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Nuclear Techniques in Food and Agriculture

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IAEA Laboratories Seibersdorf.

To Our Readers

Dear Colleagues,

As 2013 draws to a close, we are completing our activities and contributions to the 2012–2013 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 satisfy Member State needs maximally.

I want to mention two events regarding the activities of the Animal Production and Health Subprogramme. First, I have the pleasure to inform you that the Animal Production and Health Subprogramme was part of a 'One-House' IAEA team that was awarded an IAEA Superior Achievement Award for its response to Member States requests regarding the H7N9 avian influenza outbreak in several provinces of China. The aggravating factor with this new avian influenza disease was that it was asymptomatic in poultry (i.e. poultry showed no clinical disease), but symptomatic in humans (i.e. humans showed flu like symptoms) causing about 30% mortality in infected humans. This epidemiological character of the disease made it very difficult to trace and search for its origin in poultry, towards protecting human lives. The Chinese authorities, in particular the Beijing Genetics Institute, reacted appropriately to the outbreaks and characterized the virus, isolated from human patients, as an avian influenza H7N9 subtype. Knowing the panzootic potential of avian influenza viruses, the international community has immediately developed response plans on the eventual spread of the Chinese H7N9 strain and called for emergency preparedness.

Upon requests of Member States from Europe and the Asia & Pacific Region, the Animal Production and Health Subprogramme of the Joint FAO/IAEA Division and

IAEA International Atomic Energy Agency

the IAEA Technical Cooperation Department immediately reacted by taking advantage of the responsiveness of the TC Programme to unforeseen needs of Member States. In addition to the evaluation and validation of diagnostic and surveillance procedures and the transfer of technologies and the diagnostic support, two unplanned training courses were organized on short-notice under existing technical cooperation projects RER/5/016 (regional European) and RAS/5/060 (regional Asian). The two hands-on group events were conducted to enhance the capacities of specialists from at-risk regions to perform an early and rapid diagnosis and control of this novel H7N9 avian influenza strain. Twenty-four participants from seventeen Member States in Asia & the Pacific Region and twenty two participants from fourteen Member States in the Europe Region attended the two training courses. The events consisted of lectures on epidemiology, risk assessment, differential diagnosis of the H7N9 virus subtypes, sampling and submission procedures (including shipment of pathological samples to the FAO/OIE reference laboratories) and practical training on current, rapid techniques for disease diagnosis, especially with regards to the application of nuclear-based techniques for the identification and characterization of the pathogen. In both cases, the Animal Production and Health Laboratory's facilities at the IAEA Seibersdorf Laboratories were used, which included advanced molecular technological platforms and on-site computer teaching facilities to enable the bioinformatic analysis of avian influenza genomes. Thereby, specialists from the regions had the opportunity to gain an insight into risk assessment and epidemiological knowledge on the virus, while the preparedness and proficiency of Member States' veterinary diagnostic laboratories for similar future events was greatly enhanced.

Veterinarians and laboratory diagnosticians from 14 European countries took part in the training course (Photo: G. Seballos, August 2013).

The second exciting event is the planned renewal of our Nuclear Applications Laboratories at Seibersdorf. The NA laboratories were established in 1962, more than 50 years ago, and demands on the NA Laboratories have continually increased in order to meet the evolving needs and demands of Member States. As the numbers of Member States grow and as more have recognized the value and uniqueness of our laboratories and sought their support, more and more demand was placed on them. These demands are expected to further increase in the future as the issues that the laboratories are expected to address continue to evolve. While the laboratories have seen individual upgrades and extensions during the past 51 years, these were implemented on an ad hoc basis and in response to individual needs but without an overall and comprehensive concept. No concerted renovation or significant new construction has taken place during this period. Whereas technologies and techniques used in the laboratories have changed dramatically over time, the facilities have not evolved to match the requirements for operations, training and compliance with current safety and security regulations and relevant quality management requirements. The NA laboratories at Seibersdorf need both a quantitative and a qualitative enhancement. New investments in space and equipment is essential to secure the future of the laboratories for the benefit of Member States and to ensure that individual laboratories and support operations are fully compliant with the latest safety and security standards for laboratory research facilities. Please read more later in this newsletter.

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 Subprogramme, we want to welcome two cost-free experts. Dr Jenna ACHENBACH from USA who joined us in September at the laboratory to support our work on African swine fever and avian influenza and Mr Daojin YU from China who will be working on peste des petitis ruminants. We hope that they will have a pleasant and productive time with the Subprogramme. Sadly, we also said farewell to Nicholas Odongo who took up a university position in Kenya.

Finally, I wish you all and your families a happy, healthy and safe 2014.

Gerrit Viljoen,
Head, Animal Production and Health Section

Staff

Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Headquarters: Vienna International Centre, P.O. Box 100, A-1400 Vienna, Austria; Telephone: (+43 1) 2600+Extension; Fax (+43 1) 26007; Email: Official.Mail@iaea.org

Name	Title	Email	Extension
Qu LIANG	Director, NAFA	Q.Liang@iaea.org	21610

Animal Production and Health (APH) Section

Name	Title	Email	Extension
Gerrit J. VILJOEN	Section Head, APH	G.J.Viljoen@iaea.org	26053
Ivancho NALETOSKI	Veterinarian, Serologist	I.Naletoski@iaea.org	26054
Mohammed SHAMSUDDIN	Livestock Reproductionist/Breeder	M.Shamsuddin@iaea.org	21619
Hermann UNGER	Veterinarian, Virologist	H.Unger@iaea.org	21644
Mario GARCIA P.	Veterinarian, Theriogenologist	M.Garcia-Podesta@iaea.org	26048
Svetlana PIEDRA-CORDERO	Project Assistant	S.Piedra-Cordero@iaea.org	26051
Roswitha REITER	Programme Assistant	R.Reiter@iaea.org	26052

Animal Production and Health Laboratory (APHL), A-2444 Seibersdorf, Austria

Name	Title	Email	Extension
Adama DIALLO	Laboratory Head, APHL	Adama.Diallo@iaea.org	28355
Kathiravan PERIASAMY	Livestock Geneticist / Breeder	K.Periasamy@iaea.org	28358
Charles Euloge LAMIEN	Biochemist	C.Lamien@iaea.org	28314
Jenna ACHENBACH	Molecular Biologist	J.Achenbach@iaea.org	28267
Caroline ADOMBI	Biochemist	C.M.Adombi@iaea.org	28380
Francisco BERGUIDO	Immunologist	F.Berguido@iaea.org	28356
William DUNDON	Molecular Microbiologist	W. Dundon@iaea.org	28379
Richard KANGETHE	Molecular Parasitologist	R.Kangethe@iaea.org	28385
Bharani SETTYPALLI	Molecular Biologist	T.B.K.Settypalli@iaea.org	28252
Daojin YU	Geneticist	D.Yu@iaea.org	28291
Eva-Maria WINGER	Senior Laboratory Technician	E.M.Winger@iaea.org	28303
Rudolf PICHLER	Laboratory Technician	R.Pichler@iaea.org	28378
Mamadou LELENTA	Laboratory Technician	M.Lelenta@iaea.org	28321
Joanna MLETZKO	Project Assistant	J.Mletzko@iaea.org	28362

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

Animal Production and Health Subprogramme


G. VILJOEN


I. NALETOSKI


M. SHAMSUDDIN


H. UNGER


M. GARCIA


S. PIEDRA-CORDERO


R. REITER


A. DIALLO


K. PERIASAMY


C. LAMIEN


J. ACHENBACH

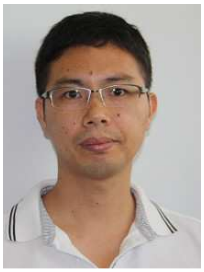

C. ADOMBI


F. BERGUIDO


W. DUNDON


R. KANGETHE


B. SETTYPALLI


DAOJIN YU


M. LELENTA


R. PICHLER


E. WINGER


J. MLETZKO

Expert Opinion

Livestock Production - Current Status in South and South-East Asia, Future Directions & Priority Areas for Research

By B.M.A. Oswin Perera, Kandy, Sri Lanka
(oswinperera@yahoo.co.uk; www.oswinperera.com)

Dr. Owin Perera, a Sri Lankan veterinarian with PhD from the University of Glasgow in animal reproduction. He started his teaching career at the Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Sri Lanka, and later on spent two cycles of 7 years each as Technical Officer of the Animal Production and Health Section, IAEA, Vienna, Austria. He has visited over 35 developing countries in Asia, Africa, Eastern Europe and Latin America, and worked with policy makers, scientists, academicians, veterinarians, laboratory technicians, livestock development personnel and farmers. Based on his multiple activities in developing countries, he has first-hand knowledge on the constraints in livestock farming, methods for addressing needs of livestock producers, and conduct of education and training programmes for livestock professionals, technicians and farmers. He is member of the International Standing Committee of the International Buffalo Federation, member of the Scientific Advisory Panel of the International Foundation for Science (IFS), Sweden, and was member of the Executive Committee and Vice President of the International Congresses on Animal Reproduction. Currently, he is back at the University of Peradeniya and very active on wildlife research, especially on elephants as Director of the Sri Lanka Wildlife Health Centre.

