence of disease circulation) and a PCR technique for direct detection of the bacterial genome.

For the clostridial infections, the trainees were using ELISA for detection of both, the bacterial toxins (alpha, beta and epsilon) and the pathogen itself (Clostridium perfringens). Extensive discussions with the expert were initiated on the interpretation of the results, considering the detection of one or multiple clostridial toxins in the examined samples. A PCR technique for detection of the genome of Clostridium perfringens was also included.

As a model for vector borne diseases, bluetongue and West Nile fever were used. An important topic was the epidemiological relationship between the presence of pathogens in vectors (primarily arthropods) and final hosts (animals or humans), as well as scientific approaches to monitor and control these diseases in both carriers. The practical module on vector borne diseases included a competitive ELISA technique (an ELISA which may be used for detection of antibodies in multiple animal species) and RT-PCR techniques used for the detection of viral ribonucleic acids (RNAs), applicable for both, vectors and final carriers.

Geo-information / visualization technologies and tools are gaining increasing interest among scientific communities, because of their potential to visualize the disease events directly on geographical maps. An expert in GIS technologies gave lectures on their use in disease visualization, monitoring and modelling. Special focus was given to the potential of these technologies to simultaneously monitor and analyse multi sectorial events which may influence disease spread, such as the dynamics of environmental temperature, humidity, rainfalls, wind directions and speed and others, and relate them to disease events. The technical officers of APH have included several practical classes with historical (but real) disease events in this package, such as: i) the use of vector and raster data in GIS software; ii) linking tabular data onto GIS platforms, iii) real-time tracking of disease developments on a GIS map; iv) aggregating disease events at the level of administrative units of MSs or at the level of pre-defined raster gridlines and v) animating disease events over a specific timeframe and specific geographical area.

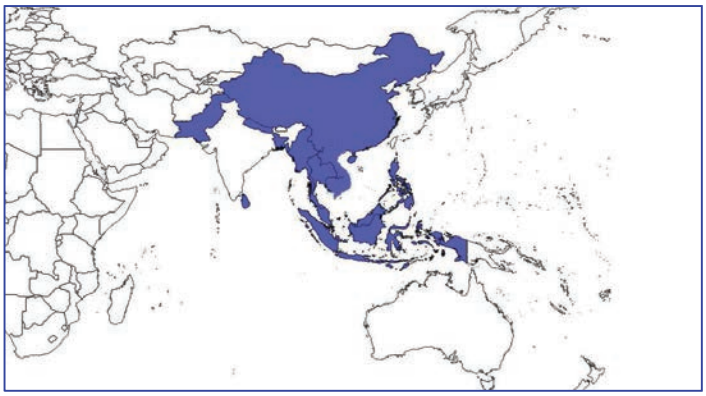

Figure 1: Participating Member States at the training course.

Figure 2: Participants at the training course with the technical officers of the APH, in front of the IAEA laboratories in Seibersdorf.

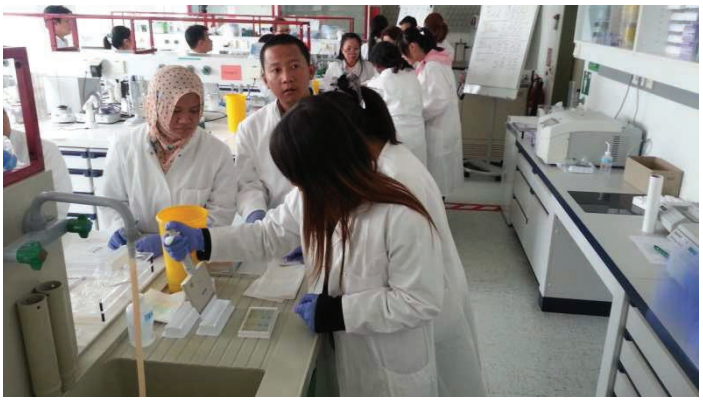

Figure 3: Practical classes on the techniques used for early and rapid detection of animal diseases at the IAEA laboratories in Seibersdorf.

Third Research Coordination Meeting on the Development of Molecular and Nuclear Technologies to Diagnose and Control Foot-and-Mouth Disease

Technical Officer: Gerrit Viljoen

The final research coordination meeting (RCM) was held in Vienna, Austria from 6 to 10 July 2015.

The food and mouth disease (FMD) CRP investigated 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.

Discussions were focused on (1) the status of FMD in the participating counterpart's respective countries (eg. FMD free *vs* FMD free zone with or without vaccination *vs* FMD endemic) with respect to the risks and threats; (2) what are 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 are 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).

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.

Meeting participants and IAEA staff.

All the counterparts developed their work plans such that, individually and or collectively, they work towards generating solutions set by the objectives of the FMD CRP with target date set at 31 December 2015:

- Methods and internationally agreed protocols for measuring the potency of FMD vaccines using *in vitro* methods.
- Guidelines for optimum population vaccination intervals based on *in vitro* measurements of potency and duration of the antibody response to structural proteins, after vaccination of cattle and small ruminants with commercially available FMD vaccines, including evaluation of reduced dose options such as intradermal administration of FMD vaccine;
- SOPs 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
- Evaluation and standardization of:
    - 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)

Regional training course on Artificial Insemination in Sheep and Goats (RAS/5/063)

Technical Officer: Mario Garcia

The course took place from 22 to 26 June 2015 in Sassari, Sardinia, Italy.

This one-week training course was held at the Agenzia della Regione Sardgna (AGRIS) and was the sixth training course of the regional project and the second training course on artificial insemination (AI). The course was focused on sheep and goats to provide knowledge and know-how on animal reproductive physiology, oestrous cycle, heat detection, semen collection and processing, techniques and procedures for artificial insemination, male selection, male management, and data recording for assessing reproductive performance. The main objective was to transfer knowledge and develop skills that can be used to improve livestock production through applying reproductive management and selective breeding strategies.

The course was open to participants from IAEA Member States in the Arab-Asia region. Three Iraqis and four Jordanians attended the course. Lectures related to semen processing and artificial insemination were given by Dr M Dattena, on nutrition preparation to the breeding season by Dr G Molle and on male selection and genetic improvement by Dr A Carta, all AGRIS staff. The Technical officer contributed with lectures on animal identification and data collection in AI programmes. Practical work on ram semen collection, semen processing and packing and semen distribution was conducted by Dr M Gallus (AGRIS) and her team. Course participants were able to view and discuss the entire process of semen collection, processing and distribution. Females are usually heat synchronized on the island so the AI technician can visit the farm and inseminate all females within 4–8 hours after semen was collected. Insemination was done following the cervical method. Farm visits provided an excellent opportunity to evaluate the results of artificial insemination in progressive farms and to discuss the benefits, constraints and overall results directly with farmers.

This course was the last technical activity of the ARASIA TC Project RAS/5/063.

Regional (AFRA) Training Course on Rapid Field Diagnostic Detection of Vector Borne Diseases (RAF/5/068)

Technical Officers: Hermann Unger, Charles Lamien

The training course will take place from 29 June to 3 July 2015 in Yaoundé, Cameroon.

The training course was attended by 24 participants from 17 MS and covered the serological and molecular diagnosis of vector borne diseases with special focus on Trypanosomosis, RVF and ASF. The lecturers from Cameroon and Australia embarked on the basic epidemiology of these diseases, their prevalence and then addressed the diagnostic tests for livestock and in the vectors. Practical training sessions were held for ELISA detection of RVF and ASF antibodies and molecular detection by direct PCR for ASF and LAMP for Trypanosomosis. The course gave the participants good hands on experience to introduce these testing methods ion their own laboratories.

Regional (AFRA) Training Course on Application of Herd Management Strategies for Improved Production (RAF/5/068)

Technical Officer: Hermann Unger

The training course took place from 24 to 28 August 2015 at the National Artificial Insemination Centre in Arusha, United Republic of Tanzania.

The training course in applied livestock management was held at the National Artificial Insemination Centre in Arusha, Tanzania, for 23 veterinarians and animal husbandry scientists involved in livestock breeding and management of 12 AFRA Member States. The course was led by 3 experts from Tanzania and Uganda and covered breeding and performance recoding of cattle using the AIDA and LIMA software solutions, identification systems for ruminants and the inhibiting factors for milk and meat production. The discussions held after each topic revealed that in most African countries, a breeding policy and proper recording is non-existent or if in place, it is not implemented and so this venue presented the tools available to implement such a policy. As the major inhibiting factors on livestock productivity lack of feeds management and udder infections were revealed. Specifically, mastitis in the context of improved breeds by artificial insemination urgently needs attention to reduce the resistance build-up of the bacteria and the resulting contamination of the food chain. It was recommended that AI centres should get involved in such simple diagnostic procedures and inseminators could provide the sampling

service as well as the treatment advice. Regarding the reproductive performance heat detection and the timely contacting an inseminator were seen as major hurdles and should be addressed by breeding organizations at farmer's level.

The feedback from this course was very positive as the lecturers addressed the issues in a very tangible way combined with their own experiences. Participants filled in a questionnaire which will be analyzed and the resulting conclusions will be published.

Regional Training Course on Enhancing Capacity of National Monitoring Teams for Diagnosis of Ebola Virus Disease under High Bio-Safety Conditions (RAF/0/042)

Technical Officers: Ivancho Naletoski, Hermann Unger

The training course will took place from 24 to 28 August 2015 in Yaoundé, Cameroon.

The regional training course comprised theoretical and practical classes on the biosafety and biosecurity measures during sample collections from animals suspected of having zoonotic viral hemorrhagic fevers (VHFs). Four international experts were invited to present their hands-on experience to the 17 participants from 9 African Member States (Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Mali, Nigeria, Sierra Leone, Togo and Uganda).

The theoretical classes covered the areas of applied biosecurity, important pathogens to be considered, practical biosafety issues to be considered during working in laboratory and in field conditions, practical and legal considerations during sampling and sample shipment, risk and risk assessment during sampling for VHFs with emphasis on Ebola Virus Disease (EVD), vaccines and treatment options for EVD, examples of on-going VHF surveillance programmes, use of personal protective equipment (PPE), and disposal of contaminated equipment, materials and remains.

The practical classes consisted of simulation exercises with step-by-step practical demonstration on: i) how to wear, adjust and control PPEs, ii) how to prepare the field around the animal when a suspected case is reported, iii) how to collect and to pack samples; iv) how to take off and decontaminate the PPE, v) how to ship samples to the laboratory, and vi) how to decontaminate the equipment, materials and working place. All participants have individually practiced the above mentioned procedures and each have received an emergency VHF sampling package (mobile suitcase with full PPEs for 20 samplings, all materials and consumables required for sampling, packaging, shipment and disposal of the contaminated waste).

During the course, substantial time was also devoted to liaising with partners (experts) and Member States' representatives to plan and organize future IAEA activities related to dangerous zoonotic diseases under the Technical Cooperation projects RAF/0/0042 and RAF/5/073, particularly the next regional training courses on biosafety/biosecurity, EVD molecular diagnostic and capture and collection of bat samples). Video recording of the course was also organized, in order to prepare e-learning materials for the field veterinarians from Member States which were not included in the two ongoing projects.

Course on the Rapid and Confirmatory Diagnosis of Avian Influenza H5N1 (RAF/5/073)

Technical Officers: William Dundon, Hermann Unger

The training course took place at the Animal Production and Health Laboratory, Seibersdorf, Austria, from 7 to 11 September 2015.

Avian influenza (AI) is caused by a virus that circulates in domestic poultry. Some of the AI strains are highly pathogenic (HPAI) causing high mortality among poultry populations. Globally, outbreaks of HPAI H5N1 have killed millions of birds and forced the culling of several hundreds of millions more in recent years. The economic and social impact of HPAI H5N1 can be devastating and so the control and eradication of this disease is considered a top priority in the fight for global food security and poverty alleviation.

In January 2015, Nigeria confirmed the presence of HPAI H5N1 to the World Organization for Animal Health (OIE) while neighbouring Burkina Faso and Niger reported outbreaks in April 2015. More recently, Cote d'Ivoire and Ghana reported outbreaks on 28 May 2015 and on 2 June 2015, respectively, confirming the rapid spread of the disease in the West Africa region.

Early and rapid diagnosis being the key to halting and controlling disease spread, National veterinary laboratories in the region need to be prepared to meet emergency requirements. Based on the experience of the IAEA's support to member states in dealing with such outbreaks in Asia, a short refresher course on laboratory emergency preparedness to tackle H5N1 highly pathogenic avian influenza outbreaks in northern and western Africa took place with twelve participants from Burundi (1), Benin (1), Burkina Faso (2), Central African Republic (1), Cameroon (1), Ghana (2), Cote d'Ivoire (1), Niger (1), Togo (1) and Zimbabwe (1) attending the course.

The course lecturers were Giovanni Cattoli and Isabella Monne from the OIE/FAO and National reference laboratory for avian influenza and Newcastle disease, Padova, Italy, and staff from the Animal Production and

Health Subprogramme. At the end of the course, each participant returned to their home laboratories with an Emergency Tool Box containing all the reagents necessary to perform the immediate screening of over 200 samples for H5N1.

Participants at the training course exercising the use of personal protective equipment during sampling in the field.

Regional Training Course on Diagnosis and Epidemiology of Peste Des Petits Ruminants (PPR) and African Swine Fever (ASF) (RAS/5/004)

Technical Officer: Hermann Unger

The training course took place from 13 to 17 September 2015 in Meymensing, Bangladesh.

The purpose of this training course was to provide comprehensive and up-to-date theoretical and practical training on serology and molecular diagnostic techniques for the diagnosis of PPR and ASF.