1. Background

The role of livestock in agriculture in South and South-East Asia is complex and significantly different from that of industrialized nations. The traditional farming systems are mostly based on mixed crop-livestock systems, with small farms predominating. The most important livestock species in the region are cattle (*Bos indicus, Bos taurus* and their crosses), buffalo (*Bubalus bubalis*, both river and swamp types), goats, sheep, pigs and poultry. In some high altitude areas Yaks (*Poephagus grunniens*) and Mithun or Gayal (*Bos frontalis*) are also important. Although the contribution of the livestock sub-sector to national GDP in most Asian countries is low, it is a crucial source of high quality protein, minerals and vitamins to the population, by way of milk, meat and eggs. For millions of smallholder farmers it provides food security, draught power, fibre, manure and fuel, and also serves as a 'living bank' in periods of economic hardship.

The farming systems in the region vary widely (Perera et al., 2005), determined by a matrix of several interacting factors that include climate (latitude, altitude and rainfall), location (rural, peri-urban or urban), cropping systems (rain-fed or irrigated, annual or perennial crops), type of operation (small or large farm, subsistence or commercial), and the species and their primary purpose (milk, meat, eggs, draught, capital or mixed). The ruminant production systems that were largely extensive or semi-intensive in the past (grassland-based or mixed crop-livestock, with rain-fed or irrigated mixed farming), which were sustained with locally available resources, have become constrained due to many factors. Competition for land from the increasing human population that demands space for habitation, crop production and other economic activities have dwindled grazing lands. Mechanization of agricultural operations and commercial market forces have also made such systems less competitive. Thus some enterprising farmers have moved to more intensive systems of production based on livestock only or landless systems with high producing breeds that require greater external inputs for feed, labour and health care (Perera, 2010). The monogastric production systems for poultry and pigs that were traditionally backyard operations based on household refuse and crop by-products have given way to intensive commercial systems of varying scale, based on commercial breeds and bought-in feed.

2. Increasing demand for livestock products and constraints for intensification

According to FAO (2011) the demands for meat and milk are projected to rise 73% and 58%, respectively, by 2050 and are driven by growing population and incomes in developing countries. The required production increases are expected to come from improving efficiency of livestock systems in converting natural resources into food and from reducing waste. For promoting and improving livestock production from a 'pro-poor' approach, FAO (2005) considers the following aspects to be of importance: (a) *establishing the basis for livestock production* – providing adequate and secure access to basic inputs required, such as land, water and feed, and risk coping mechanisms; (b) *kick-starting domestic markets for livestock and livestock-derived products* – providing secure access to livestock support services, credit and output markets; and (c) *sustaining and expanding livestock production* – securing the quality and food safety of livestock products, promoting research on breeding and feeding to produce high quality animals and products, and ensuring environmental sustainability of livestock production.

The constraints to sustainable livestock production by resource poor farmers in developing countries have been classed into three major categories (Hefferman et al., 2005) as: (a) *procurement of animals:* poor farmers find it difficult to access capital and credit facilities to purchase the required breeding stock; (b) *management:* farmers are unable to obtain animal health and production services, such as veterinary, breeding and advisory services in a timely and effective manner; and (c) *marketing:* small farmers do not have access to reliable and steady markets for their products.

The above considerations are fully applicable to the current situation that prevails in the Asian region. While some of these are clearly outside the scope of research and deal with policy issues, it is important to note that without such enabling policies and support services the results of research will have limited applications for improving livestock production.

3. Priority areas for applied research

In order for research to be effective in solving some of the above issues, it must be innovative, targeted and adaptive, with an inter-disciplinary and collaborative approach, and must involve the end-users and beneficiaries. Some priority areas for such applied research in the specific field of ruminant production, as perceived by the writer through his participation in international and national consultative processes, including a wide-ranging exercise conducted with stakeholders through the Sri Lanka Council for Agricultural Research Policy (2011), include the following:

3.1. Increasing the availability of quality animals suitable for different environments and production systems

The research objectives should be to (a) produce animals with optimum production performance, which are able to survive under the existing environmental conditions, utilizing locally available resources; and (b) to develop methods and procedures for optimizing their reproduction and productivity cost effectively. The research required would include the development of selection criteria for different breeds of ruminants suitable for different production systems, determining the cost effectiveness of different genotypes under specific farming systems, establishment of sustainable breeding programmes for commercial as well as conservation purposes, and the development or adaptation and application of modern technologies for improving productivity.

The focus of research in this area should be on three sub-themes: (a) assessing the current status of Animal Genetic Resources (AnGR) and *improving existing genotypes*; (b) *applying existing technologies* for enhancing performance and fertility; and (c) *developing, adapting and validating new tools and techniques*.

For *improving existing genotypes* it is necessary to implement recording schemes for milk and other performance traits on selected dairy farms and apply progeny testing for selecting superior animals as future breeding stock. The breeding schemes should be adapted to the local requirements and be sustainable. The cost effectiveness of different genotypes should be determined under specific farming systems for which they are intended.

In *applying existing technologies*, improving the delivery and effectiveness of artificial insemination (AI) services as a tool for genetic improvement should receive priority (see also section 3.2). A 'whole farm' approach should be adopted to identify and prioritize the constraints and opportunities in selected farming systems, and technologies for improved management, nutrition, reproduction and disease control should be integrated in a cost effective manner to overcome the constraints. Farms that have adopted such proven technology packages should be used as demonstration and training locations for disseminating the methods to other farmers.

The focus for *developing, adapting and validating new tools and techniques* should be on molecular methods for genetic characterization of selected populations of economically important breeds, and assisted reproductive technologies (ARTs) for multiplying the genetic merit of superior females and males. The latter includes the adaptation of embryo transfer and semen sex-sorting technologies for practical use in developing countries, and cryopreservation of genomes for conservation. The

development or adaptation of appropriate software, databases and information technology packages is also necessary for use in the decision making process for improvement, utilization and conservation of livestock.

3.2. Provision of reliable breeding and follow-up services for reproductive management

The delivery of AI and related support services has been a major bottleneck for improving dairy production. Improved modalities for providing the required services, their monitoring and continuous improvement should be the focus of research in this area.

From the farmer's perspective, accurate detection of heat in cows and buffaloes is a difficult task, especially in small farm operations. Thus, development of a cheap and practical method for heat detection would contribute to higher conception rates and shorter calving intervals, leading to economic benefits. Although the measurement of progesterone in samples of blood or milk collected at strategic times in relation to AI can provide information on whether the animal was actually in heat, and can also be used subsequently to check whether the animal is likely to have conceived, the disadvantage is that the analyses by radio-immunoassay (RIA) or enzyme-immunoassay (EIA) must be done in a laboratory with specialized equipment. Thus high priority should be given to the development of a cheap and practical 'cow-side' method (e.g. based on a dip-stick or slide format) for the detection of heat and early diagnosis of non-pregnancy.

3.3. Development of low-cost feeding strategies using locally available feed resources

The lack of feed resources for economic year-round feeding is a major issue in most dairy production systems (Smith et al., 2005). Research is needed on methods for improving the utilization of locally available feed resources to obtain optimum production of milk and meat from ruminants. This would involve the development, utilization and conservation of forage resources, both natural and cultivated, as well as development of novel feedstuffs from agricultural by-products. The research findings should be applied using the 'whole farm' approach outlined in section 3.1.

3.4. Controlling diseases, including sub-clinical and production diseases

Research should include studies that will produce the information needed for making and implementing policies and programmes to control and eradicate existing infectious diseases, and to prevent losses due to parasitic, metabolic and sub-clinical diseases. The studies should focus on developing (a) rapid, sensitive and specific diagnostic and detection techniques for identifying pathogens affecting animals, (b) improved methods for the control of common infectious and production diseases, and (c) surveillance and related strategies to detect emerging diseases and to prevent introduction of exotic diseases.

3.5. Improving the management skills of farmers

This area needs studies to develop appropriate educational and extension materials and to deliver them to farmers through the most effective media using modern communication methods. The ubiquitous cellular phone, which is now common among village farmers, could be a novel approach to farmer education and provision of information in the future.

3.6. Improving the quality and safety of livestock products

Studies should provide the information needed for making and implementing policies on setting standards and improving the quality and safety of livestock products as well as of animal feeds and pharmaceuticals that influence animal products. This should include studies on ingredients used in the value addition of dairy and meat products, and methods for improving the quality of animal products through advanced technologies. Surveys are also needed to identify unhygienic practices in relation to milking, slaughter and subsequent processing of milk and meat products, and on the usage, quality and safety of animal feeds, pharmaceuticals, biologicals and chemicals used in agriculture and veterinary practices. Other areas requiring study include methods for narrowing the gap between the farm-gate price and the consumer sale price of milk and methods for optimally using livestock by-products and excreta using environmentally sound principles.

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Forthcoming Events

Renovation of the FAO's and IAEA's Nuclear Sciences and Applications Laboratories in Seibersdorf - *ReNuAL*

Objective

Our aims, as part of the IAEA's Nuclear Sciences and Applications (NA) Laboratories in Seibersdorf, are to ensure that the FAO/IAEA Agriculture & Biotechnology Laboratories (ABL) are fit-for-purpose and appropriately positioned to meet the evolving needs of Member States with adequate infrastructure in place for the next 20–25 years. The goals are to:

- Redesign and expand the current infrastructure to ensure the efficiency and effectiveness of laboratory operations and services to better meet the current and future requirements of Member States.
- Ensure that the laboratories remain a vibrant research and training institution that continues to attract highly qualified scientists and other staff committed to advancing applied nuclear sciences to serve the needs and interests of Member States.

The current situation

The NA Laboratories in Seibersdorf comprise eight laboratory groups, five of which are cooperatively supported by the FAO and the IAEA through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. The laboratories support the delivery of nuclear sciences and applications through regular budget-supported activities, such as coordinated research projects (CRPs), through extrabudgetary mechanisms and through the IAEA's Technical Cooperation Programme. Currently, 87 staff work in Seibersdorf, including 58 staff at the FAO/IAEA Agriculture & Biotechnology Laboratories, supported by consultants, cost-free experts, visiting scientists and interns. The laboratories maintain a balance among applied/adaptive research and development, education and training, and scientific and technical services. Key activities in the laboratories include:

- Applied/Adaptive Research and Development: All laboratories are instrumental in developing and adapting proven methodologies and technologies for transfer to Member States. Research is demand driven and leads to new possibilities in the provision of services that in turn support research in Member State laboratories. Currently, over 50 CRPs are directly supported by the NA laboratories in Seibersdorf.
- Education and Training: The NA laboratories provide trainees and fellows from Member States with hands-on training in nuclear techniques through the TC programme and via extrabudgetary funding. The number of fellows, scientific visitors, training course and workshop participants is currently reaching 350 Member State experts per year. Most training courses are oversubscribed and there is currently little capacity to receive more.
- Scientific and Technical Services: The laboratories provide quality assured technical services, such as calibration and dosimetry audits, reference materials, proficiency testing and other analytical support services, for which the demand continues to grow. The laboratories' services include supporting the research of Member States' scientific institutions by establishing and sharing best practices worldwide and building collaborative global scientific networks.
- Support for the delivery of technical cooperation projects: The NA laboratories currently provide support to almost 300 TC projects through education and training activities, scientific and technical services and technical advice.

The Need for ReNuAL

Established in 1962, more than 50 years ago, demands on the NA Laboratories in Seibersdorf have continually increased in order to meet the evolving needs and demands of Member States. As the numbers of Member States grow, more have recognized the value of the laboratories and sought their support. These demands are expected to further increase in the future as the issues that the laboratories are expected to address continue to evolve.

While the laboratories have seen individual upgrades and extensions during the past 51 years, these were implemented sporadically and in response to individual needs but without an overall and comprehensive concept. No concerted renovation or significant new construction has taken place during this period. Whereas technologies and techniques used in the laboratories have changed dramatically over time, the facilities have not evolved to match the requirements for operations, training and compliance with current safety and security regulations and relevant quality management requirements.

The NA laboratories in Seibersdorf need both a quantitative and a qualitative enhancement. New investments in space and equipment are essential to secure the future of the laboratories for the benefit of Member States and to ensure that individual laboratories and support operations are fully compliant with the latest safety and security standards for laboratory research facilities.

At the 2012 IAEA General Conference, Director General Amano expressed his intention to launch a new initiative for to the modernization of the IAEA's Nuclear Sciences and Applications Laboratories at Seibersdorf, of which the FAO/IAEA Agriculture & Biotechnology Laboratories are the largest single component. This initiative was

supported through the adoption of Resolution GC(56)/RES/12. In August, this year, FAO Director General da Silva warmly welcomed the invitation of Mr Amano to support this initiative and to assist in mobilising the necessary resources among Member States. As part of this endeavour, the current document outlines this initiative, targeted to ensure the availability of fit-for-purpose laboratories appropriately positioned to meet the needs and demands of Member States for the next 15–20 years.

Major elements of ReNuAL

The ReNuAL project aims to ensure adequate infrastructure and equipment with a forward-looking approach for the FAO/IAEA Agriculture & Biotechnology Laboratories to carry out their mandate proficiently. Current projections, taking into account specific laboratory needs, space norms and training forecasts, foresee an increase in overall space of 59% compared to the current situation. Acquiring a balanced mix of key programmatic priorities and the necessary laboratory, office and training space, along with the highest priority equipment, will be crucial to the success of this project.

The current *ReNuAL* project, with strict adherence to programmatic prioritization, incorporates the following:

- A 36% expansion in laboratory space.
- A 152% increase in office and training facilities that allows concurrent training of up to three groups of twenty trainees.
- A 44% increase in storage and technical infrastructure space.
- The comprehensive renovation of the current laboratory facilities to ensure adherence to applicable safety regulations and to guidelines on barrier-free access for the disabled.
- Scientific equipment and instrumentation that ensure methodological alignment with the majority of external stakeholders.
- Design, planning, contingency and project management costs commensurate with the volume of the projected construction and renovation plan.

Budgetary Target and Timeline

The ReNuAL concept anticipates an overall investment of around €50 million over the next four years, with a core investment of around €32 million, and envisages completion by 2017. It foresees financing through a combination of regular budget and extrabudgetary funding. To this end, the IAEA has allocated approximately €2.6 million of Regular Budget funds each year over the next four years, i.e. a total of around €11 million, while the remaining investments will be generated from a variety of extrabudgetary sources. Efforts will also be made to attract private sector support.

Fit-for-Purpose Laboratories

The ReNuAL project will ensure that the laboratories will:

- Serve as a hub for growing networks of Member State laboratories in the respective thematic areas as a means to enhance their sustainability.
- Address emerging issues, for example, the impact of and adaption to climate change, new transboundary animal diseases, rapidly growing issues in the field of cancer.
- Foster the development of new nuclear applications, products and services.
- Increase capacity-building activities by providing hands-on training in both conversant and new areas.
- Institutionalize a systematic approach to quality assurance through modern facilities capable of accreditation to international standards where relevant. Contribute to improving the quality of Member States' laboratories within the framework of respective agricultural, food, environmental, health and safety standards.

From Labs to Member States

The Joint FAO/IAEA Agriculture & Biotechnology Laboratories (ABL) in Seibersdorf support and implement programmatic activities in response to Member State needs in the areas of food and agriculture. Their mandate is to assist Member States in the development and adaptation of new and existing technologies, involving isotopes, radiation and complementary techniques, to suit local requirements and environmental conditions, and to provide relevant training and analytical services.

Applied research and development are linked to coordinated research activities and technical cooperation projects, two of the IAEA's main delivery mechanisms in transferring nuclear technologies to Member States. The laboratories research and develop new and adapt existing technologies to suit local needs in Member States. This creates extraordinary opportunities for the laboratories' scientists and technicians to work with external stakeholders and Member States in meeting the often very specific challenges of both developing and developed countries. During the subsequent technology transfer process, laboratory outputs are disseminated and tested in the field and results are fed back for further improvement and validation — providing the unique feedback loop that makes this approach so effective.

Training and capacity building are crucial components of technology transfer. While most training activities are carried out and supported locally in Member States or in regional laboratories, numerous train-the-trainer workshops, courses and seminars are held at the FAO/IAEA Agriculture & Biotechnology Laboratories, involving several hundred trainees annually, with the overall goal of building sustainable capacity in Member States. While the key impetus may be the technology, thorough emphasis is placed also on the wider aspects of the problems to be studied or solved. Thus, trainees return home with comprehensive knowledge and with an extensive scientific and technical network ready to assist.

Technical and analytical support are provided to Member States through evaluation, standardization and selection of appropriate equipment and processes for each specific project and need, taking into account local conditions and infrastructure. FAO and IAEA technical staff responsible for implementing field projects has extensive experience in routine operations, maintenance and repair of the necessary processes and equipment.

The NA Laboratories in Seibersdorf

The NA laboratories in Seibersdorf — eight in total — are a unique feature in the United Nations system. Five of these laboratories are co-operatively managed by the FAO and the IAEA through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. These are:

- The **Animal Production and Health Laboratory** supports Member States in the use of radioisotopes and related technologies to map superior genes for increased animal productivity, and develops and transfers molecular and immunoassay methods for diagnosis and control of transboundary animal diseases.
- The **Food and Environmental Protection Laboratory** uses nuclear technologies to trace and authenticate food products and to detect and monitor contaminants in foods and the environment, improving Member State laboratory practices in food safety and quality to safeguard health and facilitate international trade.
- The **Insect Pest Control Laboratory** develops environmentally friendly methods of pest control for area-wide control of key insect pests, such as fruit flies, tsetse flies, moths and disease transmitting mosquitoes. It is renowned worldwide for its work on the sterile insect technique.
- The **Plant Breeding and Genetics Laboratory** focuses on mutation breeding to increase biodiversity for desired traits of crop plants and hence to accelerate the breeding of varieties with higher yield, yield stability, nutrition and improved resistance to environmental stresses such as disease, drought and salinity.
- The **Soil and Water Management and Crop Nutrition Laboratory** uses isotopic and radiation methods to measure and monitor soil, water and nutrients in cropping systems as a basis for developing strategies that ensure judicious and efficient use of resources and that minimize environmental degradation.