Dr Rafiqul Islam from University Mymensing together with Ms Anja Globig from the German FLI facilitated the course. Eighteen participants from Bangladesh, Belarus, China, Indonesia, Iraq, Cambodia, Malaysia, Myanmar, Oman, Pakistan, Philippines, Sri Lanka and Thailand participated at this training.

National Training Course on Quality Assurance on Molecular Biology, General Principles: Case of Rabies Diagnosis (MOR/5/034)

Technical Officer: Ivancho Naletoski

The training course took place from 28 September to 2 October 2015 at the Direction des Services Vétérinaires in Rabat, Morocco.

The objective of the course was to train the professional staff of the national laboratory network on the harmonized diagnosis of rabies virus infection. Ms Picard Meyer facilitated the course and 12 local participants attended.

LinkTADs - Linking Epidemiology and Laboratory Research on Transboundary Animal Diseases and Zoonoses in EU and China

Technical Officer: Ivancho Naletoski

In the period from 12 to 14 October 2015, the LinkTADs project has organized a series of meetings at the IAEA Headquarters in Vienna on: i) new diagnostic technologies, ii) coordination of research; and iii) Veterinary laboratory systems and policy. The first two meetings fall within the scope of WP4, while the last one incorporates WP4 and WP5.

The aim of the meetings was to review and discuss the current development of advanced laboratory technologies in the field of animal health, main streams in research and diagnostic areas and the instruments and adaptations needed to integrate the updated diagnostic platforms into the on-going control strategies and programmes. Forty four participants attended the meeting, including 16 speakers, out of which nine were external invited lecturers.

All the presentations have been uploaded to the e-resources section of the LinkTADs website: http://linktads.com/e_resources/laboratory_science. They are marked as protected, meaning that to view and download them a user would need to register on the LinkTADs member area.

LinkTADs meeting participants.

Final Research Coordination Meeting on Genetic Variation on the Control of Resistance to Infectious Diseases in Small Ruminants for Improving Animal Productivity

Technical Officers: Mohammed Shamsuddin, Kathiravan Periasamy

The final research coordination meeting (RCM) on genomic analysis to characterize resistance to parasites (D31026-CR-3) took place from 28 September to 3 October 2015 at the Vienna International Centre, Vienna, Austria.

The objectives of the RCM were to (1) prepare a final report on accomplishments of CRP objectives, (2) present and discuss results of individual research contracts, (3) share CRP work done at APH Laboratory at Seibersdorf, (4) conduct a workshop on analysis of genotype/phenotype data, (5) finalize manuscripts for publication, (6) discuss and agree on methods/tools for dissemination of results to Member States and (7) summarize major achievements, identify lessons learnt and way forward.

Individual RC holders presented their results summarizing the project activities and focusing specifically on works conducted since the second RCM in Indonesia in 2013. The workshop at the Seibersdorf Laboratories involved presentations on APH laboratory supports to the CRP, and data on candidate gene SNPs and genotypes generated from DNA samples sent by RC holders. Lectures and demonstrations were made on the Genetics Laboratory Information and Data Management System (GLIDMaS) – a database application to store and manage genetic data, the analyses of SNP genotype data and phenotype-genotype association and genetic and statistical models for analysis of phenotype data from field trials.

Individual RA holders presented the current state of knowledge on the topic. The meeting also consisted of individual consultation sessions between individual RC holders and RA holders.

The CRP has resulted in the development of tools and methodologies for conducting on-station and field studies on animal genetics involving application of advanced molecular technologies in animal genetics under diversified production systems. Although between breed differences were not always clear, high genetic variations were recorded in almost all RC holders in resistance/tolerance to gastrointestinal nematodes (GIN) in small ruminant populations. Exploratory analyses of genetic data suggest that gene effects can be revealed by designing experiments with outliers, regarding resistance/susceptibility to GIN, and generate larger filed data sets. The GLIDMaS database has been regarded as a useful tool for storing, management and analyses of genomic and phenotypic data from diverse animal production system.

Agency supports to research involving nuclear derived molecular techniques for genetic characterization of animals for resistance/tolerance to diseases, adaptability to diverse environmental conditions and traits reflecting productivity should continue within the respective countries and results should be disseminated to breeders and farmers. Validation of the CRP results should be done before applying these in animal breeding. The next step would be to conduct genome wide analyses, validation and application of genomic information in local animal breeding scheme. Funding from local sources should also be explored.

Meeting participants.

Consultants Meeting on Application of Isotopes Technologies in Animal Nutrition

Technical Officer: Mohammed Shamsuddin

The consultants meeting on Application of Isotopes Technologies in Animal Nutrition was held at IAEA Headquarters, Vienna, from 20 to 23 October 2015. The meeting was attended by five experts, one each from Australia (Mr Shimin Liu), Netherlands (Mr Jan Dijkstra), South Africa (Mr Ignatius V Nsahlai), Switzerland (Mr Jorge Spangenberg) and the United States of America (Mr Peter Robinson) and staffs from FAO and IAEA.

The meeting aimed at reviewing the current knowledge on the application of isotope-related tools and techniques in animal nutrition and to advice on future research directions. Challenges of feeding ruminants across production systems and production goals, improvement foreseen to improve animal feeding especially in grassland/rangeland production systems and application of stable isotope technologies in animal nutrition research and practices were discussed.

The application of stable isotope techniques such as the use of compound specific stable isotopes of long chain n-alkanes would help quantifying intake and diet selection of cattle grazing heterogeneous pasture. It was considered a timely and realistic initiative by the APH-NAFA, IAEA to implement a CRP on the application of stable isotopes for the development, adaptation and validation of tools, techniques and protocols for a practical method to predict pasture/rangeland intake of ruminants and thus allow farm level design of effective feed supplementation strategies to optimize animal production.

A detailed work plan, including technical procedures, for the implementation of the CRP was prepared. Basic requirements of technical staff, infrastructure, laboratory equipment, were identified and recommended to ensure quality results. The proposed CRP would create a uniform dataset of n-alkanes concentrations and their stable carbon isotope composition of common pasture grass, legume and browse species, measured in many world ecosystems, which are consumed by cattle. Results would help developing a practical NIRS based prediction equation of intake and diet composition of cattle consuming multi-species pasture grasses, legumes and browses to be applied in feed supplementation strategies for animals at pasture thus assist livestock extension services and farmers improve productivity.

Meeting participants.

Final Research Coordination Meeting on the Use of Enzymes and Nuclear Technologies to Improve the Utilization of Fibrous Feeds and Reduce Greenhouse Gas Emission from Livestock

Technical Officers: Mohammed Shamsuddin, Gerrit Viljoen

The final RCM on the evaluation of use of enzymes to improve digestibility of fibrous feeds (D3.10.27) was held from 9 to 13 November 2015 at the Center for Nuclear Energy in Agriculture (CENA), University of Sao Paulo (USP), Piracicaba, Brazil. The meeting was attended by all 10 research contract (RC) holders, 3 of the 4 agreement (RA) holders and 20 participants from CENA-USP. Professor Luiz Antonio Martinelli was invited to give a talk on the use of stable isotopes in agricultural research, especially tracking sources and ingredients of many food and food products at the opening session of the meeting.

The objectives of the meeting were (1) presentation and discussion of results of individual research contracts, (2) finalisation of manuscripts for publication, (3) discussion and agreeing on methods/tools for disseminations of results to Member States (MS), (4) preparation of a final report on accomplishments of CRP objectives and (5) identification of lessons learnt and APH-NAFA roles to take animal nutrition research further to supports MS for better utilisation of local feed resources by harmonisation of tools and procedures for the enhancement of the livestock industry

The scientific programme of the meeting included presentations, discussions, work groups, and a field and farm visit to Embrapa Southeast Livestock – Sao Carlos (www.embrapa.br/en/pecuaria-sudeste). The field visit involved presentations by Embrapa scientists and an onsite

visit to the PECUS project which evaluates the dynamics of GHG emissions and the carbon balance in agricultural production systems of Brazil's Biomes.

Individual RC holders presented their results summarizing the project activities. The second stage of the meeting consisted of individual consultation sessions between each RC holder, RA holders and the FAO/IAEA staff. The group prepared a spreadsheet with data from individual contracts for a future meta-analysis.

Based on the results presented by the various RC holders, there were needs identified for further improvement of manuscripts for publications and potential meta-analysis. Among the issues considered were the focus and schedule for future work and sustainability of activities, including potential sources of future funding; a plan for publication of results and a future CRP. CENA-USP with Mr Adibe Abdalla as the organiser provided excellent meeting facilities, including transport services within the town and for farm visits, and the highest level of hospitality, which were instrumental for a successful meeting.

All RC holders completed their research works according to work plans, published research results (number of publications were up to 14 from individual RCs, many of them published in peer reviewed journals). Almost all RC holders completed drafting final report and the others have given a clear time frame for the completion of the final draft.

Across the experiments and enzyme treatments, despite of individual variability, there has been a general trend of better intake, fibre degradation, dry matter digestibility microbial protein synthesis and production of gas and volatile fatty acids at *in vitro* and *in vivo* studies. There were notable variations among enzymes and specific forages used and thus the use of enzymes can be recommended for certain forages depending upon the enzyme products only. Methane production was variable upon enzyme supplementations; however, examination of methane emission must be done in relation to dry matter intake and animal products.

Results of individual RC were discussed and data was pooled for statistical analysis that would give more power to the interpretation of results. Dr Adegbola Adesogan and Karen Beauchemin have taken the responsibility for the analysis of data and the preparation of the first draft, which is expected to be finalised by September 2016.

The CRP resulted in 30 publications in various journals, conference proceedings, books, etc. As many as 20 students including MS, PhD and post-doctoral research projects have been supported by the CRP across MS. Personal skills of RC holders improved substantially on planning and conduction of animal nutrition researches, data analysis and interpretation, and preparation and publication of research articles.

The CRP has resulted in the development of tools and methodologies for conducting animal nutrition research under diversified production systems.

Meeting participants.

Training course on Transboundary Animal Diseases Diagnosis: Sequencing and Bioinformatics Analysis of Animal Pathogen Genomes

Technical Officers: Charles Lamien, Jenna Achenbach

The training course was held from 9 to 20 November 2015 at Seibersdorf Laboratories, Austria.

The objective of this training was to promote the use of 'gene based identification and classification of pathogens' by veterinary diagnostic and research laboratories of Africa and Asia, and strengthen the participants' countries capacity in genomic sequence analysis of pathogens causing zoonotic and transboundary animal diseases. Principles and hands-on experience on sequence analysis and phylogeny tools were covered. In addition, the practical applications of molecular analyses and epidemiology of selected pathogens helped the participants to better understand the usage of bioinformatics tools for better identification of animal pathogens and a more efficient management of transboundary and zoonotic animal diseases. A detailed report will be available in the next Newsletter.

Training course participants during theoretic sessions.

Regional Regional (AFRA) Training Course on Vector Trapping and Identification (RAF/5/068)

Technical Officer: Hermann Unger

The regional training course took place from 23 to 27 November 2015 at the Kenya Agricultural and Livestock Research Organization (KALRO).

The training course aimed to transfer knowledge in application of vector trapping, identification and mapping strategies to reduce impact and prevalence of vector borne diseases. The course covered:

- Introduction into vector physiology, biology and epidemiology of diseases,
- Trapping methods: Trap design and strategic trapping,
- Identification of the most important vectors: Anopheles, Culicoides, ticks,
- Mapping vector distribution and tools for mapping,
- Molecular identification of trapped vectors.

The training course included practical work to identify vectors under the microscope, setting up traps and viewing database tools for vectors.

Ms Grace Murilla, together with her staff, facilitated the course. The participants came from Algeria, Ghana, Mauritania, Mali, Malawi, Morocco, Sudan, Tunisia, UR Tanzania, Zambia and Zimbabwe.

Regional Training Course on Enhancing Capacity for Diagnosis of Ebola Virus Disease (EVD) by Molecular Methods (RAF/0/042)

Technical Officer: Hermann Unger

The regional training course took place from 7 to 11 December 2015 at the Ugandan Virus Research Institute, Entebbe, Uganda.

The recent outbreak of Ebola Virus Disease in West Africa has clearly shown the weaknesses of the diagnostic services in the sub-region. The purpose of this course was to build or enhance the human capacity to diagnose zoonotic diseases with a very high risk of infection transmission. The participants are now capable to (1) advice on biosafety standards to be implemented in the respective laboratories, (2) organize sample and work processes under these biosafety rules and (3) perform molecular diagnostics in safe conditions for the rapid diagnosis and confirmation of such diseases. The participants were provided the most recent protocols and SOPs for the molecular detection of Filo viruses, CCHF and RVF and were trained in the application of these molecular diagnostic tools. An additional training was provided in the setting up, handling and disinfection of glove boxes and the safe extraction of genomic materials from animal specimen.

The 17 participants came from Benin, Burkina Faso, Cameroon, Cote D'Ivoire, Mali, Niger, Nigeria, Senegal, Togo and Uganda. The course was facilitated by Messrs Trevor Shoemaker and Hermann Unger. Mr Michael Warnau gave the introductory talk on the aim of the project and held discussion with the counterparts regarding the implementation of these technologies in the MS laboratories.

Symposium on Epizootic Diseases: Lumpy skin disease, Sheep pox, Goat pox and Peste des petits ruminants

Organized by Prof Friedrich Schmoll, Head of the Division Animal Health, Austrian Agency for Health and Food safety.

On 11 December 2015, there was a joint meeting of the Austrian Agency for Health and Food Safety and the Austrian Federal Ministry of Health. The Symposium on Lumpy skin disease, Sheep pox, Goat pox and peste des petits ruminants took place at the Institute for Veterinary Disease Control Mödling.