The three NA laboratories at Seibersdorf operated exclusively by the IAEA are:

- The **Dosimetry Laboratory**, part of the IAEA's human health programme, oversees the quality assurance aspects of the use of radiation in medicine in Member States. It provides dosimetry calibrations for national standards laboratories and conducts audits of the dose in radiotherapy and radiation protection.
- The **Nuclear Spectrometry and Applications Laboratory**, part of the IAEA's nuclear science programme, works with laboratories in Member States to enhance their use of nuclear instrumentation and analytical techniques, for example in promoting the use of various types of accelerator for materials testing and historical artefact preservation.
- The **Terrestrial Environment Laboratory**, part of the IAEA's environment programme, helps Member States to better understand and protect the terrestrial environment. To this end, the laboratory develops environmental assessment strategies and ensures the quality of analytical results by recommending methods, providing reference materials and organizing proficiency tests.

Regional training course on Techniques and Organization of Artificial Insemination Field Services in Cattle in Myanmar (MYA/5/022)

Technical Officer: Mohammed Shamsuddin

The meeting is planned from 13 to 24 January 2014 in Yangon Myanmar.

The purpose of the meeting is to provide on-site, hands-on training on rearing and management of AI bulls and semen collection, evaluation and processing; the use and practice of the artificial insemination technique in cattle; organising effective AI field services with emphasis on efficient distribution and management of semen and/or liquid nitrogen; AI record keeping, and analysis and reporting to farmers and AI service providers for making breeding decisions; and the evaluation of the AI service quality, including pregnancy diagnosis, improving fertility, management of infertility.

Twenty-five local participants are expected to attend this course.

Technical meeting with directors of veterinary laboratories participating in the project to strengthen animal disease diagnostic capacities in selected sub-Saharan countries

Technical Officer: Adama Diallo

The meeting is planned from 4 to 6 February 2014 in Vienna Austria.

The purpose of this meeting is to discuss results of past activities, draw on lessons learned from past experiences, and advise on future plans of the project to strengthen animal disease diagnostic capacities in selected Sub-Saharan African countries, supported by the South African Renaissance Fund (ARF), and USA- and Japan-supported-PUI project.

Final regional coordination meeting on Strengthening Capacities for the Diagnosis and Control of Transboundary Animal Diseases in Africa (AFRA) (RAF/5/057)

Technical Officers: Hermann Unger and Adama Diallo

The final coordination meeting of the regional AFRA project RAF/5/057 is scheduled to be held from 24 to 28 February 2014 in Arusha, Tanzania.

The aim is to review the progress made during the 5-year project and the results achieved in each participating country. Short presentations highlighting the impact of the activities to strengthen laboratory capacities from molecular diagnostics to sero-surveillance will be presented and critical bottlenecks in the control of transTAD's and lessons learned from the implementation of the project activities discussed. The recommendations and conclusions will serve as the base for the final report and as a guide for the new AFRA project RAF/5/068.

The second purpose of this meeting is to define actions to be taken in each participating country and prepare a detailed workplan for the next cycle for the follow up project.

Two project applications for a follow up of project RAF5057 were received, one focusing on vector borne diseases (VBD) and their control, the other on appropriate practices for the management, nutrition and health care of genetically improved stock including the use of modern reproductive techniques to bring about sustainable increases in productivity. In discussions with the applicants and stakeholders these two proposals were merged to address, in the coming five year period, the detection and control of VBD's including vector trapping and analysis and to analyse livestock management issues specifically for the peri-urban production. This meeting is meant to define the directive and milestones the project should encompass and draw up a work plan for the first two years.

Senior veterinary officers of the respective ministries from all AFRA member countries are welcome to participate in the meeting and the project.

National training course on Techniques and Organization of Artificial Insemination Field Services in Cattle (ERI/5/009)

Technical Officer: Mohammed Shamsuddin

The two-week training aims at providing on-site, hands-on training to artificial insemination (AI) technicians on the use and practice of the AI technique in cattle, organising effective AI field services with emphasis on efficient distribution and management of liquid nitrogen and frozen semen, AI record keeping, and analysis and reporting to farmers and AI service providers for making breeding decisions as well as the evaluation of the AI service quality. This includes pregnancy diagnosis, improving fertility and the management of infertility.

The training will be held from 17 to 21 March 2014 and 20 participants from Eritrea are expected to join the training.

Research coordination meeting on the on 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

The second research coordination meeting is planned from 5 to 9 May 2014 in Izmir, Turkey.

The purpose of the meeting is to to review the work carried out in the previous two years and to prepare the work plan and activities for the next phase of the project.

Regional training course on Livestock Data Collection and Analysis for Breeding Improvement (RAS/5/063)

Technical Officer: Mario Garcia Podesta

The training course is part of the activities of TC project RAS/5/063. The training course is planned from 11 to 15 May 2014 in Amman, Jordan.

The course aims to transfer knowledge and know-how on the importance of animal identification and tracing with the use of microchip implants and rumen boluses containing microchips as tools for animal identification. These tools will be used for monitoring productivity and health, retrieving farm and animal data for evaluating the productive and reproductive performance of livestock, selection and monitoring of phenotypically superior males for breeding purposes and the application of DNA technology towards marked-assisted breeding programmes for improving small ruminant productivity.

The course is open for scientists of Member States participating in RAS/5/063 that are involved in activities related to artificial insemination in livestock, flock management, evaluation of animal performance or in livestock data analysis.

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

Technical Officers: Hermann Unger

The first research coordination meeting of the new coordinated research project in support of the early and rapid diagnosis and control of African swine fever (ASF) is planned to be held from 2 to 6 June 2014 in Vienna, Austria.

The purpose of the meeting is to present different approaches of the selected research contract holders and discuss the technical inputs with the research agreement holders for an optimal performance. The main topics will address improved diagnostics and their development and validation; collection of field isolates and the whole genome sequencing of important strains; implementation of sanitary measures to control ASF in outbreak situations. The work plan for the first two years of this CRP will be finalized with the participants.

Consultant meeting on Early Pregnancy Diagnosis in the Bovine using Nuclear and Molecular Technique

Technical Officer: Mohammed Shamsuddin

The Consultant Meeting aims at updating the current state of research information targeted to identify pregnancy-associated glycoprotein, early conception factor, interferon tau (IFN-tau) and IFN-tau stimulated genes as the best-bet candidate for early pregnancy diagnosis on farms. Interferon tau is promising for its early production by the bovine conceptus from Day 14 to 18 (Day of breeding = Day 1). Polymerase chain reaction (PCR) and radioimmunoassay have been used to detect genes and the resultant conceptus-produced molecules in the maternal blood, respectively. The techniques, especially PCR, once developed, can be modified to fit into the loop mediated isothermal amplification (LAMP) assay and be used for early pregnancy diagnosis on farms to identify non-pregnant animals by Day 17 and be bred during the next oestrus, which is likely to occur during Day 18-24. The practice will not only reduce the number of non-productive animals in a herd and increase herd level productivity but also increase the number of breedings per year and artificial insemination service quality. The technique will contribute to climate-smart animal agriculture by improving herd-level productivity and reducing greenhouse gas emission per unit of food from animals.

The meeting is planned to be held from 11 to 13 June 2014.

Research coordination meeting on the Use of Irradiated Vaccines in the Control of Infectious Transboundary Diseases of Livestock

Technical Officer: Adama Diallo

The third Research Coordination Meeting of a Coordinated Research Project (CRP) on The Use of Irradiated Vaccines in the Control of Infectious Transboundary Diseases of Livestock will be held in Vienna, Austria, from 23 to 27 June 2014. The purpose of the meeting will be to discuss the results achieved since the start of the CRP in 2010 and to plan future activities. Technical officers, in link with agreement holders, will discuss with each contract holder to develop a work plan that would deliver the basic information required to establish the optimum conditions for attenuation and to devise methods to assess the degree of pathogen inactivation/attenuation and to validate their effectiveness as immunogens in protecting animals against infection.

Past Events

Regional (AFRA) training course on Transboundary Animal Diseases Surveillance Applying Molecular Techniques (RAF/5/057)

Technical Officers: Hermann Unger, Adama Diallo

The training course is part of the activities of TC Project RAF/5/057. The training course was held 1 to 5 July 2013 in Ghana.

Paticipants from Algeria, Burkina Faso, Botswana, Chad Cameroon (2), Ghana (4), Cote d'Ivoire, Kenya, Mali, Malawi, Morocco, Niger, Nigeria, Sudan, Uganda (2), United Republic of Tanzania and Zambia attended the meeting. The lecturers were Dr Zablon Njiru and Dr Andy K. Alhassan.

The training course provided a comprehensive and up to date, theoretical and practical training on molecular diagnostics and epidemiological techniques applying qPCR and LAMP technologies. The principles of sequencing, alignment, interpretation of sequence data and molecular mapping were demonstrated and trained with internet based software; reporting procedures including spatial distribution patterns and phylo-genetics were taught.

Regional training course on the Serological and Molecular Detection of the Avian Influenza Strain H7N9 (RER/5/016)

Technical Officers: Ivancho Naletoski, Adama Diallo

The training course was held from 10 to 30 August 2013 in Seibersdorf, Austria.

Participants from Albania (2), Armenia (2), Azerbayjan (2), Bulgaria (3), Croatia, Georgia, Hungary, Latvia, TFYR of Macedonia (2), Montenegro (2), Serbia (2), Tajikistan, and Turkey. The lecturs were provided by FAO, OIE, IAEA, Steven Van Borm, Rongbao Gao, Timm Harder, Maria Serena Beato, Alice Fusaro and Marek Slomka.

During February 2013 an outbreak of an influenza-like disease affected the human population in several provinces of China. Due to the rapid response of the Chinese authorities in March 2013 the virus was classified as avian influenza H7N9 strain, which was not detected by conventional diagnostic tests and has previously not been reported to infect people. By 29 May 2013, 132 human cases were diagnosed with 37 deaths.

Intensive investigations, primarily at the Chinese Centre of Disease Control, CDC have shown that the avian strain had mutated at several positions, resulting in better adaptability to a mammalian host, primarily the human population. Knowing the panzootic potential of avian influenza viruses, the international community has immediately developed response plans on the eventual spread of the Chinese H7N9 strain and called for emergency preparedness.

The Animal Production and Health Section of the Joint FAO/IAEA Division and the Technical Cooperation Department of IAEA immediately reacted to these calls by organizing two unplanned training courses under the existing technical cooperation projects RER/5/016 (regional European) and RAS/5/060 (regional Asian; for further details please see next item in this newsletter).

The course aimed at enhancing the early and rapid diagnosis and control of high pathogenic avian influenza (HPAI) and low pathogenic avian influenza (LPAI). In particular, at enhancing technical risk assessment and epidemiological knowledge on avian influenza H7N9 through specific lectures on epidemiology, risk assessment, differential diagnosis of the virus sub-types involved, sampling and submission procedures (including shipment of pathological samples to the FAO/OIE reference laboratories) and at providing practical training on current rapid techniques for disease diagnosis, in particular, the use of nuclear-based or related techniques for the identification and characterization of the pathogen(s). In addition, the course included genome sequencing, molecular epidemiological and bioinformatical analysis of HPAI and LPAI viruses with special emphasis on H7N9 viruses. Specifically, the on-site computer teaching facilities were used for the bioinformatics analysis of avian influenza genomes using web-based and freeware analysis software, including analysis and interpretation of the cleavage site, according to the currently recognized procedures. The ultimate goal was to contribute to the early detection and early reaction capabilities in Member States to prepare them for the current H7N9 avian influenza threat and for similar influenza threats of the future.

Regional training course on the Rapid and Confirmatory Diagnosis of Avian Influenza H7N9 (RAS/5/060)

Technical Officers: Hermann Unger, Adama Diallo

This training course was carried out under the TC Project RAS/5/060 from 9 to 20 September 2013 in Seibersdorf, Austria.

Participants from Afghanistan, Bangladesh, Indonesia, Islamic Republic of Iran, Iraq, Jordan, Kuwait, Malaysia, Myanmar, Oman, Pakistan, T.T.U.T.J of T. Palestinian

A., Philippines, Sri Lanka, Syrian Arab Republic, Viet Nam and Yemen attended the course. Lecturers came from CDC China, IZSVe Italy, FLI Germany, AHVLA UK, CODA-CERVA Belgium, FAO, OIE and IAEA to present the latest information and techniques in the fight against influenza.

As the new avian influenza H7N9 strain appeared in Asia early 2013 enhancing and updating the technical skills, risk assessment and epidemiological knowledge was requested by IAEA MS participating in the regional project. Through lectures on epidemiology, risk assessment, differential diagnosis of the virus subtypes involved and sampling and submission procedures, important background information was transferred. During practical sessions, current rapid techniques for disease diagnosis, in particular, the use of nuclear based and related techniques for the identification and characterization of the pathogen were demonstrated. In addition, an introduction into genome sequencing, molecular epidemiological and bioinformatics analysis of H7N9 viruses was provided and the most important tools and techniques applied in practicals. This course presented a great networking opportunity for the participants within their regional groups and with experts. The feedback provided by participants was very positive and served the ultimate goal of contributing to the early detection and early reaction capabilities in Member States.

Joint IAEA/FAO/OIE regional stakeholder workshop on Awareness Raising for Veterinarians Involved in the Control of Transboundary Animal Diseases (RER/5/016)

Technical Officer: Ivancho Naletoski

The workshop was held from 16 to18 October 2013 at the VIC, Austria. Thirty-six participants from 15 countries of the European region participated in the workshop. Additionally, five experts were invited to give their talks and lead the discussions in their respective areas (Dr Zientara Stéphan, ANSES laboratory in Maisons Alfort, France; Dr Sánchez-Vizcaíno, José Manuel, OIE Reference laboratory for ASF in Madrid; Dr Schaffner Francis, Avia-GIS, Switzerland). The target audience were professionals responsible for diagnosis of target diseases in the designated national animal health laboratories, official veterinarians working for the competent national authorities, and representatives of the field veterinary services responsible for implementation of the surveillance and control programmes. The invited experts gave lectures on early disease detection, strengthening of the communication lines among the veterinarians responsible for implementation of the disease control plans and feedback analysis in order to define and implement improvement targets in the system.

Presentations during the RER/5/016 workshop.

A special session at the end of the workshop was organized to discuss several topics. The topics for the session were general preparedness and response, and the role of international standards (especially the established and approved IAEA standards) in the overall preparedness for response to nuclear and/or radiological emergencies. Two experts had presentations on the topics, Dr Balogh Lajos from the National FJC Research Institute for Radiobiology and Radiohygiene in Budapest, Hungary and Mr Jean-Francois Lafortune, Emergency Preparedness Coordinator at the Incident and Emergency Centre of IAEA.

Regional (ARASIA) training course on Radioimmunoassay Procedures and Data Interpretation (RAS/5/063)

Technical Officer: Mario Garcia Podesta

The training course took place from 7 to 11 October 2013 at the Ecole Nationale de Médecine Vétérinaire, in Tunis, Tunisia. The purpose of the course was to transfer knowledge and develop skills on milk and plasma progesterone RIA and ELISA as a tool to improve reproductive management in relation to artificial insemination in small ruminants.

Fourteen ARASIA participants from Iraq, Jordan, Oman and Yemen participated in the course. Unfortunately, the three Syrian participants were not able to travel. In addition, six local participants, one Libyan supported by the Arab Atomic Energy Agency and a Chadian (trainee under TC CHD/5/004) joined the group. Lectures and laboratory work were conducted by two international experts, the course director and the technical officer.

Training course participants.

Lectures focused on the reproductive physiology of the oestrous cycle of does and ewes, the seasonality and male effect on the ovarian cyclicity, and the use of RIA and ELISA for measuring hormones and assessing the reproductive status of cattle and small ruminants. Laboratory work was conducted on the use of ELISA readers and gamma counters, on the preparation of plasma and serum standards and quality control samples, and on the procedures and data interpretation of progesterone RIA and ELISA techniques using commercial kits. The principles of radioimmunoassay (RIA) and enzyme-linked immunosorbent assay (ELISA) techniques, their comparative advantage for analysing reproductive hormones, especially progesterone, and the basic requirements in terms of trained staff, laboratory equipment, storage, use and disposal of chemicals and radioactive material were fully discussed.

Gamma counter for measuring ^{125}I.

Course participants understood the principles of RIA and ELISA for measuring reproductive hormones in blood samples. They are now capable of: (1) preparing standards for the calibration curve and internal quality control samples for evaluating the performance of the assays, (2) evaluating the accuracy of their pipetting, (3) Running a radioimmunoassay and an ELISA test for determining progesterone concentration in blood samples, (4) Interpreting the concentration values and clinical data to evaluate the reproductive status of the animal.

The group was highly motivated and showed great interest in learning the two techniques, in getting good results and in interpreting the laboratory data in relation to the clinical data. Course participants understood that laboratory results without clear reproductive data (e.g. date of standing heat, date of artificial insemination, date of calving), proper animal identification and adequate handling of samples are meaningless. A full session was dedicated to discuss a series of examples taken from past experiences in various developing countries. Lecturers' presentations, RIA and ELISA manuals, and additional learning material were distributed in CDs to all participants. Moreover, the five counterpart institutions of RAS/5/063 are receiving basic RIA equipment, including manual gamma counters, to facilitate the monitoring of reproductive hormones in small ruminants.

The support of the host institute and of the Arab Atomic Energy Agency was highly appreciated.

National training course on Techniques and Organization of Artificial Insemination Field Services in Cattle (ERI/5/009)

Technical Officer: Mohammed Shamsuddin

The training course took place from 4 to 11 November 2013 in Asmara, Eritrea.

The course lecturers were Messrs Paul Egang'a and Paul Mollel.

The objectives were to provide on-site, hands-on training to inseminators on (a) the use and practice of the artificial insemination technique in cattle, (b) organising effective AI field services with emphasis on efficient distribution and management of liquid nitrogen and frozen semen, (c) AI record keeping, and analysis and reporting to farmers and AI service providers for making breeding decisions and (d) the evaluation of the AI service quality, including pregnancy diagnosis, improving fertility, management of infertility.