The first part of the symposium dealt with notifiable pox diseases e.g. Sheep pox (SPP), Goat pox (GTP) and Lumpy skin disease (LSD). SPP and GTP are pox diseases of small ruminants while LSD affects ruminants, especially cattle, buffalos and wild ruminants. SPP and GTP are endemic in many African, Middle Eastern and Asian countries. Recurrent epidemics have also been reported in Greece and Bulgaria. LSD, which is endemic in Africa and Asian countries, is rapidly spreading throughout the Middle East and has also arrived in Turkey. In May 2015, LSD outbreaks occurred in 'European Turkey' and spread quickly to Greece by August 2015. Apart from arthropods vectors for all three pox diseases, the movement of infected animals is thought to be the most efficient mechanism to introduce the diseases into European countries, particularly for long distance spread. The risk of SPP, GTP and LSD becoming endemic in animal populations in the EU is, therefore, high. The symposium gave an overview of the current situation in Europe, of the impact and consequences of SPP, GTP and LSD entering the EU, of the epidemiology and availability, effectiveness and feasibility of the main disease prevention and control measures. Three experts in the field of pox diseases gave talks: Dr Dimitrios Dilaveris, who is working at the Directorate-General for Health and Food Safety of the European Commission, provided information on recent events in the European

Union; Prof Georgi Georgiev, from the Risk Assessment Directorate of the Bulgarian Food Safety Agency, spoke about the spread of SGP, GTP and LSD, the current situation, tendency and prognosis for Bulgaria, and finally, Dr Charles Lamien from the Animal Production and Health Laboratory of the International Atomic Energy Agency gave an overview on the molecular diagnosis and epidemiology of capripoxvirus infections.

Peste des petits ruminants (PPR) is a severe viral disease of small ruminants caused by a Morbillivirus closely related to rinderpest virus. It is widespread in Africa and Asia and is currently also found in Turkey and Northern Africa. PPR, is transmitted easily by direct contact within infected herds, but can also be transferred to infection-free areas by transport of infected animals. Prof Georgi Georgiev addressed this issue by talking about PPR distribution in Turkey: a signal of irregular movement of small ruminant animals from Asia to Europe; Dr William Dundon from the Animal Production and Health Laboratory of the International Atomic Energy Agency presented a global overview on PPR. The meeting finished with a visit to the Center for Biosafety in Mödling.

Stories

From Lab Coats to Hazmat Suits: IAEA Trains Scientists to Work Safely with Ebola

Low and middle income countries in Africa are confronted with the challenge to timely and accurately diagnose dangerous diseases that can spread from animals to humans and to prevent their further spread. The IAEA, in partnership with the Food and Agriculture Organization of the United Nations (FAO) and in collaboration with the World Health Organization (WHO), is providing assistance to African Member States on the use of nuclear-derived techniques in identifying and characterizing quickly and effectively zoonotic diseases such as Ebola, highly pathogenic avian influenza, Crimean-Congo haemorrhagic fever and Rift Valley fever quickly and effectively.

In cases where a single pathogen needs be identified from among a million similar micro-organisms, nuclear technologies are the only platform to provide the high sensitivity and specificity necessary. Catching these pathogens in livestock and wildlife helps in anticipating possible risks of transfer to humans.

Protective gear worn by participants during the training demonstration. (Photo: A.Dixit/IAEA).

Before scientists, veterinarians and field workers can undertake zoonotic diagnostic tests on animals, they need to learn how to protect themselves and prevent further spread of the diseases to animals or humans. An IAEA training held in Cameroon earlier this autumn taught them exactly that.

“Training courses such as this one help to bridge the knowledge gap and ensure personnel safety,” said Victor Matt-Lebby, senior health specialist and Director of Hospital and Laboratory Services in Sierra Leone. During the 2014-2015 Ebola outbreak, which claimed over 4000 lives in his country, several of Matt-Lebby’s field workers and scientists succumbed to the disease. “We have experienced how important it is to protect our personnel when handling contaminated samples.”

Other countries, luckily, do not have first-hand experience in dealing with outbreaks as virulent as the Ebola outbreak in Sierra Leone and its neighbours, but the danger of zoonotic diseases is a real threat to the entire continent, as demonstrated by the current highly pathogenic avian influenza (HPAI-H5N1) epidemic in several West-African countries. “We need to empower our local field teams and staff to collect field samples in a safe and secure way and our laboratories to safely analyse these samples using nuclear-derived technologies,” said Stella Acaye Atim, a veterinarian from Uganda, one of 17 participants in the one-week course.

These nuclear-derived technologies play a critical role in the early and rapid detection of these diseases, using applications such as the polymerase chain reaction (PCR), reverse transcription polymerase chain reaction (RT-PCR) and enzyme-linked immunosorbent assay (ELISA), explained Michel Warnau, Section Head in the Technical Cooperation Division for Africa at the IAEA. “These cutting-edge technologies are recognized as fast and efficient, as within a few hours they can detect specific zoonotic viruses,” he said. “But a prerequisite to this work

is to learn about protective gear sample collection, handling and transportation – all in a safe and secure way."

The barrier between the skin and the virus: wearing protective gear

"Double gloves, boots and overshoes, face masks, goggles, full head cover make up the uncomfortable but essential equipment that veterinarians and field workers need to wear," said Trevor R. Shoemaker, an epidemiologist from the U.S. Centers for Disease Control and Prevention, based in Uganda. "To top it all, literally, another layer of plastic is wrapped around the body for extra safety".

During the practical demonstration of irradiated personal protection equipment, many participants noted the criticality of full body cover, making sure that no skin was exposed. After double checking that there was no risk of exposure, the safety outfit needs to be scrupulously checked by another person.

"For me, this training has been an eye-opener as I have understood how I need to kit myself for any investigation using the protective gear," said Amina Garba S. Abu, a laboratory scientist from Nigeria. "We also need to be mindful of when discarding material, to ensure that it's been thoroughly sprayed with a disinfectant."

Wearing the personal protection equipment is no easy feat, particularly as the almost hermetically sealed environment inside is extremely warm. "Working in this gear for more than 40 to 50 minutes is quite a challenge," said Hermann Unger of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

From collection to transportation: Monitor and track samples

While collecting and transporting samples, it is vital that the samples are properly sealed, placed in air tight containers, correctly labelled and shipped with utmost care. This was another aspect of the course, where participants also received information on how to handle extremely dangerous infectious agents and biomaterials and how to use specific containment equipment.

While collecting samples, care needs to be taken to prevent any possible drips or leaks, said Thomas Strecker, a lecturer at the Institute of Virology of Marburg University, Germany. "You need to be alert to prevent unknowingly transmitting the viruses."

This course, prepared in response to Member State needs, supports African countries in strengthening preparedness against possible animal and zoonotic disease outbreaks, so that they are better prepared and can implement the appropriate preventive and control measures as early as possible. In the case of Sierra Leone, for instance, laboratory equipment received from the IAEA last year has been crucial to the diagnosis of Ebola in parts of the country, Matt-Lebby said.

Participants from Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Mali, Nigeria, Sierra Leone, Togo and Uganda attended the training in Cameroon, and many of them will participate in the follow-up training in Uganda in December, where they will be using nuclear-derived techniques whilst wearing protective gear and applying safe and secure analyses, said Ivancho Naletoski of the Joint FAO/IAEA Division.

Nuclear-Derived Techniques Improve Cattle Productivity and Milk Quality in Cameroon

Yaoundé, Cameroon – Increasing agricultural production and improving the quality of milk and meat are key to combatting poverty and increasing food security in Africa. Countries such as Cameroon are increasingly turning to innovative, nuclear and nuclear-derived techniques, to control and prevent diseases among livestock, and boost cattle and milk production.

"Nuclear techniques are important tools in practically all fields of animal science when the objective is to advance the productivity and health of economically vital domestic animals," said Abel Wade, Head of Cameroon's National Veterinary Laboratory (LANAVET) Annex. "Our country will face an unprecedented animal-product demand crisis if we don't use all the available scientific tools to ensure good breeding and increase the healthy cow head count." Cows are the main livestock in Cameroon: the country has 5.8 million cattle, compared with 4.6 million goat and 4 million sheep. Cattle are also regarded as a symbol of wealth.

Crossbred cows in a dairy farm in Cameroon. (Photo: Mario García Podesta /IAEA).

The IAEA has assisted Cameroon through its technical cooperation programme to use nuclear and nuclear-derived procedures such as radioimmunoassay (RIA) and enzyme-linked immunosorbent assay (ELISA), molecular

diagnostics and genetic screening in reproduction and breeding, artificial insemination and disease control programmes for livestock since the early 1990s. Nuclear techniques for artificial insemination were introduced in Cameroon eight years ago. "If we don't have healthy cows, we will not have good meat to eat or nutritious milk to drink," said Wade. "Our farmers are dependent on livestock not only to feed their families, the village community but also our population."

Laboratory technician assessing data at the Institute of Agricultural Research for Development, Bambui, Cameroon.

Focus on productivity

In collaboration with the IAEA and the Food and Agriculture Organization of the United Nations (FAO), LAVANET and the country's Institute of Agricultural Research for Development are engaged in training technicians on disease control and artificial insemination to improve cattle productivity and breeding management. Veterinarians, veterinary extension services and breeders in the region have access to tested bull semen and are receiving training in artificial insemination, breeding management and animal health control. "Artificial insemination allows scientists to improve the genetic make-up of the offspring, leading to up to five times more milk produced per cow," said Mario García Podesta of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

The methodology assists technical staff in improving the reproductive management of cattle farms and in obtaining more calves, meat and milk than with traditional farm management. The application of progesterone RIA in artificial insemination helps identifying 20-40% more cows for breeding than conventional methods that involved watching behavioural signs. It can subsequently increase the conception rate by between 5% and 50%, depending on the effectiveness of the traditional method and management previously used, said M. García Podesta.

Improving livestock also involves tracking and preventing diseases. LANAVET is performing surveillance to detect infectious diseases in northern Cameroon, where the seasonal movement of people with their livestock between summer and winter pastures poses disease risks to livestock Wade explained. Some of the most serious disease risks to cattle, sheep, goat and pigs are foot-and-mouth disease, contagious bovine pleuro-pneumonia, brucellosis, tuberculosis, peste des petits ruminants and African swine fever, which can become endemic if not swiftly addressed. Mobile labs using isotopic, nuclear and nuclear-derived techniques help to identify these risks early and rapidly, which results in effective response, he highlighted.

Reaching out

To extend awareness of the benefits of artificial insemination among rural farmers, who depend on traditional methods of cattle rearing, the Institute's regional centre in Bambui works with them directly in getting across the message and providing access to the tools required for artificial insemination. "It is our duty to meet the demands of the farmers, and make them aware of the advantages of this procedure in strengthening livestock," said Victorine Nsongka, Head of the Animal Production and Health Section of the Institute of Agricultural Research for Development in Bambui. "The proactive efforts by the Institute to successfully convince our farmers will assist in meeting the rising demand for meat and milk production."

A related project, currently in its preparatory phase, will lead to the artificial insemination of 70 000 cows over the next six years in northwestern Cameroon, Nsongka said. Sponsored by the Islamic Development Bank, this initiative will also use the IAEA-supported techniques and will lead to the development of an artificial insemination and reproduction network in the region, she added.

The application of nuclear techniques developed by the IAEA to monitor reproductive hormones, using nuclear and nuclear-derived techniques such as RIA and ELISA, has resulted in a better understanding of the reproductive physiology of livestock species, in identifying and ameliorating limiting factors affecting reproductive efficiency.

Cameroon's government is reaching out to extend support to breeding centres in Burkina-Faso, Benin, Central African Republic and Chad to increase the proportion of dairy animals through the use of semen from genetically superior animals through artificial insemination.

Improving vaccine efficiency to fight livestock diseases with new Flow-cytometer

Seibersdorf, 14 October 2015. Vaccines protect livestock against animal diseases and are crucial in disease control programs. Before novel vaccines are released to the market, they undergo a long and complex development, testing and approval process. A new state-of-the-art piece of equipment, a flow-cytometer, has been provided by the

Government of Germany to the Animal Production and Health Laboratory in Seibersdorf. This new equipment will enable the laboratory to better investigate immune responses induced by such vaccines and provide better insights on their potential.

"Vaccines are the most cost effective tools in preventing animal diseases," explained Viskam Wijewardana, Animal Health Officer in the laboratory that is part of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. "Designing and developing effective vaccines for unmet needs is therefore a priority in the laboratory".

The most crucial phases of vaccine development are the exploratory and pre-clinical stages. In these stages, the researchers aim to understand the disease in itself to develop vaccines with a high efficiency. The flow cytometer helps elucidate the hosts' immune cells involved and their responses to a disease-causing pathogen. As a result, better vaccines and immune stimulators can be designed. Furthermore, transferring the technology to Member State laboratories will expand the research base for understanding the immunology of emerging and re-emerging diseases and their prevention.

The new equipment is an in-kind contribution by the Government of Germany to the modernization project called "Renovation of the Nuclear Applications Laboratories" (ReNuAL) in Seibersdorf. The German Ambassador, His Excellency Mr Friedrich Däuble, symbolically switched on the flow cytometer when visiting the Seibersdorf laboratory this week.

The German Ambassador, His Excellency Mr. Friedrich Däuble, switches on the flow cytometer at Seibersdorf

The new equipment will enable scientists to better understand and fight two devastating livestock diseases, for which no vaccines exist at present: African swine fever and Trypanosomosis.

"Our research has shown that irradiating pathogens to a specific level will lead to a metabolically active yet not multiplying germ, which could be used to induce immunity in the host. With this new equipment we can much better analyze the host immune response and thus improve the designing of vaccines," explained Mr, Wijewardana. "The training of scientists from Member States and the transfer of the technology is already planned, for instance, for experiments on African swine fever. These scientists are actively involved in the development of cellular immunology technologies," he added.