FAO and National University of Life and Environmental Sciences regional workshop on Adapting Innovations and Technologies for Diagnostic Purposes to Contribute to the Increase of Livestock Production and Food Safety

Technical Officer: Ivancho Naletoski

The FAO Regional Office for Europe and Central Asia organized the workshop from 6 to 7 November 2013 in Kiev Ukraine in order to evaluate the needs and establish future strategies for the improvement of the preparedness to respond to disease challenges in the Eastern European and Central Asian countries. Priority areas were the early detection systems and the current status and possibilities for implementation of advanced diagnostic systems in the laboratories of the invited Member States. Participants from Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russian Federation, Tajikistan, Turkey and Uzbekistan have attended the workshop. The APHS was invited to have a presentation on the advanced diagnostic techniques for detection of disease pathogens in animals.

Participants at the workshop in Kiev, Ukraine

Recommendation of the meeting (reflecting also the needs of participating Member States) are as follows: (1) Ring test trials/proficiency testing should be organized to maintain the proficiency; (2) EMPRES-i Russian language interface can be developed and tested in former USSR countries; (3) Radiological testing is an essential component of food safety control authority – countries are encouraged to cooperate with the Joint FAO/IAEA Division, using available technical expertise, database and network. The National Liaison Officers should be contacted for any request for Joint FAO/IAEA Division; (http://tc.iaea.org/tcweb/projectinfo/GetNLOByRegion.asp?cid=RER) (4) Guidance is required for technical specifications for laboratory equipment, consumables, reagents; (5) Countries, FAO/IAEA, and other developing/donor organizations, are encouraged to support adaption of new innovative techniques, methods; (6) Create laboratory network in the sub-region: joint training and capacity building. The available social networks could be used; (7) Assistance in shipment of samples to OIE/FAO/EC reference laboratories is needed; (8) Roster of laboratory experts should be developed and updated regularly.

The presentations of the participants, as well as the report and the recommendations are available on following link: http://www.fao.org/europe/meetings-and-events-2013/nubip/en/

National training course on Techniques of Artificial Insemination Field Services and Feeds and Feeding of Cattle in Madagascar (MAG/5/020)

Technical Officer: Mohammed Shamsuddin

The training course took place from 11 to 22 November 2013 in Antanarivo, Madagascar.

The aim of the course was to develop a pool of skilled field workers who can deliver quality artificial insemination (AI) services; involving practice and organization of AI field services, management of frozen semen and liquid nitrogen, AI records of fertility and infertility, and interventions on farms to improve animal nutrition and productivity in smallholders periurban dairy farms.

Training course participants

The training course was organized by the Département de recherches zootechniques et vétérinaires (DRZV) as part of the activities of IAEA TC MAG5020 project.

The International Atomic Energy Agency appointed two external lecturers, Dr Naceur Slimane from École nationale de médecine vétérinaire, Tunisia and Dr Paulo Alexandre Cortes Salgado from Cirad Reunion, France. The local organizer was Mr Norbertin Ralambomanana, Département de recherches zootechniques et vétérinaires; Centre national de la recherche appliquée au développement rural; Ministère de la recherche appliquée au développement, Antananarivo, Madagascar.

The course was attended by 28 participants from DRZV and the Department of Livestock of which 15 were AI technicians. It was conducted at DRZV. The practical training was conducted at the facility of the Department of Livestock and in private farms.

The following topics on AI and reproductive health management were taught to the participants:

- Anatomy of the reproductive tract of cows; importance for transrectal palpation, size, shape, volume of different and their individual variations
- Physiological of reproduction in cow; sexual cycle behaviour, ovarian hormones and hormonal regulation of the oestrous cycle in ruminants
- Biotechnology of animal reproduction; AI techniques, optimal time of AI with regard to ovulation, sperm transport, capacitation and fertile life of ovum and spermatozoa
- Successes and failure of AI
- Postpartum anoestrus in cows; nutrition, ovarian cysts, clinical studies, aetiology, remedial measures
- Repeat breeding cow; clinical study, infectious and functional aetiology, pathogenesis remedial measures
- Clinical management of reproduction in cows
- Ultrasonography for the study of reproductive physiology and diagnosis of reproductive disorders
- Principle and practice of radioimmunoassay (RIA) and enzyme immunoassay (EIA) of reproductive hormones and their clinical interpretation
- Bovine mastitis; clinical study, aetiology and remedial measures

Training on artificial insemination

The practical part included hands-on exercise/practice of transrectal palpation of the reproductive tract of the cow, catheterization of the cervix using the technique of the inseminator, semen handling and recording of data and practice of the California Mastitis Test for the diagnosis of mastitis in cows. Four empty cows and cows' genital tracts collected from abattoirs were used by the trainees for practicing AI. All AI technicians were found confident to continue AI field services.

The training on animal nutrition included the following topics:

- Dairy farming and its constraints; climate, genetics, feeding, economic disease, nutritional and metabolic diseases, parasitism and common infections, Gram negative bacteria and stress
- The importance of feeding; productivity, profitability and prevention
- Digestive physiology of ruminants; digestive tract, ingestion and feeding activities, digestion in the rumen
- Ruminant feed rationing; basic principle, units used by INRA's rationing system, ingestion and digestibility, intake capacity, feed units, nitrogen and PDI, minerals, vitamins and water
- Ruminants' energy and nitrogen requirements
- Feed constituents of ruminants' ration; particularities of tropical forages, agro-industrial by-products, concentrate feeds
- A complete cycle feeding and nutrition requirement of dairy cows; calving to calving; INRA's 2007 standards
- Replacement dairy heifers; foetal life, suckling, from weaning to puberty, from puberty to reproduction
- On farm intake evaluation
- Near Infrared Spectrometry
- Nutritional indicators in cattle farming; body condition score, energy balance, blood parameters
- Nutritional imbalances; acidosis, ketosis, steatosis (fatty degeneration), alkalosis, milk fever

Demonstration of California Mastitis Test in cows

Practical exercises involved uses of software rationing (DC Ration Spreadsheet) and software for simulation of feeding strategies for a whole year (LIFE SIM Dairy). In order to help participants to find the balance between energy and protein intake in the diet, respecting animals' intake capacity (French Fill Units), participants were trained to use the Excel's Solver function.

According to the training evaluation made by the participants, about 80% of the participants felt that the content of the training was directly transferable to their profes-

sional activity. More than 80% of the participants felt that this training will have a positive impact on the quality of their work. Finally, 73% of the participants were very pleased to have participated in this training.

Second regional TC coordination meeting on Improving the Reproductive and Productive Performance of Local Small Ruminants by Implementing Reliable Artificial Insemination Programmes (RAS/5/063)

Technical Officer: Mario Garcia Podesta

The coordination meeting took place from 25 to 27 November 2013 in Muscat, Oman, with the participation of national project coordinators of ARASIA TC Project RAS/5/063 (Iraq, Jordan, Oman, Syria and Yemen).

The purpose of this coordination meeting was to present the current status of sheep and goat production systems, including improvements in Artificial Insemination (AI) programmes in small ruminants, to discuss the results of completed project activities and the benefit for participating ARASIA Member States, and to review and update the project work plan for 2014–2015.

Consultants meeting on Advances in Development of Early Warning Tools for Detection of Vector Borne Diseases of Animals, Including Zoonoses - Focus on Vectors

Technical Officer: Ivancho Naletoski

The consultants meeting took place from 4 to 6 December 2013 at IAEA Headquarters, Vienna, Austria.

Vector borne diseases, such as African swine fever, blue tongue, West Nile fever and others, are gaining importance during the last decade. A large portion of these diseases have zoonotic potential and pose significant risk for the public health. Trapping vectors and evaluation of the epidemiological risk to transmit disease/s (number of vectors per unit geographical surface, vector differentiation and techniques for pathogen detection in the vectors and vector mapping) have been shown as a weak point in the surveillance systems of many Member States. Consequently, the consultant meeting was aimed to answer many questions on the available and feasible solutions for the counterparts.

Thirteen experts presented on the topic. Representatives of the FAO and OIE headquarters in Rome and Paris, respectively have actively participated at the meeting, as well as five invited guests.

Main recommendations of the meeting were that a stepwise implementation of harmonized SOPs in the laboratories of Member States, as well as multi-sectorial knowledge (veterinary, ecology, entomology etc.) is required in order to establish consistent, comparable and sustainable techniques for evaluation of the epidemiological importance of the disease vectors.

Kick-off meeting on the recently approved EU funded FP7 project: Linking Epidemiology and Laboratory Research on Transboundary Animal Diseases and Zoonoses in China and EU – LinkTADs

Technical Officer: Ivancho Naletoski

The LinkTADs project was recently approved for financing by the EU-FP7 Programme. Five research institutes from each, EU and China are participants in the project, coordinated by the FAO headquarters in Rome. The APHS of the Joint FAO/IAEA Division, is a partner in the project under the umbrella of FAO.

The main goal of the project is research coordination for the most important economical and zoonotic diseases of animals between EU and China. The first kick-off meeting was organized to define the precise areas and tasks of the project in order to ensure smooth implementation of the project activities. The meeting was held from 9 to 11 December 2013 at the FAO headquarters in Rome.

National Training Course on Techniques and Organization of Artificial Insemination Field Services and Feeds and Feeding of Cattle in Madagascar (MYA/5/022)

Technical Officer: Mohammed Shamsuddin

The training course took place from 9 to 20 December 2013 in Insein, Myanmar.

Fifteen local participants attended the training course. The course lecturers were Messrs Mohammed Bhuiyan and Mr Ponweera Alexander.

The objectives were to provide on-site, hands-on training on (a) rearing and management of AI bulls and semen collection, evaluation and processing, (b) the use and practice of the artificial insemination technique in cattle, (c) organising effective AI field services with emphasis on efficient distribution and management of semen/liquid nitrogen, (d) AI record keeping, and analysis and reporting to farmers and AI service providers for making breeding decisions, and (e) the evaluation of the AI service quality, including pregnancy diagnosis, improving fertility, management of infertility.

Stories

Mozambique addressing animal health needs through nuclear and related techniques

The Central Veterinary Laboratory (LCV) in Mozambique is a national reference laboratory belonging to the Directorate of Animal Science (DCA), one of the Technical Directorates of the Agricultural Research Institute of Mozambique (IIAM) in the Ministry of Agriculture.

LCV pays special attention to the diagnosis of major and relevant diseases affecting local livestock such as footand mouth disease (FMD), Newcastle disease (ND), African swine fever (ASF), contagious bovine pleuropneumonia (CBPP), Rift Valley fever (RVF), lumpy skin disease, rabies, trypanosomosis, tick borne diseases, tuberculosis, brucellosis, salmonellosis, collibacilosis, and gastro intestinal parasites. The results of these activities are used to carry out epidemiological and surveillance studies, to identify emerging diseases and to prepare for animal health risks, to increase the diagnostic capacity of the laboratory, and to build capacities in the regional and provincial veterinary laboratories.

Hands-on training of laboratory technicians at LCV

The IAEA, through TC Project MOZ/5/022 has upgraded the veterinary services of Mozambique. The Agency provided the highly needed nuclear and nuclear related molecular and immunological technological platform for the early and rapid diagnoses of animal diseases that could build on the classical diagnostic platform that was operational in Mozambique. The immunological (e.g. ELISA) and molecular (e.g. PCR) capacities of the laboratory were increased. The knowledge and technical skills of the technical staff was upgrade through training abroad in specialized laboratories, especially on serology and molecular techniques for the diagnosis of transboundary animal diseases, including FMD, ASF, CBPP, RVF and ND, and on laboratory quality assurance management. The working capacity of the diagnostic laboratory is currently well over 10 000 samples per year.

Lab technician performing ELISA test for FMD

The results of diagnostic activities and disease control campaigns of the veterinary diagnostic laboratory are being felt throughout the country. It has a positive effect on the livelihoods of many communities through the rapid identification and prevention of the most important and strategic animal diseases. One of the several examples is the intervention on the FMD outbreak in 2010 that occurred in the southern part of the country. The timely detection by the ELISA technique of FMD antibodies in the sera of affected animals helped to control the spread of the disease to other animals and to other areas. In a strategized and focused sampling frame (i.e. taking sera samples of all sick animals as well as animals at risk) from Gaza Province, 31 samples were confirmed as FMD positives out of a total of 189, confining the spread of the

Training of LCV staff

disease to a few localities whilst protecting the neighboring areas. In addition, a survey carried out in the same period at Matutuine district in Maputo Province revealed a seroprevalence of about 0.6%. The extension of the immunological platforms with the molecular platforms will facilitate the characterization of the circulating FMD

virus at the time, which will help with the matching of outbreak FMD virus with vaccine FMD virus.

TC MOZ/5/002 has been instrumental in the training of other veterinary diagnosticians. A training course on Molecular Diagnosis - PCR was co-conducted and funded by the IAEA, the Biotechnology Center (CB-UEM) and the Veterinary Faculty (FAVET-UEM) of the Eduardo Mondlane University (UEM), and the Institute of Agriculture Research of Mozambique (IIAM-MINAG). This course was held at the UEM campus using the facilities of the CB-UEM and FAVET-UEM. The main objective of the course was to give participants scientific and theoretical knowledge of molecular biology and principles of molecular diagnostic techniques applied to animal diseases and to expose them to routine practical procedures associated with molecular diagnostic tests. The course was structured to include both theoretical principles and methodologies and hands-on laboratory and practical bench experiments. The course was attended by a total of 19 participants, especially from the Institute of Agricultural Research of Mozambique (IIAM-MINAG), and participants were divided in four groups to maximize participation during practical sessions.

Periurban Smallholder Dairy Farms Improves Livelihood in Madagascar

Agriculture in Madagascar accounts for almost 30% of GDP, 40% of export earnings and employs more than 70% of the labour forces. Livestock is an important income earner for many families. About 60% of rural families depend on livestock fully or for part for their livelihood. Only 2 950 000 ha, about 13% of total land area, is cultivated for arable and permanent crops leaving a huge area as potential pasture for livestock. However, annual growth in milk and meat production remained modest during 1990–2000 and limited to 1.2% and 1.4%, respectively. About 10.4 million cattle, 1.8 million goats and sheep and 1.3 million pigs constitute the livestock industry of Madagascar.

Indigenous zebu cattle are distributed throughout the island and the periurban, smallholder dairy farms rear cattle of adapted European breeds (*Bos taurus*) and crosses between *B. taurus* and *B. indicus*. Integrated approaches towards strengthening the value chain would improve the situation as it has been successful elsewhere with smallholder production systems.

Indigenous cattle in Madagascar under genetic characterization.

The smallholder production system faces challenges not only in procuring inputs and services but also in selling their produces because of lack of bargain power, which is further exacerbated by a long value chain coupled with inefficient players in it. A technical cooperation project (MAG/5/020) of the IAEA aims at reducing rural poverty by improving the productivity of livestock where nuclear and molecular techniques have been utilized for genetic characterization of indigenous and adapted livestock. Project activities also involve increasing competitiveness of the livestock industry by improving reproduction, nutrition and health management of cattle in smallholder dairy farms.

Many rural and periurban landless and smallholders families have started dairy farming with crossbred and adapted Holstein cows as a means of their livings, which has been encouraged by the growing demand of milk in Antananarivo. These farmers meet 50–100% of their family expenditures with income from dairying. Crop residues and by-products and cut and carry green grasses from road side and community lands have been used to feed cattle. Cut and carry green grasses are available for six months that constitute the rainy season of the year. During the dry six months, the staple cattle feed is rice straw, while crushed maize, cassava, rice bran, oil cake, soybean meal, broken snail shell, and salt are added at variable proportions and combinations are fed to cattle as a concentrate mix.

Good milk price enable farmers to keep feed cost around 50% of of income from selling milk, which is an indication of good producers' profit margins. Depending on the level of management skills, milk production costs vary between 0.27 and 0.45 US$/L and it is sold at 0.55 US$/L.

A progressive farmer and his family in a farm producing yogurt

Many consumers in and around Antananarivo prefer yogurt to fresh milk and there is a good value addition if milk is converted into yogurt and then sold to consumers. Haja and Julien are two of the beneficiary farmers of the project who manufacture yogurt from the milk produced. They succeed to have a value addition of up to 85% on top of fresh milk price. Haja, in addition to his own produces, buys fresh milk from neighbours and has been continuously scaling up his yogurt production. He has already branded his yogurt in the market.

Branded yogurt produced by a small holder farmer and his family.

These smallholder farmers are not without problems. Madagascar has very recently started its veterinary school. At present there are only few veterinarians, who obtained their veterinary degrees abroad by their own initiatives. Apart from the the public veterinary services, only very few veterinarians run private practices. These veterinarians are usually located in the city and rural farmers face difficulties to receive on-farm services. The livestock department of Madagascar has inseminators and paravets working in the field. The IAEA TC project has implemented several national trainings for further improving the skills of 15 inseminators and 12 paravets.

Farmers' income is likely to increase further if reproductive efficiency is improved in the farm by introducing reproductive health management programmes and better feeding. The IAEA TC project has supported capacity building not only by national and international training of personnel but also by providing equipment. The national capacity on delivering quality reproductive health management programmes has been strengthened by supporting the counterpart institute with the application of radioimmunoassay for measuring reproductive hormones and ultrasonography to improve reproductive management.

Madagascar has some unique species, breeds and types of mammals, which are different from rest of the world. The country is one of the repositories of the world's largest biodiversity. However, because of economic hardship and continued pressure on land for the production of food, the existence of many of these unique animal species and breeds are now threatened. Moreover, indiscriminate cross breeding risks genetic erosions of livestock species. The IAEA TC project has collected phenotypic data and samples for DNA analysis and genotyping indigenous and adapted cattle. This will allow genetic characterization of cattle in Madagascar. The project will take the livestock industry of Madagascar a long way towards marker assisted breeding of cattle and other livestock for important economic traits.

The integrated approach involving genetic characterization of livestock, improving reproduction, nutrition and health management of dairy cows in periurban smallholder dairy farms coupled with innovative yogurt production and marketing has been demonstrating positive impact on the livelihood.