IAEA training course helps tackle the H5N1 avian influenza outbreak in West Africa

Seibersdorf, 29 September 2015. Nigeria in January, Burkina Faso and Niger in April, Côte d'Ivoire at the end of May, Ghana a few days later in the beginning of June – a list that reads like a travel itinerary through West Africa traces the route of recent bird flu outbreaks in the region. Globally, the H5N1 strain of avian influenza outbreaks have killed millions of birds. The economic, social and human impact can be devastating.

Reacting to these outbreaks, the IAEA in cooperation with FAO, recently held a training course for those Member States experiencing or considered at risk of bird flu outbreaks. "The key to control zoonotic diseases is to be proactive rather than reactive," said Gerrit Viljoen, Head of IAEA's Animal Production and Health Subprogramme.

The 5-day refresher training took place at the IAEA's Animal Production and Health Laboratory in Seibersdorf in September. It is part of the support that the Agency, through its Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and its Africa Division of the Technical Cooperation Department offers to Member States in dealing with such outbreaks. The training course gave the participants the chance to refresh and enhance their knowledge in rapid diagnosis of H5N1 using nuclear, nuclear-derived and related molecular diagnostic techniques through lectures and hands-on sessions on disease management, sample collection, differential or confirmatory diagnosis, official reporting and submission procedures.

Participants in the H5N1 training course in IAEA's research laboratories in Seibersdorf, Austria.

"Early and rapid nuclear and nuclear-derived diagnosis is key to prepare Member States to react in a timely manner to infectious animal diseases," explained Michel Warnau, Section Head of IAEA's Technical Cooperation Division for Africa. "National veterinary laboratories in the region need to be prepared to meet emergency requirements and equipped with appropriate diagnostic kits and well-trained personnel."

In addition to familiarization with the latest techniques, the participants were provided with emergency kits which will allow them to immediately implement the latest H5N1 diagnostic protocols upon their return to their national laboratories.

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
D3.20.28	The control of foot and mouth disease (FMD) - in closure	Gerrit Viljoen
D3.20.29	The use of irradiated vaccines in the control of infectious transboundary diseases of livestock	Hermann Unger
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
New CRPs		
D3.10.28	Application of Nuclear and Genomic Tools to Enable for the Selection of Animals with Enhanced Productivity Traits	Mohammed Shamsuddin
D3.20.32	Early detection of transboundary animal diseases (TADs) to facilitate prevention and control through a veterinary diagnostic laboratory network (VETLAB Network)	Ivancho Naletoski
Planned CRPs		
	Irradiation of Transboundary animal disease (TAD) pathogens as vaccines and immune inducers	Hermann Unger
	Nuclear and related techniques for analyzing forage and improving feed digestibility	Mohammed Shamsuddin

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 nematodes (GIN) 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.

The final RCM of the CRP took place during 28 September to 3 October 2015 at the Vienna International Centre, Vienna, Austria.

The CRP has resulted in the development of tools and methodologies for conducting on-station and field studies on animal genetics involving application of advanced molecular technologies in animal genetics under diversified production systems. Although between breed differences were not always clear, high genetic variations were recorded in almost all RC holders in resistance/tolerance to gastrointestinal nematodes (GIN) in small ruminant populations. Exploratory analyses of genetic data suggest that gene effects can be revealed by designing experiments with outliers, regarding resistance/susceptibility to GIN, and generate larger filed data sets. The GLIDMaS database has been regarded as a useful tool for storing, management and analyses of genomic and phenotypic data from diverse animal production system. Validation of the CRP results should be done before applying these in animal breeding. The next step would be to conduct genome wide analyses, validation and application of genomic information in local animal breeding scheme. Funding from local sources should also be explored.

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.

The final RCM of the CRP was held during 9 to 13 November 2015 at the Center for Nuclear Energy in Agriculture (CENA), University of Sao Paulo (USP), Piracicaba, Brazil. The meeting was attended by all 10 research contract (RC) holders, 3 of the 4 agreement (RA) holders and 20 participants from CENA-USP.

All RC holders completed their research works according to work plans, published research results (number of publications were up to 14 from individual RCs, many of them published in peer reviewed journals). Almost all RC holders completed drafting final report and the others have given a clear time frame for the completion of the final draft.

Across the experiments and enzyme treatments, despite of individual variability, there has been a general trend of better intake, fibre degradation, dry matter digestibility microbial protein synthesis and production of gas and volatile fatty acids at in vitro and in vivo studies. There were notable variations among enzymes and specific forages used and thus the use of enzymes can be recommended for certain forages depending upon the enzyme products only. Methane production was variable upon enzyme supplementations; however, examination of methane emission must be done in relation to dry matter intake and animal products.

The CRP resulted in 30 publications in various journals, conference proceedings, books, etc. As many as 20 students including MS, PhD and post-doctoral research projects have been supported by the CRP across MS. Personal skills of RC holders improved substantially on planning and conduction of animal nutrition researches, data analysis and interpretation, and preparation and publication of research articles.

The control of foot and mouth disease (FMD)

Technical Officer: Gerrit Viljoen

The CRP involved countries and laboratories both from endemic and regions free from foot-and-mouth disease (FMD). The participating laboratories have different levels of expertise ranging from internationally acclaimed research facilities with numerous global collaborations to laboratories that presently cannot perform diagnostic assays due to various reasons. One aspect of the CRP was to make the expertise available to those laboratories that are in need, to set up the links and build capacity. Participants were strongly encouraged to contact the agreement and contract holders for research inputs and other needs. The final research coordination meeting (RCM) was held in Vienna, Austria from 6-10 July 2015. You can find the meeting report under Past Events.

The project covered a number of aspects related to vaccines and post vaccination monitoring. Through the CRP an attenuated Asia-1 vaccine strain was developed that can be used in the existing production facilities using the currently accepted technologies but which will not cause outbreaks

should the virus accidentally escape from the facility. Since it is based on using the registered international techniques for FMD vaccine production, application and uptake should be rapid. This technology will be applicable to any other FMD strain, therefore potentially having important global impact. The project will continue with validation and testing the vaccine in animals in the next phase.

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

Technical Officer: Hermann Unger

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 killed vaccines which might be denatured in their immunogenic sites and displaying a different recognition system of the immune system. Irradiation of pathogens may be an alternative to chemical inactivation of the pathogen for developing efficient vaccines.

This CRP which now ends, evaluated the irradiation doses for different pathogens to suppress amplification but keeping the pathogen metabolically active. This strategy allows for safety, i.e. the pathogen cannot multiply and thus not affect the host. Due to its low metabolic activity it is still recognized by the host immune system as a live organism, which for instance does invade cells. This mechanism activates the cellular immune system, recognizing 'infected' cells and leading to a memory effect which extends the time of immunity to often several years.

In the first phase of the project the most efficient dose of irradiation was evaluated. In the second phase the metabolic activity was determined. In the last phase the immunogenicity was evaluated in animals. Good results have been obtained with some cases such as, Theileria annulata, brucellosis and Fasciola gigantica. In those cases the evaluation in the natural host remains to be carried out. Such tests were already carried out for the fish parasite Ichthyophthirius multifilis and the ruminant gastro-intestinal parasite Haemonchus contortus. The results obtained so far are very promising with a 99% reduction in parasites after challenge and it is foreseen to continue with the H. contortus vaccine in the next CRP to evaluate the technical requirements facilitating the medium scale production of this novel irradiated vaccine.

It is foreseen to start with a new CRP on irradiated vaccine technologies in 2016.

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 highly pathogenic avian influenza (HPAI) that needs 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) was 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 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 by 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.

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

Technical Officers: Herman Unger, Charles Lamien

This CRP started in 2014 and focuses on evaluating technologies which could help to control ASF worldwide.

African swine fever is a contagious viral disease of pigs transmitted by ticks or through contact. In domesticated pigs, it leads to acute disease with high mortality and survivors are chronically infected serving as the reservoir for further transmission. 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 a small scale business, 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 issues regarding its epidemiology or virology are not understood.

The CRP performed already a validation trial for the serological diagnostic ASF tests (ELISA based) and embarks now on testing molecular diagnostic tools to define the fitness of purpose for each and every tests available. In parallel, samples from infected pigs, wild or domestic, are collected for virus isolation. These isolates should be characterized and some of them sequenced in order to create a better 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 candidate 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. The second RCM is planned to take place from 20 to 24 June in Lusaka, Zambia. General information applicable to all coordinated research projects.

New CRPs

Application of Nuclear and Genomic Tools to Enable for the Selection of Animals with Enhanced Productivity Traits

Technical officer: Mohammed Shamsuddin

The World will be facing the challenge of manifolds increase in the production of food from animal origin to address the high demand that is expected to arise from population growth, income increases and urbanization. Breeding for robust animals with production systems optimised for exponential increase in productivity while retaining their adaptability to harsh environment and tolerance to tropical diseases could remain only option for the intensification of livestock productions with as minimum as possible environmental impacts. Crossbreeding zebu cattle with temperate taurine cattle has been tried in many countries for a rapid increase in the productivity but results were not always satisfactory. Lack of animal identification and not having a system in place for recording and analysing performance data to make appropriate breeding decision were identified to be main constraints that limited the enhancement of animal productivity by breeding, especially in developing countries.

The overall objective of the project is to enable Member States, especially developing countries to use genomic tools for enhancing the efficiency and effectiveness of genetic improvement of livestock. This project aims application of nuclear and nuclear-derived molecular techniques to addresses two major issues prevailing in developing countries and are directly associated with food security and livelihood improvement. Firstly, it will generate genomic data of performance recorded animals, which will enable breeders and farmers relate production traits with parentage and genetic admixture of animals leading to identification and selection of superior (both genotypically and phenotypically) sires for breeding by using artificial insemination. Secondly, 60CO will be applied to develop a radiation hybrid panel of camel and use that for whole genome sequencing and identification of breeding markers that nobody has done yet for camel.

As outputs the project is expected to leave bind an animal identification system in place and 1000 phenotype recorded animals per breed/population from each country, develop a gene bank of phenotype recorded animals in participating countries (potentially available for future genotyping), validate genetic tool(s) for testing parentage, relationship and admixture level, develop whole genome radiation hybrid panels for camel, develop a set of performance data for different genetic groups in different production systems and deliver SOPs, protocols and guidelines for continued animal genetic research and application of results in animal breeding.

Participation in the CRP:

The CRP is mainly open to institutions that have access to artificial insemination programmes for cattle or buffalo. In addition, these institutions should have:

• Local and/or external support either through funding from other bodies or through agreements with local partners, as well as links with national livestock development authorities.

• Transportation capabilities to field sites and the necessary resources to conduct field work, to perform data and sample collection, and to do computerized data recording and analysis. It is expected that the team will be able to monitor a minimum of 1000 females per breed or population plus available sires.

• Laboratories for molecular genetic analyses and basic expertise on DNA based technologies.

Action Plan

Scientists interested in participating in this CRP may contact us (Mohammed Shamsuddin, M.Shamsuddin@iaea.org or Mario Garcia Podesta, M.Garcia-Podesta@iaea.org) for specific details of the programme and modalities of participation.

Early detection of transboundary animal diseases (TADs) to facilitate prevention and control through a veterinary diagnostic laboratory network (VETLAB Network)

Technical officer: Ivancho Naletoski

The Veterinary Laboratory Network (VETLAB Network), currently integrates 32 African and 17 Asian MS which are dedicated to share knowledge and experience and support each other during the implementation of international standards, routine diagnostic procedures, sharing diagnostic approaches for specific disease outbreaks, thus facilitating the emergency preparedness and response to animal health emergencies. The concept of networking has proven its fitness for purpose during the rinderpest eradication campaign. Nowadays, this concept has resulted with great successes in some of the MS, where the diagnostic laboratories have received accreditation for the ISO 17025 standard. Additionally, several other laboratories in this network are in advanced phases of implementation of the standard and expect soon accreditation.

When transboundary disease events are likely to appear, or have already appeared, regional laboratory preparedness is critical for the implementation of the complex, multi-sectorial disease responses. Therefore, the maintenance, strengthening and upgrade of the laboratory networks is of utmost importance for the planning and the start-up of proper contingency plans aimed to prevent and / or control the currently threatening diseases.

The VETLAB Network is a concept for the establishment of a unique regional / interregional communication and activity skeleton which enables for sustainable functioning

and upgrade of the laboratories under internationally recognized principles.

Critical step for harmonization of the diagnostic techniques is the establishment of primary and/or secondary standards (as appropriate) which would use as reference during the calibration and maintenance of the diagnostic tests. The CRP will target establishment of such standards for use in serological and molecular diagnostic c techniques. The CRP will have the following outputs:

1. To develop a set of internationally acceptable standards for the serological diagnostic techniques for priority diseases among the partners of the VETLAB Network.

2. To develop a set of internationally acceptable standards for the molecular diagnostic techniques for priority diseases among the partners of the VETLAB Network.

3. To development a procedures for simultaneous detection of multiple pathogens (multi-pathogen detection panels).

4. To develop a procedure for easy access, free-of-charge genetic sequencing services for pathogens of the priority diseases among the partners of the VETLAB Network.

5. To establish an information platform for integrated information collection, geo-visualization, analysis and decision making.

Participation in the CRP

• Institutions and scientists with experience in collection of serum samples in larger amounts (slaughterhouses, disease eradication).

• Institutions and scientists with experience in preparation of inactivated and calibrated pathogens for use in molecular assays.

The team will be comprised of 10 research contracts and 3 technical contracts.

Scientists interested in participating in this CRP may contact the project officer: at: i.naletoski@iaea.org.

Planned CRPs

Nuclear and Related Techniques for Analysing Forage and Improving Feed Digestibility

Technical Officer: Mohammed Shamsuddin

The FAO/IAEA Subprogramme on Animal Production and Health has largely contributed to the identification and evaluation of the nutritional value of a wide selection of conventional, non-traditional, and unconventional animal feeds, including shrub and tree foliage, fibrous and tanniferous plants, and agricultural and industrial by-products. Hundreds of these potential feed resources have successfully been tested, in many cases using isotopic techniques, in laboratory and field trials where these feeds have partially or totally substituted traditional feed components. The results have allowed for the enhancement of livestock productivity and improved farmers' livelihood.

Livestock uses 30 percent of the earth's entire land surface, mostly permanent pasture. Improving efficiency of these grassland uses means enhancing livestock productivity while reducing its environmental impacts. Conventional techniques do not enable scientists and producers measure the feed intake at grazing/browsing and therefore predict dry matter intake and the nutritional value of it. Without knowing the quantity and quality of nutrients consumed by the animal, farmers and extension livestock officers cannot determine the amount and type of supplements required by the animals for obtaining the expected production yields.

The project aims to develop a practical method to predict pasture intake of ruminants grazing heterogeneous pastures and rangeland using stable isotopes to provide tools for better grassland management that enhance animal productivity and reduces impact on environment due to overgrazing, and to allow the design of effective feed supplementation strategies at farm level to optimize animal production.

Three major laboratory activities are planned: a) the analysis of concentrations and stable carbon isotope composition (delta13C values vs. VPDB - Vienna Pee Dee Belemnite) of n-alkanes in the plant and faecal samples to predict dry matter (DM) intake and its plant proportions; b) The use of conventional chemical analysis of plants to determine their nutritional value, and c) The development of the near infrared reflectance spectroscopy (NIRS) predictive equations of DM intake and the plant profile of that intake to facilitate the design of diets and supplements required to cover the nutritional needs of animals for getting the expected production levels. The combination of the three technologies applied to plant and faecal samples obtained in a common research protocol used by all participating countries will allow reaching the scientific objectives of the CRP.

Participation in the CRP:

The CRP is mainly open to institutions that have:

• Local and/or external support either through funding from other bodies or through agree peste des petits ruminants ments with local partners, as well as links with national livestock development authorities.

• National ruminant livestock production that heavily relies on pasture, silvo-pasture and or grassland.

• Transportation capabilities to field sites and the necessary resources to conduct field work, to perform data and sample collection, and to do computerized data recording and analysis.

• Established laboratories for proximate feed assays and basic expertise on conducting animal nutrition experiments.

Scientists interested in participating in this CRP may contact us (Mohammed Shamsuddin at M.Shamsuddin@iaea.org or Mario Garcia Podesta at M.Garcia-Podesta@iaea.org) for specific details of the programme and modalities of participation.

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://cra.iaea.org/cra/index.html

General information applicable to all coordinated research projects and submission of proposals:

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

Large scale genotyping of sheep and goat under field trial for parasite resistance

Gastro-intestinal (GI) parasitic infestations incur huge economic losses to poor and marginal farmers rearing sheep and goats across the world. The loss per year has been estimated to the tune of $10 billion. Breeding programs with the goal of enhancing host resistance to parasites will help to alleviate this problem in the long term. In continuation of its efforts to establish a low density DNA marker panel for parasite resistance, Animal Production and Health Laboratory (APHL) identified and developed genotyping assays for novel candidate gene SNP (single nucleotide polymorphism) markers to be associated with phenotypes of Haemonchus resistance in sheep and goats. Large scale genotyping of 1367 goat samples derived from field trials performed in Bangladesh, China, Nigeria, Sri Lanka, Pakistan, Myanmar and India were completed. A panel of 141 goat SNP markers located in 72 candidate genes including pattern recognition receptors (Toll like receptors, NOD like receptors, RIG I like receptors, C type Lectin binding receptors), cytokine genes (e.g. Interleukins, Interferons), Caprine histocompatibility genes was used to type 18 indigenous goat breeds for evaluation of parasite resistance. In case of sheep, 1524 samples derived from field trials performed in Argentina, Brazil, Ethiopia, Iran, Indonesia and India were completed. A panel of 174 sheep SNP markers was used to type 10 indigenous sheep breeds for evaluation of parasite resistance. Datasets of genotypes from a total of 3115 sheep and 1367 goats have been generated and statistical analysis is currently under progress in collaboration with counterparts from various member states.

Genome wide association study (GWAS) for parasite resistance in sheep

In addition to candidate gene polymorphisms, genetic variations located throughout the genome play a significant role in the inheritance of traits related to parasite resistance. Hence, genome wide analysis of Corriedale sheep from Argentina exhibiting extreme phenotypes was initiated. 48 sheep with low EBVs (Estimated Breeding Values) for faecal egg count (supposed to be relatively resistant/tolerant sheep) and 48 sheep with high EBVs for faecal egg count (supposed to be relatively susceptible sheep) were completed using a 60K Affymetrix microarray. Genotyping will be extended to additional sheep samples with phenotype extremes and to other breeds to perform a genome wide association study and identification of genomic regions under selection for parasite resistance.

Support to MSs for implementation of Global Plan of Action on animal genetic resources (AnGR)

Genetic characterization of indigenous buffalo populations of Myanmar

Water buffalo (*Bubalus bubalis*) is an important livestock in South and South East Asia. Buffaloes are valuable not only as milk producers, but have multiple roles in rural livelihood system, particularly as a draught animal in paddy cultivating areas and contribute significantly to employment generation and nutritional security. Myanmar has a long history of raising buffaloes for draught purposes with an estimated population of 2.6 million. There are 2 types of buffaloes in Myanmar, one is smaller, commonly found in low lands and the other is bigger and found in the hilly regions like Shan State. They have more working capacity than oxen and are well suited to work in low-lying swampy areas. Although most of these buffaloes are considered to be swamp type, river buffaloes are also available in some areas. Characterization and documentation of these buffalo populations is of prime significance for genetic improvement and biodiversity conservation programs. APHL initiated and completed the design, development and optimization of DNA marker panels for genetic characterization of water buffaloes. Six multiplex panels covering 21 microsatellite DNA markers were standardized for genotyping and the marker panels performed well for characterization of both the sub-species of buffaloes, river and swamp types. Indigenous buffalo populations from three different provinces of Myanmar were genotyped and sequenced (mitochondrial DNA D-loop variations). Statistical analysis of genotype and sequence data is currently under progress.

Mapping molecular diversity of indigenous goat genetic resources of Asia

The world goat population is approximately 1.0 billion with more than half of them present in Asia. The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture initiated a programme to characterize goat genetic resources of Asia. Nine Asian countries, Bangladesh, China, Indonesia, Iran, Pakistan, Sri Lanka, Vietnam, Myanmar and India, were supported to conduct breed surveys, evaluate production environments and assess phenotypic and genetic characteristics of indigenous breeds/populations. A meta-analysis of genotypes from 2249 goats belonging to 57 goat breeds located in 9 Asian countries was conducted to assess genetic diversity, relationship and population structure. The level of genetic variability among goat breeds/populations across Asia was consistent with the history of domestication, with variability being higher near the center of domestication and a decreasing gradient while moving away from this center.

Genetic differentiation among goat breeds/populations within different countries varied from 1.9% (Myanmar goats) to 12.6% (Indonesian goats) with a global F_{ST} of 12.7% (Figure 1). Genetic differentiation among local goats within countries was limited, an indication of high gene flow across breed/ populations

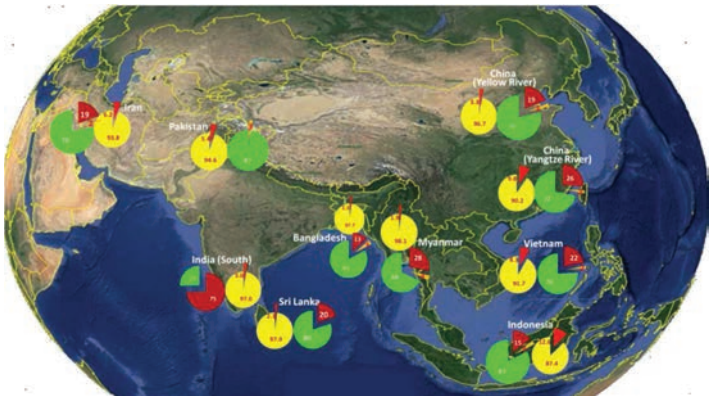

Figure 1. Between (red) and within (yellow) breed variation; mean percent loci deviating from Hardy-Weinberg equilibrium (Dark red-Significant heterozygosity deficit (P<0.05); Orange-Significant heterozygosity excess (P<0.05); Green-Not deviating from Hardy-Weinberg equilibrium (P>0.05)) among indigenous goat populations from Asian countries.

Genetic differentiation among goat breeds/populations within different countries varied from 1.9% (Myanmar goats) to 12.6% (Indonesian goats) with a global F_{ST} of 12.7% (Figure 1). Genetic differentiation among local goats within countries was limited, an indication of high gene flow across breed/ populations. The microsatellite based phylogeny showed two major clades: the Chinese goats clustered distinctly while the goat breeds from other countries clustered separately in a single clade. Weak genetic structure was observed in Bangladeshi, Sri Lankan and Myanmar goats, moderately strong genetic structure was observed in Pakistani goats while strong genetic structure was observed in Indonesian, Iranian, Vietnamese and Chinese goats. Model based cluster analysis of metadata broadly grouped Asian goats into two major geographical clusters (Chinese and West Asian) which can be partitioned further into four groups: Chinese, West Asian, South East Asian and South Asian. The results from meta-analysis clearly established the genetic distinctness of Chinese goats from other major Asian goat breeds.

Animal Health

Application of 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. The disease puts a large number of cattle at risk with annual losses estimated to be as high as US$5 billion. A vaccine would provide the most effective means of managing the disease in Africa and other endemic areas. At APHL, experiments have been carried out to characterize the effects of using low level irradiation doses on trypanosomes. These experiments showed that immunisation with low dose irradiated parasites induce a stronger immune response when compared to high dose irradiated parasites. To further study the effect of low dose irradiation on protozoan parasites, an expression micro-

array platform that covers the genomes of three trypanosome species, *T. brucei, T. evansi* and *T. congolense* was designed at APHL, so as to give a global view of irradiation effect on gene expression (Figure 2).

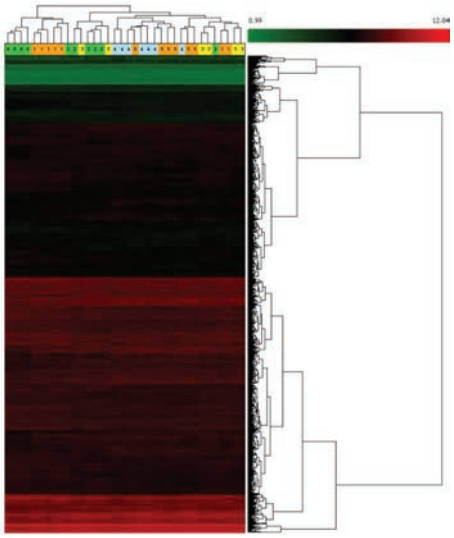

Figure 2. Hierarchical clustering of differentially expressed genes in T. evansi cultures subjected to different doses of irradiation ranging from 0Gy to 250Gy. Clusters in green represent a repression in expression and those in red an induction in expression when compared to non-irradiated parasites.

Expression analysis of T. evansi genome irradiated using doses ranging from 0Gy to 250Gy was carried out using the Affimetrix platform. At least six technical replicates per irradiation dose were used for expression analysis and initial results indicate that at least 3534 genes ($p>0.05$) are differentially expressed when subjected to different irradiation doses. These results are now being analysed in depth to identify genes responsible for loss of virulence and infectivity. The classification of differentially expressed genes according to function i.e. are the genes affected by irradiation responsible for structural, metabolic or enzymatic processes will be important in deciding which targets to develop for new vaccines and drugs.

African swine fever

African swine fever (ASF) is one of the most devastating transboundary animal diseases for the swine industry, both in Africa and the Balkan region. The disease also represents a serious threat to Europe with the recent detection of ASF in wild boar in several countries (including Russia, Belarus, Lithuania, Poland, and more recently Latvia, Estonia and Italy), showing the continued movement of virus within Europe. APHL continued to collaborate with MSs to assess the epidemiology of ASF virus (ASFV) and study the viral genome through IAEA technical cooperation projects, coordinated research projects (CRP D3.20.31- Early and Rapid Diagnosis and Control of Transboundary Animal Diseases — Phase II: African Swine Fever) and extra budgetary projects (Peaceful Uses Initiative). Molecular characterization of ASFV in Ethiopia, Mozambique, Nigeria, Tanzania, and Mali showed new genetic variants emphasizing the need for continued monitoring and characterization of circulating ASFV strains to be able to provide information that could lead to the production of a successful vaccine. APHL also continued to assist MSs in the detection of ASF particularly in Africa. Recently, real-time PCR based ASF diagnostic technology was transferred to Ghana and Mozambique to improve the capacities of national veterinary laboratories in handling suspected outbreaks.

Study of pox diseases in Ethiopian camels

Camels are economically important animals that are well adapted to arid and semi-arid climates and are valued for nomadic pastoralism for transportation, racing, and production of milk, wool and meat. Two major pox diseases are known in camels: camelpox and camel contagious ecthyma. Camelpox is an infectious disease caused by camelpox virus (CMPV) and belongs to the genus Orthopoxvirus of the family Poxviridae. Camel contagious ecthyma, also known as Auzdyk disease, is caused by pseudocowpox virus (PCPV) classified under the genus Parapoxvirus of the Poxviridae family.

As part of its work to improve the management of pox diseases in ruminants and camels, APHL has developed a pan-pox real time PCR method and started the transfer of the assay to Member states (MS). The current assay was used in Ethiopia as a front-line assay to investigate pox diseases in camels. This allowed the clear identification of CMPV and PCPV as two major causes of skin diseases of camels in the country. To further analyze and understand the epidemiology of these diseases in the country, representative samples, collected from diseased camels from different geographical locations of Ethiopia between 2011 and 2014, were molecularly analyzed. The full hemagglutinin gene for CMPV (HA, 925bp) and major envelope protein gene (B2L, 1137bp) for PCPV, of Ethiopian isolates were amplified, sequenced and compared to publicly available sequences. The results confirmed the circulation of CMPV and PCPV among one-humped camels (Camelus dromedarius).

Figure 3. Contagious ecthyma in young camels. Note the presence of severe nodular lesions on the upper and lower lips and around nostril.

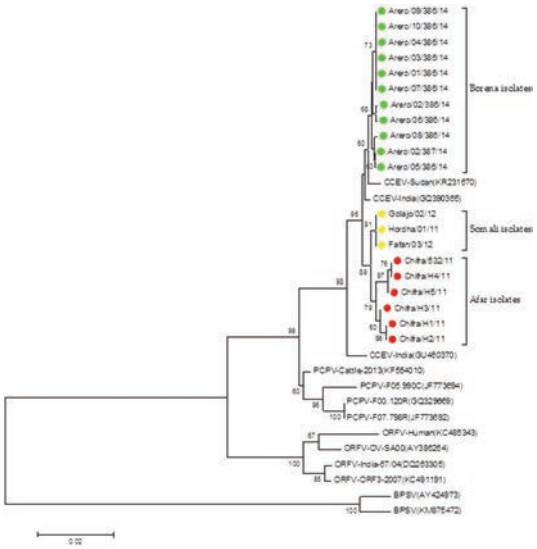

Figure 4. Phylogenetic analysis of 33 parapoxviruses based on nucleotide sequences of the B2L gene (1137nt). The B2L sequences of twenty Ethiopian outbreak isolates and 13 sequences retrieved from the GenBank were used.

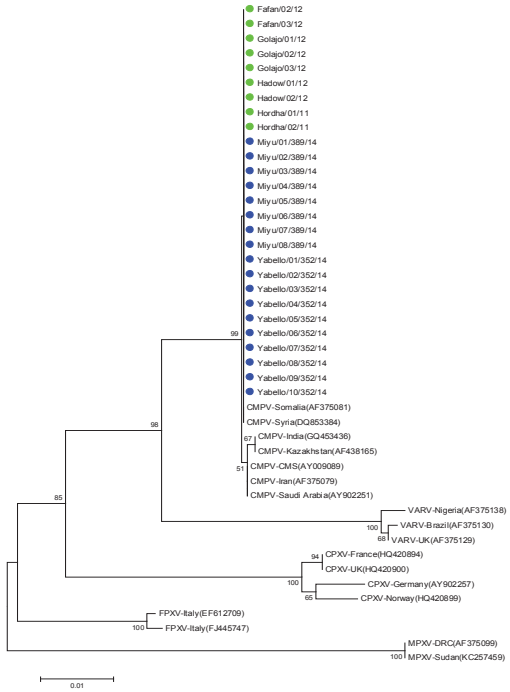

Figure 5. Phylogenetic analysis of 45 orthopoxviruses based on nucleotide sequences of the HA gene (948nt). The HA gene sequences of twenty-seven Ethiopian outbreak isolates and 18 sequences retrieved from the GenBank were used.

Twenty-seven CMPVs and 20 PCPVs were identified from pox disease outbreaks samples and compared to foreign isolates. Three major clusters of PCPV were found in Ethiopia, with cluster 1 isolates closely related, but not identical to Sudanese PCPVs. They were more distant to all other PCPVs retrieved from cattle worldwide. For CMPV, all Ethiopian isolates formed a single cluster. They were closely related to CMPVs from Somalia and Syria. This study has also highlighted the existence of co-infection with CMPV and CPCPV in two samples collected in suspicion of camelpox and demonstrated the misdiagnosis of camelpox infections due to the similarity of the clinical symptoms to those of PCPV infections.

Fellows/interns/consultants

Mr Lwin Ko Ko Kyaw from Livestock Breeding and Veterinary Department, Yangon, Myanmar was trained on "Genetic characterization of indigenous buffaloes of Myanmar" at APHL for three months (6th July, 2015 to 2nd October, 2015) under TC fellowship (MYA/14013).

Ms Brenda Chileshe from National Institute for Scientific and Industrial Research, Lusaka, Zambia was trained on "Analysis of data for genetic characterization of Zambian native Zebu cattle using nuclear and extra-nuclear DNA markers" at APHL for three months (1st October, 2015 to 24th December, 2015) under TC fellowship (ZAM/14015).

Mr Lourenço Paulo Mapaco from the Central Veterinary Laboratory, Directorate of Animal Science, Mozambique was trained at APHL on laboratory diagnosis of transboundary animal diseases using molecular techniques for three months from 15th June to 14th September 2015 under IAEA/TC Project MOZ/5/005.

Field support missions

1. Follow up report of a visit to the Laboratoire Central Veterinaire de Bingerville, Abidjan, Cote d'Ivoire, by a APHL staff

A staff member of the Animal Production and Health Laboratory (APHL) travelled from 25 to 29 May, 2015 to Abidjan, Cote d'Ivoire to transfer animal pathogen typing technologies to the Laboratoire Central Vétérinaire de Bingerville. The aims of this mission were (1) to transfer and implement technologies and build capacities, (2) to respond to the emergency H5N1 situation in Cote d'Ivoire and (3) to provide an emergency "tool kit". During the week, LCV Bingerville was assisted in the set-up of their instrument and staff was trained on animal pathogen detection by real time nucleic acid amplification technology including multiparametric pathogen detection assays. Additionally, they were trained to use sequencing technology for a better identification and characterization of animal pathogens.

To date, the laboratory has provided valuable feedback on the successful adoption of the rapid detection and subtyping of H5N1 using a duplex real time PCR detection procedure. This technology is now being used as a front-line tool by the virology laboratory for the screening of suspected H5N1 cases in support of the national effort to control the current HPAI crisis in the country. Twenty seven (27) outbreaks were confirmed using this method in in 5 geographical locations in the country: Bouaké (3 backyard poultry farms, 1 turtle dove bird), Abidjan (15

live birds markets, 2 commercial farms and 3 backyard poultry farms), Grand-Bassam (1 commercial farm), Bingerville (1 live birds market, 1 backyard poultry farm) and Anyama (1 live birds market). All these confirmed outbreaks were newly affected areas.

Interestingly, there was a full agreement between the laboratory results and those provided by the OIE reference laboratory, Padova, Italy, which was requested to confirm the outbreaks. Moreover, the laboratory was also able to use sequencing technology to fully characterize the samples from one outbreak. This achievement highlights the capability of the virology laboratory of the LCV, Bingerville and the importance of the capacity building strategies adopted by the Joint FAO/IAEA division. It is of great importance to note that prior to the adoption of real-time PCR, the virology laboratory of LCV carried out the conventional RT-PCR to detect and fully subtype H5N1 isolates. The successful adoption of a closed vessel system for the rapid subtyping of H5N1 will facilitate the management of the current avian influenza crisis; laboratories will gain in speed and accuracy resulting in a faster delivery of results, while minimizing the risk of contamination, allowing for a quick response to newly re-emerging outbreaks. To this end, the current assay was also included as a component of the emergency tool box supplied by the joint division to many Western African veterinary laboratories to facilitate the identification of influenza A viruses of the H5N1 subtype.

2. Laboratoire Central de l'élevage, Niamey, Niger

In January 2015, Nigeria confirmed the presence of HPAI H5N1 to the World Organisation for Animal Health (OIE) while neighbouring Burkina Faso and Niger reported outbreaks on 1st and 21st of April, 2015, respectively. A field support mission was made to Laboratoire central de l'élevage (LABOCEL), Niamey, Niger (25-28, August) along with the provision of an Emergency Tool Box containing the necessary reagents and material to immediately screen more that 200 samples for H5N1. During the four day mission, the personnel of LABOCEL were trained on a number of protocols through demonstration and practical sessions. These included the isolation and purification of RNA from swab samples, conventional RT-PCR identifying the H5 gene in clinical samples, conventional RT-PCR identifying the N1 gene in clinical samples and a duplex Real-Time PCR that simultaneously identifies the presence of the N1 and H5 genes in clinical samples. At the end of the mission, LABOCEL was able to implement all the assays for rapid diagnosis of H5N1 and acquired the capacity to screen large number of suspected samples.

3. Accra Veterinary Laboratory, Veterinary Services Directorate, Ministry of Food and Agriculture (MOFA), Accra, Ghana

The mission was carried out from 17 to 22 August 2015 to support the national and regional efforts to combat current HPAI H5N1 outbreaks in western Africa. An expert from APHL undertook this emergency travel to assist Ghana in the rapid identification of H5N1 cases currently occurring in Ghana and the potential spread from neighbouring countries such as Burkina Faso, Cote d'Ivoire, and Nigeria. The objective of the mission was to introduce real time PCR technology for the diagnosis of HPAI H5N1. A duplex H5N1 detection assay that detects both H5 HA and N1 NA in the same assay was transferred, thus greatly reducing the work time involved in detection and reporting. The laboratory staffs were quick to learn the concepts behind real time PCR and were sufficiently capable of running and analysing the data. Follow up with the laboratory director, Dr Joseph Awuni, has shown the continued use of this assay in rapidly and accurately detecting H5N1 in outbreaks in Ghana, with data reports being sent on a regular basis to IAEA.

4. Laboratoire National d'Elevage et de Recherches Vétérinaires, Dakar, Senegal

An expert from APHL travelled to Dakar, Senegal from 28 September to 2 October 2015. The main goals of this mission were to transfer new technology and coordinate future collaboration efforts between the laboratory staff and the joint FAO/IAEA division regarding African swine fever. This laboratory has been very capable of performing real-time PCR assays, so the focus was to transfer the working knowledge of several new multiplex assays that have been developed at IAEA. These real-time assays are based on multiple pathogen detection, whereby, one animal sample can be tested for many pathogens in a single procedure. The first assay involved detection of Pasteurella, Mycoplasma capricolum subsp. capripneumoniae (MCCP), peste des petitis ruminants virus (PPRV) and capripoxvirus, from small ruminant animals. This assay is valuable because these pathogens can cause similar clinical symptoms that could delay treatment if the wrong pathogen is suspected. Another assay was a pan-poxvirus detection procedure that included testing of eight pathogens that can present with common clinical signs. This assay can differentiate between three genus, Orthopoxvirus, capripoxvirus, and Parapox virus. Within each genus, the assay can differentiate between CPXV, CMPV, SPPV, GTPV, LSDV, ORFV, PCPV, and BPSV. Transfer was also done with the duplex HPAI H5N1 real-time RT-PCR assay for avian influenza. While Senegal is currently not affected by HPAI, the mission helped to build capacity and prepare the laboratory for early and rapid diagnosis in case of cross border movement of disease. Laboratoire National d'Elevage et de Recherches Vétérinaires, in Dakar, Senegal.

5. The Central Veterinary Laboratory, Maputo, Mozambique

This mission was undertaken from 5th to 9th October 2015 by an expert from APHL, as part of the project to strengthen animal disease diagnostic capacities in selected Sub-Saharan African countries, supported by the South African Renaissance Fund (ARF). The mission included the transport and installation of a new Real-Time PCR platform (CFX96 Biorad) in the laboratory. A number of molecular diagnostic protocols were successfully demonstrated on the instrument for the detection of important transboundary animal diseases such as African swine fever, avian influenza and peste des petits ruminants. The laboratory staff were trained on the protocol for the identification and pathotyping of NDV. Field samples collected from different outbreaks in Mozambique between August and November 2014 were tested using the newly implemented protocol and the results were confirmed by conventional RT-PCR. The provision of a real-time instrument and the implementation of a new diagnostic protocol for NDV has provided an important tool to CVL for the diagnosis and pathotyping of NDV. Previously, using conventional diagnostic techniques the laboratory was only able to provide confirmatory diagnosis of NDV and was unable to determine whether the circulating viruses were velogenic, mesogenic or lentogenic, a vital piece of information for the correct control and management of this important disease.

6. Laboratoire Central Veterinaire, Bamako Mali

APHL staff travelled from 31st August to 04th September to Bamako, Mali, for transfering animal pathogen typing technologies to the Laboratoire Central Veterinaire (LCV), Bamako, Mali. The mission was carried out under the framework of the project to strengthen animal disease diagnostic capacities in selected Sub-Saharan African countries, supported by the South African Renaissance Fund (ARF), and Peaceful Uses Initiative (PUI) projects supported by USA and Japan. LCV recently received the molecular diagnostic platform under the project and the mission was undertaken to transfer real time PCR technology, focusing on multi-targets detection, as an additional tool for a more rapid and accurate diagnosis of transboundary animal diseases. The laboratory staff was trained on well-established protocols, including those developed at APHL, as well as protocol selection procedures to facilitate the implementation of new assays by the laboratory. 15 scientists and technicians of all departments of the LCV participated in the training (Figure 6). The primary objectives of the training were successfully achieved as the laboratory staff was able to set up, execute and interpret the results of real time PCR assays for the detection of African swine fever, peste des petits ruminants viruses and CaPV genotyping.

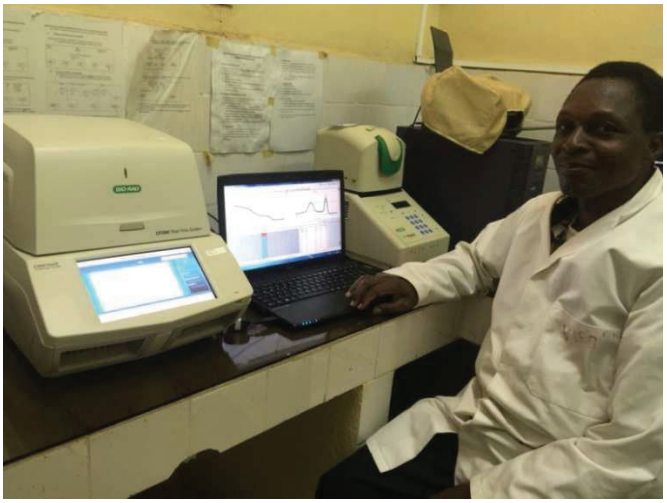

Figure 6. A scientist of LCV, Bamako, Mali, operating the real time PCR instrument

They were also able to perform and analyze the results of multi-parametric assays to detect pathogens responsible for respiratory diseases and pox-like lesions in ruminants. Given the recent emergency of HPAI H5N1 outbreaks in several Western African countries, the mission also ensured LCV to acquire capacity for H5N1 diagnosis. An emergency "tool kit" of supplies for H5N1 diagnosis was provided along with the required training. It is expected that this technology will help the laboratory to better fulfil its mandate within the national strategies for the control of transboundary animal diseases.

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. 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
ANG/5/013	Applying Nuclear and Molecular Techniques for Diagnosis and Control of Transboundary Animal Diseases **Objective:** To support veterinary services in the control of transboundary animal diseases.	G. Viljoen I. Naletoski
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
BEN/5/010	Using Nuclear Techniques for Better Utilization of Local Feed Resources and Improved Reproduction Practices to Enhance Productivity and Conserve Nature **Objective:** To improve livestock productivity by using crop residue-based feedings and better practices of animal reproduction.	M. Shamsuddin
BGD/5/030	Building Capacity to Improve Dairy Cows Using Molecular and Nuclear Techniques **Objective:** To improve the productivity, health and reproduction of dairy cows using molecular and nuclear techniques.	M. Shamsuddin G. Viljoen
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 Podesta M. Shamsuddin K. Periasamy
BKF/5/015	Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique **Objective**: To support the national and regional efforts to combat HPAI H5N1 outbreak in Burkina Faso	H. Unger I. Naletoski
BKF/5/017	Using Modern Animal Breeding Methods, Nuclear and Genomic Tools to Improve Dairy Production in Smallholder Production Systems **Objective**: To improve the productivity of cattle through the application of genetic characterization, artificial insemination and control of zoonotic diseases.	K. Periasamy M. Shamsuddin

TC Project	Description	Technical Officer(s)
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
BOT/5/011	Establishing District Laboratories that use Nuclear and Molecular Techniques for Early and Rapid Diagnosis of Endemic and Transboundary Animal Diseases **Objective**: To improve diagnostic capacity of transboundary animal diseases like FMD, PPR, ASF, RVF and endemic diseases like vector borne diseases, clostridial diseases, anthrax, and reproductive diseases through establishment of district laboratories, where nuclear molecular diagnostic techniques will be used.	G. Vljoen C. Lamien
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/5/009	Controlling Contagious Bovine Pleuropneumonia and Peste de Petit Ruminants **Objective:** To contribute to food security through improved animal health and production.	H. Unger
CHD/5/005	Studying the Causes of Pulmonary Diseases in Small Ruminants **Objective:** To contribute to poverty reduction and ensure the population's food security by increasing livestock productivity.	H. Unger C. Lamien
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/5/012	Optimizing Livestock Production Systems through Cultivation and Efficient Use of Local Feed Resources, Monitoring of Performance and Reduction of Environmental Pollution through Solid Waste and Biogas Utilization **Objective:** To improve productivity of dairy cattle by using improved forage-based feeding systems, reproductive practices and generation of energy from manure while reducing greenhouse gas emissions.	M. Shamsuddin I. Naletoski
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/5/020	Enhancing the Livelihood of Rural Communities through Addressing Major Zoonotic and Economically Important Small Ruminant Diseases **Objective:** To investigate and control major small ruminant and zoonotic diseases in Ethiopia.	H. Unger C. Lamien

TC Project	Description	Technical Officer(s)
GHA/5/035	Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique **Objective:** To support the national and regional efforts to combat HPAI H5N1 outbreak in Ghana.	H. Unger I. Naletoski
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
IVC/5/037	Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique **Objective**: To support the national and regional efforts to combat HPAI H5N1 outbreak in Cote d'Ivoire.	I. Naletoski H. Unger
IVC/5/038	Studying Small Ruminant Respiratory Diseases **Objective**: To understand complex respiratory syndrome in small ruminants by identifying the various factors involved in the different seasons, with a view to improving strategies for their control	H. Unger G. Viljoen
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 Podesta M. Shamsuddin
KAM/5/003	Supporting Sustainable Livestock Production **Objective:** To improve animal production through applications of modern breeding technologies and improved feeding.	M. Shamsuddin M. Garcia
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.	M. Shamsuddin
LAO/5/003	Using Nuclear and Molecular Techniques for Early and Rapid Diagnosis and Control of Transboundary Animal Diseases in Livestock **Objective:** To ensure quick and reliable test techniques for the detection of the animal disease pathogen to support the early warning and effective control and prevention of transboundary animal disease.	G. Viljoen
LES/5/003	Using Nuclear and Molecular Techniques for Improving Animal Productivity **Objective:** To improve livestock production.	G. Viljoen
LES/5/006	Enhancing Animal Production and the Health of Sheep and Goats in Lesotho **Objective:** To improve the efficiency of animal health and reproductive management of sheep and goats.	G. Viljoen
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

TC Project	Description	Technical Officer(s)
MAG/5/024	Applying Nuclear and DNA-Based Techniques to Improve Productivity of Local Livestock **Objective:** To contribute to increase productivity of livestock by 25% by means of sustainable improvement of indigenous and locally adapted cattle through genetic characterization, selection and multiplication of superior germplasm through an efficient artificial insemination programme.	M. Shamsuddin K. Periasamy
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
MAR/5/025	Improving the Productivity of Dairy Cattle through On-Farm Application of Achieved Research Information on Feeding Practices **Objective:** To enhance productivity of smallholder dairy farming through improved reproduction practices and better feeding with locally available forage and browse species.	Ms. 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
MLI/5/027	Using Nuclear and Molecular Techniques for Early and Rapid Diagnosis, Epidemiological Surveillance and Control of Transboundary Animal Diseases **Objective:** To reduce TAD impact on the development of the livestock sector in Mali.	I. Naletoski C. Lamien
MLW/5/002	Strengthening Capacity for the Diagnosis, Prevention and Control of Animal Diseases of Public Health Importance **Objective:** To establish nuclear related diagnostic systems and tools (serological and molecular) for the screening and rapid diagnosis (both field and laboratory) of important animal diseases for veterinary public health.	H. Unger
MNE/5003	Improving Diagnosis of Animal Diseases and Food Pathogens **Objective:** To improve the response to animal health and food safety challenges in Montenegro.	I. Naletoski
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

TC Project	Description	Technical Officer(s)
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
MON/5/022	Implementing Early Diagnosis and Rapid Control of Transboundary Animal Diseases, Including Foot-and-Mouth disease (FMD) and Peste des Petits Ruminants (PPR) **Objective:** To enhance early and rapid diagnosis of Transboundary animal diseases, including FMD and PPR.	H. Unger G. Viljoen
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/5/026	Improving the Livelihoods of Smallholder Livestock Farmers by Developing Animal Feeding Strategies for Enhanced Food Security **Objective:** To enhance food security through the utilization of local feed resources and develop the potential for the balancing ration leading to methane emission from enteric fermentation.	M. Shamsuddin
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
NEP/5/004	Improving Animal Productivity and Control of Transboundary Animal Diseases using Nuclear and Molecular Techniques: Phase II **Objective:** To improve food security by integrated management of animal nutrition, reproduction and health	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
NER/5/018	Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique **Objective**: To support the national and regional efforts to combat HPAI H5N1 outbreak in Niger	H. Unger I. Naletoski

TC Project	Description	Technical Officer(s)
NIC/5/008	Improving Technical Capabilities for Detection of Diseases and Residues in Agriculture **Objective**: To improve capacity in detection of diseases and residues in animal and plant commodities for food trade.	G. Viljoen
NIR/5/038	Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique **Objective**: To support the national and regional efforts to combat HPAI H5N1 outbreaks in Nigeria	I. Naletoski, H. Unger
PAK/5/050	Developing a Facility for the Diagnosis of Transboundary Animal Diseases and Vaccine Production **Objective**: To improve livestock productivity through the control of transboundary animal diseases in Pakistan.	H. Unger, V. Wijewardana
PAL/5/007	Upgrading Animal Feeding Laboratory in Terms of Human Capacity Building and Infrastructure **Objective**: To benefit livestock farmers by helping them to improve productivity by assuring them of certified quality animal feeds.	I. Naletoski, M. Shamsuddin
PAP/5/002	Genetically Characterising and Improving Productivity of Cattle by Enhanced Reproduction and Better Feeding **Objective**: To improve productivity of cattle by genetic characterisation for enhanced reproductive efficiency and better feeding.	K. Periasamy, M. Shamsuddin
PER/5/032	Conducting Genetic Characterization of Alpacas for Resistance to Diseases **Objective**: To identify genetic markers for resistance to diseases to be incorporated in breeding alpacas.	K. Periasamy, M. Shamsuddin
RAF/0/042	Promoting the Sustainability and Networking of National Nuclear Institutions for Development **Objective**: To enhance the self-reliance and sustainability of national nuclear institutions and other end users of nuclear techniques in African Member States through the rationalization of scientific programmes and managerial practices.	I. Naletoski
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 C. Lamien
RAF/5/073	Strengthening Africa's Regional Capacity for Diagnosis of Emerging or Re-emerging Zoonotic Diseases, including Ebola Virus Disease (EVD), and Establishing Early Warning Systems. **Objective**: To enhance control of emerging zoonotic diseases in the African region, through safe and accurate early detection of pathogens in wildlife and livestock.	H. Unger I. Naletoski
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 K Periasamy

TC Project	Description	Technical Officer(s)
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.	G. Viljoen / I. Naletoski C. Lamien
RER/9/137	Enhancing National Capabilities for Response to Nuclear and Radiological Emergencies **Objective**: To enhance Member States' capabilities to prepare for and respond to radiation emergencies, including a special emphasis on enhancing food security and safety by improving veterinary authorities participation in the national coordination mechanism.	I. Naletoski
RLA/5/071	Decreasing the Parasite Infestation Rate of Sheep (ARCAL CXLIV) **Objective**: To contribute to the sustainable increase in sheep production at the national and regional level.	M. Shamsuddin
SEN/5/036	Controlling Mycoplasma Mycoides Infection — Contagious Bovine Pleuropneumonia (CBPP) and Contagious Caprine Pleuropneumonia (CCPP) **Objective**: To contribute to the enhancement of livestock production in Senegal.	H. Unger
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
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
SIL/5/015	Enhancing Ebola Diagnostic Capacity using nuclear-derived technique at WHO/NICD EVD Lakka Laboratory, Freetown, Sierra Leone **Objective:** To support the national efforts and international response to combat Ebola outbreak in Sierra Leone.	I. Naletoski H. Unger G. Viljoen
SIL/5/018	Strengthening Artificial Insemination and Disease Diagnosis Services Coupled with Improved Feeding to Enhance the Productivity of Cattle **Objective**: To increase livestock productivity by improving artificial insemination (AI) services and the management of animal health and nutrition.	H. Unger M. Shamsuddin
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
SRL/5/046	Improving Livelihoods Through Dairy Cattle Production: Women Farmers' Empowerment **Objective**: To increase the productivity of dairy farms and improve animal health and management practices.	M. Shamsuddin M. Garcia Podesta

TC Project	Description	Technical Officer(s)
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
TOG/5/001	Improving and Promoting Bovine Milk Production through Artificial Insemination **Objective:** To implement artificial insemination and improved feeding techniques to enhance the productivity of cattle farming as a tool to enhance food security in Togo.	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/5/035	Improving Food Safety through Surveillance of Fish Diseases **Objective**: To avail credible information about trace metals and aflatoxins in fish.	H. Unger C. Lamien
UGA/5/038	Supporting National Animal Production and Productivity through the Establishment of Regional Animal Health Centres and Improving Disease Control at the National Animal Disease Diagnostics and Epidemiology Centre **Objective:** To improve the national capacity for control of tranboundary animal and zoonotic diseases through well-coordinated and efficient diagnostic services at the National Animal Disease Diagnostics and Epidemiology Centre and the Regional Animal Disease Diagnostics and Epidemiology Centres in Uganda.	H. Unger
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 Podesta
URT/5/031	Improving Indigenous Cattle Breeds through Enhanced Artificial Insemination Service Delivery in Coastal Areas **Objective**: To improve the productivity of indigenous cattle through enhanced artificial insemination (AI) services delivery in coastal areas of Tanzania.	M. Shamsuddin
VIE/5/019	Applying Nuclear Related Techniques for Transboundary Animal Diseases (TADs) Diagnosis **Objective**: To contribute to the control and prevention of Transboundary Animal Diseases (TADs) in Viet Nam.	G. Viljoen V. Wijewardana
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

TC Project	Description	Technical Officer(s)
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
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.	H. Unger
ZAI/5/024	Upgrading Vaccine Production to Protect Livestock from Transboundary Animal Disease **Objective:** To improve livestock productivity through the control of Trans-boundary Animal Diseases in the South of DRC.	H. Unger V. Wijewardana
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 V. Wijewardana

Publications

Genetic variability and bottleneck analyses of Kanni adu goat population using microsatellite markers

Jeyakumar, M., Thiruvenkadan, R. Saravana, R., and ***Periasamy, K.***

The Indian Journal of Small Ruminants, 2015, 21(2): 216-22

Microsatellite data on 25 loci were generated and utilized to evaluate the genetic architecture and mutation drift equilibrium of Kanni Adu goats of southern Tamil Nadu. The genetic diversity analysis of Kanni Adu goats displayed higher level of within breed variability in terms of mean number of alleles per locus (11.24±0.87) and heterozygosity values (Ho= 0.677±0.041, He=0.857±0.016). Within population inbreeding estimate (FIS=0.215±0.040) showed moderate level of inbreeding, which warrant adoption of appropriate breeding strategies under field conditions. The polymorphism information content (PIC) value ranged from 0.531 to 0.915 suggested higher polymorphism in this breed. In general, the sign, standardized differences and Wilcoxon rank tests indicated heterozygosity excess in Kanni Adu goat population in infinite alleles and two-phase model and non-significant in stepwise mutation model. Hence, the mode-shift indicator test was utilized and it indicated the absence of genetic bottleneck in the recent past in Kanni Adu goats. It suggests that any unique alleles present in this breed may not have been lost. The study indicated that Kanni adu goats exhibited substantial amount of genetic variation as reflected from the heterozygosity and number of alleles per locus.

Genetic Bottleneck Analyses of Kodi Adu Goat Breed Based on Microsatellite Markers

Thiruvenkadan, A.K., Jayakumar, V., R. Saravanan, R., and ***Periasamy, K.***

Indian Veterinary Journal, 2015, 92 (3) : 24 - 27

The genetic characterization and bottleneck analysis in Kodi Adu goat was done using 25 FAO recommended microsatellite markers. The mean observed number of alleles and polymorphism information content (PIC) were estimated to be 11.52±0.95 and 0.817±0.023 respectively. The mean observed and expected heterozygosities were 0.660 ± 0.045 and 0.846 ± 0.018 respectively. The mean expected equilibrium gene diversity across 21 microsatellite loci under TAM, SMM and TPM were 0.793±0.028, 0.854±0.023 and 0.827±0.026 respectively. All the three statistical tests revealed significant deviation of Kodi Adu goats from mutation-drift equilibrium under the IAM and TPM models, however, non-significant deviation under SMM model. The mode shift analysis supported the results under SMM indicating the absence of genetic bottleneck in the recent past in Kodi Adu goats.

Specific detection of peste des petits ruminants virus antibodies in sheep and goat sera by the luciferase

Berguido, F.J., *Bodjo, S.C., Loitsch, A., Diallo, A.*

Journal of Virological Methods, 2016, 227, 40–46

Peste des petits ruminants (PPR) is a contagious and often fatal transboundary animal disease affecting mostly sheep, goats and wild small ruminants. This disease is endemic in most of Africa, the Middle, Near East, and large parts of Asia. The causal agent is peste des petits ruminants virus (PPRV), which belongs to the genus Morbillivirus in the family Paramyxoviridae. This genus also includes measles virus (MV), canine distemper virus (CDV) and rinderpest virus (RPV). All are closely related viruses with serological cross reactivity. In this study, we have developed a Luciferase Immunoprecipitation System (LIPS) for the rapid detection of antibodies against PPRV in serum samples and for specific differentiation from antibodies against RPV. PPR and rinderpest (RP) serum samples were assayed by PPR-LIPS and two commercially available PPR cELISA tests. The PPR-LIPS showed high sensitivity and specificity for the samples tested and showed no cross reactivity with RPV unlike the commercial PPR cELISA tests which did cross react with RPV. Based on the results shown in this study, PPR-LIPS is presented as a good candidate for the specific serosurveillance of PPR.

Sample preparation for avian and porcine influenza virus cDNA amplification simplified: Boiling vs. conventional RNA extraction

Fereidouni, S.R., Starick, E., Ziller, M., Harder, T. C., ***Unger, H.,*** *Hamilton, K., Globig, A.*

Journal of Virological Methods (2015) 221: 62-67. doi: 10.1016/j.jviromet.2015.04.021

RNA extraction and purification is a fundamental step that allows for highly sensitive amplification of specific RNA targets in PCR applications. However, commercial extraction kits that are broadly used because of their robustness and high yield of purified RNA are expensive and labor-intensive. In this study, boiling in distilled water or a commercial lysis buffer of different sample matrices containing avian or porcine influenza viruses was tested as an alternative. Real-time PCR (RTqPCR) for nucleoprotein gene fragment was used as read out. Results were compared with freshly extracted RNA by use of a commercial extraction kit. Different batches of virus containing materials, including diluted virus positive allantoic fluid or cell culture supernatant, and avian faecal, cloacal or oropharyngeal swab samples were used in this study. Simple boiling of samples without any additional purification steps can be used as an alternative RNA preparation method to detect influenza A virus nucleoprotein RNA in oropharyngeal swab samples, allantoic fluid or cell-culture supernatant. The boiling method is not applicable for sample matrices containing faecal material.

Detection and genome analysis of a lineage III peste des petits ruminants virus in Kenya in 2011

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

Transboundary and Emerging Diseases (2015). doi: 10.1111/tbed.12374 [Epub ahead of print]

In May 2011 in Turkana County, north-western Kenya, tissue samples were collected from goats suspected of having died of peste des petits ruminant (PPR) disease, an acute viral disease of small ruminants. The samples were processed and tested by reverse transcriptase PCR for the presence of PPR viral RNA. The positive samples were sequenced and identified as belonging to peste des petits ruminants virus (PPRV) lineage III. Full-genome analysis of one of the positive samples 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 have significant implications for surveillance and control of this important disease as it moves southwards in Africa.

Current status and phenotypic characteristics of Bulgarian poultry genetic resources

Teneva, A., Gerzilov, V., Lalev, M., Lukanov, H., Mincheva, N., Oblakova, M., Petrov, P., Hristakieva, P., Dimitrova, I., ***Periasamy, K.***

Animal Genetic Resources (2015) 56 : 19-27

Poultry biodiversity conservation is a great challenge for many countries. Within the last several years, the number of endangered local breeds has increased, leading to a considerable loss of genetic resources. A similar trend was observed among the poultry breeds, including chicken, local turkey and goose breeds/lines established in Bulgaria, part of which is definitely lost. Currently these breeds/lines are at risk and/or threatened with extinction. The information obtained by phenotypic characterization of these breeds is the first step for planning the management of poultry genetic resources through setting up improved selection schemes and conservation strategies. In this paper, we reviewed the current state of knowledge regarding the morphological and phenotypic diversity of local poultry breeds and some old productive poultry lines in Bulgaria.

Environmental factors and dam characteristics associated with insulin sensitivity and insulin secretion in newborn Holstein calves

Kamal, M.M., Van Eetvelde, M., Bogaert, H., Hostens, M., Vandaele, L., ***Shamsuddin, M****., Opsomer, G.*

Animal (2015) 9: 1490-1499. doi: 10.1017/S1751731115000701

The objective of the present retrospective cohort study was to evaluate potential associations between environmental factors and dam characteristics, including level of milk production during gestation, and insulin traits in newborn Holstein calves. Birth weight and gestational age of the calves at delivery were determined. On the next day, heart girth, wither height and diagonal length of both the calves and their dams were measured. Parity, body condition score and age at calving were recorded for all dams. For the cows, days open before last gestation, lactation length (LL), length of dry period (DP) and calving interval were also calculated. The magnitude and shape of the lactation curve both quantified using the MilkBot model based on monthly milk weights, were used to calculate the amount of milk produced during gestation. Using the same procedure, cumulative milk production from conception to drying off (MGEST) was calculated. A blood sample was collected from all calves (n=481; 169 born to heifers and 312 born to cows) at least 5 h after a milk meal on day 3 of life to measure basal glucose and insulin levels. In addition, an intravenous glucose-stimulated insulin secretion test was performed in a subset of the calves (n=316). After descriptive analysis, generalized linear mixed models were used to identify factors that were significantly associated with the major insulin traits (Insb, basal insulin level; QUICKI, quantitative insulin sensitivity check index; AIR, acute insulin response; DI, disposition index) of the newborn calves. The overall average birth weight of the calves was 42.7 ± 5.92 kg. The insulin traits were significantly associated with gender and season of birth when data of all calves were analyzed. In addition, the insulin traits in calves born to cows were significantly associated with MGEST, DP and LL. The Insb was estimated to be higher in calves born to the cows having passed a higher MGEST (P=0.076) and longer DP (P=0.034). The QUICKI was estimated to be lower in calves born to the cows having passed a higher MGEST (P=0.030) and longer DP (P=0.058). Moreover, the AIR (P=0.009) and DI (P=0.049) were estimated to be lower in male compared with female calves. Furthermore, the AIR (P=0.036) and DI (P=0.039) were estimated to be lower in calves born to cows having passed a longer LL. The decisive effects of MGEST, DP and LL in cows on the insulin traits of their calves may provide a basis for developing managerial interventions to improve metabolic health of the offspring.

Evaluation of ovsynch protocols for timed artificial insemination in water buffaloes in Bangladesh

Hoque, M. N., Talukder, A. K., Akter, M., ***Shamsuddin, M.***

Turk J Vet Anim Sci (2014) 38: 418-424. doi: 10.3906/vet-1302-35

A total of 65 water buffaloes (groups A, B, and C) at =>60 days postpartum with a body condition score (BCS) of =>2.5 were selected to evaluate ovsynch protocols for timed artificial insemination (TAI). The group A buffaloes (n = 25) were treated with a simple ovsynch protocol (GnRH - Day 7 - PGF2 alpha - Day 2 - GnRH -16 h - TAI). The group B buffaloes (n = 22) received PGF2 alpha treatment 12 days before the initiation of simple ovsynch (PGF2 alpha at Day -12 + simple ovsynch; modified ovsynch). The group C buffaloes (n = 18) were treated with

a double ovsynch protocol (GnRH - Day 7 - PGF2 alpha - Day 3 - GnRH - Day 7 - GnRH - Day 7 - PGF2 alpha - 48 h - GnRH - 16 h - TAI). Milk P4 ELISA was used for tracking ovulation and conception rates. Ovulation rates were higher in buffaloes that received the double ovsynch treatment (group C; 83.3%) than those with simple ovsynch (group A; 72.0%; $P < 0.05$). The group C cows (44.4%) achieved a higher conception rate than the cows of groups A (28.0%) and B (36.4%) ($P < 0.05$) and multiparous buffaloes having BCS of =>3.5 responded better to the ovsynch treatments than the primiparous ones ($P < 0.05$). The double ovsynch protocol increases both ovulation and conception rates in comparison to the simple and modified ovsynch protocols and is more effective in multiparous cows than in primiparous ones.

Risk factors for postpartum anestrus in crossbred cows in Bangladesh

Kamal, M. M., Uddin Bhuiyan, M. M., Parveen, N., Momont, H. W., ***Shamsuddin, M.***

Turk J Vet Anim Sci 38: 151-156. doi: 10.3906/vet-1303-74

Ultrasonography and a structured questionnaire were used in a cross-sectional study to gather data on the prevalence and risk factors for anestrus in crossbred cows at ≥60 days postpartum in 273 smallholder farms. The prevalence of anestrus was 18%. The odds ratio (OR) for true anestrus was 17.52 and 2.81 times higher ($P < 0.05$) in cows with poor (≤2.0) and excessive (>3.5) body condition score (BCS), respectively, compared to those with optimal BCS (2.5–3.5), 2.82 times higher in suckled than in nonsuckled cows ($P = 0.03$), and 2.53 times higher in cows that calved during the cold season than in those that calved during the hot season ($P = 0.03$). The OR for anestrus was 1.62 times higher ($P = 0.017$) in cows managed by an employee than in those managed by the farmers themselves ($P = 0.001$), and 2.66 times higher ($P = 0.003$) in small farms (≤5 cows) than in large farms (≥11 cows). The OR was 0.71 to 0.46 times lower in farms having a guaranteed market to sell milk than those with an uncertain traditional milk market ($P < 0.05$). Maintaining optimal BCS of cows, farmers' training on management of cattle reproduction, and development of a market linkage to sell milk would improve the number of cows for breeding by 60 days postpartum.

VETLAB Network

The Animal Production and Health Subprogramme (APH) supported veterinary diagnostic laboratories in Member States (MSs) towards the successful worldwide eradication of Rinderpest through the FAO/IAEA Rinderpest Laboratory Network. Building on this success, APH continues its efforts in maintaining and building diagnostic laboratory capacities to support the control of animal and zoonotic disease threats to MSs in cooperation with the FAO and OIE. The VETLAB Network participants are being supported through IAEA and FAO programmatic activities as well as by South Africa through the African Renaissance Fund (ARF) and USA and Japan Peaceful Uses Initiative (PUI).

APH is now taking an additional step in introducing the VETLAB Network Newsletter in the hope of providing a forum for participating laboratories and other stakeholders to communicate and exchange knowledge/information, to showcase achievements and to share expertise within the VETLAB Network.

Impressum

Animal Production and Health Newsletter No. 63

The APH Newsletter is prepared twice per year by the Animal Production and Health Section, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and FAO/IAEA Agriculture & Biotechnology Laboratory, Seibersdorf.

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