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	Nicholas Odongo
D3.20.26	The early and sensitive diagnosis and control of peste des petits ruminants (PPR)	Adama Diallo
D3.20.28	The control of foot and mouth disease (FMD)	Gerrit Viljoen
D3.20.29	The use of irradiated vaccines in the control of infectious transboundary diseases of livestock	Adama Diallo
D3.20.30	Use of stable isotopes to trace bird migrations and molecular nuclear techniques to investigate the epidemiology and ecology of the highly pathogenic avian influenza	Ivancho Naletoski
D3.20.31	Early and rapid diagnosis and control of TADs – second phase- African Swine Fever	Hermann Unger

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

Technical Officer: Mohammed Shamsuddin

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

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

RCHs have already started or nearly completed the field trial that involves studying sheep and goat breeds for resistance to natural infections with GI parasites. DNA has been extracted from blood samples and most of the RCHs have sent an aliquot to the IAEA's Animal Production and Health Laboratory (APHL) in Seibersdorf for genotyping. Single Nucleotide Polymorphism based DNA markers were discovered in different candidate genes at Seibersdorf laboratory. Part of the DNA samples collected from resistant/susceptible sheep and goat breeds by the RCHs during artificial challenge trials were genotyped. The CRP will end in 2015.

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

Technical Officers: Mohammed Shamsuddin, Gerrit Viljoen

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

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

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

The early and sensitive diagnosis and control of peste des petits ruminants (PPR)

Technical Officers: Adama Diallo, Herman Unger

Peste des petits ruminants (PPR) is a highly contagious transboundary animal disease of wild and domestic small ruminants caused by a morbili virus similar to rinderpest virus and is on the list of economically important animal diseases to be reported to the OIE. PPR spread in endemic regions through nomadic herdsmen and livestock trade. High morbidity and mortality rates up to 90% in affected herds make PPR a killer disease for small ruminant populations. This not only affects rural economies severely but also reduces the genetic resources and endangers breeding policies. Clinically, PPR is characterized by high fever, depression and anorexia followed by ocular and nasal discharge, pneumonia and severe diarrhea. These symptoms can easily be confounded for pasteurellosis or rinderpest and diagnostic tests for RP were giving positive results due to the cross reactions.

The disease is endemic in parts of Africa, the Near and Middle East and South Asia and the incidence is gradually expanding. The Animal Production and Health Subprogramme receives regular requests from Member States for support. In Africa PPR was limited to countries north of the equator, but since 2007 Gabon, Democratic Republic of the Congo, Kenya, Angola, and Uganda amongst others reported outbreaks. The situation is similar in the former Soviet Union countries of Asia. In addition, PPR is one of the targets of the United Nation Food and Agriculture Organisation's (FAO) Emergency Preventive System (EMPRES) programme.

It is not easy to isolate PPR virus in cell culture and might need up to two to four weeks for a positive result to be confirmed. In the late 1980s specific reagents (monoclonal antibodies) and nucleic acid techniques (DNA probe hybridization and polymerase chain reaction (PCR) became available and allowed more precise diagnosis. Today different ELISA's and PCR procedures are in use. However, these techniques are evolving quickly and need constant adaptation. An APH organized consultancy meeting in 2007 on the early and rapid diagnosis of emerging and re-emerging transboundary animal diseases concluded that amplification systems, in the form of real time PCR (rt-PCR), as well as isothermal amplification (IA) approaches, have moved from research environments to routine diagnostic applications. The APH Subprogramme was encouraged to foster the transfer of these new technologies to IAEA and FAO Member States. Their application of early and sensitive PPR diagnostic tools, in combination wtih protective and DIVA (differentiation between infected and vaccinated) vaccines to PPR, would improve our management and control of the disease.

The overall objective of the CRP is to develop, validate and transfer to Member States sensitive, specific and rapid tests for the diagnosis of peste des petits ruminants (PPR) to help them better manage and control this TAD.

The specific research objectives are:
(a) Evaluate and validate current Reverse Transcriptase-PCR (RT-PCR) methods in use for the diagnosis of PPR.
(b) Evaluate and validate real time PCR.
(c) Design and evaluation of the loop-mediated isothermal amplification (LAMP) assay.
(d) Evaluate and validate a penside test currently under development for rapid and cheap identification of PPR virus in the field.
(e) Evaluate and validate the use of ELISA in epidemiological studies of disease prevalence and protection due to vaccination.
(f) Contribute to the build up a PPRV gene sequence data bank for molecular epidemiology analysis.

Eleven research contract holders from Bangladesh, Burkina Faso, Cameroon, China, Cote d'Ivoire, Ghana, Mali, Nigeria, Pakistan, Sudan and Turkey, and four agreement holders from Australia, Ethiopia, France and Sweden participated in the CRP.

The final RCM was held from 19 to 22 November 2012 at the IAEA in Vienna and IAEA Nuclear Sciences and Applications Laboratories in Seibersdorf.

The control of foot and mouth disease (FMD)

Technical Officer: Gerrit Viljoen

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

The first research coordination meeting (RCM) of the coordinated research project (CRP) on The Control of Foot and Mouth Disease, FAO, Rome, Italy, from 10 to14 January 2011, was held in collaboration with FAO and EU-FMD. It was attended by all, but one, research contract holders and agreement holders, as well as several observers from EU-FMD and FAO and foot and mouth (FMD) vaccine and diagnostic manufacturers and producers. Discussions were focused on: (1) the status of FMD in the participating counterpart's respective countries (e.g. FMD free vs. FMD free zone with or without vaccination vs. FMD endemic) with respect to the risks and threats; (2) what is currently being done in terms of vaccine matching; (3) what criteria are being used to choose FMD vaccines and how they are being applied; (4) how is vaccine potency being determined and utilized; (5) how are post-vaccination monitoring and surveillance being performed; (6) the status of counterpart's vaccine laboratory quality assurance and FMD laboratory analysis and diagnoses (i.e. their analysis and/or diagnostic laboratory proficiencies and capacities both for routine testing and research, laboratory infrastructure and procedures). The work plans of all the research contract holders (RCH) and the agreement holders (AH) were developed and discussed, and all the agreement holders will supervize (based on their respective expertise) identified aspects of the work plans.

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

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

preparations, correct vaccine formulations (i.e. homologous strain or isolate vaccine to protect against outbreak, new generation vaccines with a broader protection base (i.e. cross protection between different strains and isolates) or alternative formulations of existing vaccines).

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

It is important to:

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

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

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

Technical Officer: Adama Diallo

Vaccination has been one of the greatest achievements of mankind in enabling the eradication of serious, life-threatening diseases of man and his domesticated livestock. Many of the vaccines used today rely on technologies developed over 100 years ago involving some form of attenuation, i.e. the use of an alternative or mutant strain of a pathogenic organism that has reduced virulence whilst maintaining immunogenicity, or inactivation, where chemical or physical methods are used to kill virulent pathogenic strains. In general, attenuated vaccines are more efficient than vaccines that are killed by chemical procedures that might denature the immunogenic antigens, make them less efficient in inducing good protective immune response. Irradiation of pathogens may be an alternative to chemical inactivation of the pathogen for developing efficient vaccines. This IAEA CRP aims at developing vaccines for the control of some animal diseases through the irradiation of pathogens, irradiation in a way to obtain an organism not able to multiply anymore while maintaining the ability to synthesize proteins that will trigger the immune system in the host to provide a good protection against an infection. The objective of the first phase of the project was to identify the most efficient dose of irradiation to obtain such a product. For that objective the effect of different doses of irradiation was evaluated on the capacity of irradiated pathogens on their capacity of biosynthesis and growth in vitro or in vivo. Those studies allowed the determination of a range of efficient doses for each of the pathogens. In most cases, the effect of the irradiation was evaluated on the growth of the pathogen in vitro and then in mice or rabbits, non–natural hosts of those pathogens. Good results have been obtained with some cases such as, Theleria annulata and Fasciola gigantica. In those cases the evaluation in the natural host remains to be carried out. This test was already carried out in the case of the fish parasite Ichthyophthirius multifilis and the ruminant gastro-intestinal parasite Haemonchus contortus. The results are very well promising. The third and final RCM is scheduled to take place in 2014.

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

Technical Officer: Ivancho Naletoski

Among several important issues in the epidemiology of the highly pathogenic avian influenza (HPAI) that need attention is the role the 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 eventually present in the faeces and extraction and analysis of somatic DNA to detect the bird species. These two techniques will be used to link the AI carrier status and the carrier species without even capturing the birds, and may thus be used as a non-invasive platform to generate important epidemiological information on migration pathways (obtained by SIA) and the transmission of the virus to a certain geographical area. Faecal samples should be collected randomly at the same sites where feathers are collected. Samples will undergo two test procedures:

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

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

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

Of great epidemiological interest would be the potential application of the same technology to trace short-range migration in wildlife carriers, in order to determine their role in transmission of animal and/or human pathogens.

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

The first RCM was held at the IAEA from 31 October to 2 November 2012. The next meeting is planned for 2014.

The early and rapid diagnosis and control of TADs – second phase –African Swine Fever (AFS)

Technical Officers: Herman Unger, Charles Lamien

This new CRP is envisaged to start early 2014. After a successful first phase with focus on avian influenza control, now ASF will be addressed.
ASF is a contagious viral disease of pigs transmitted directly or by ticks. It leads to acute disease with high mortality and maintains a chronic infection when survived. Wild boars are the natural reservoir. Endemic in wide parts of sub-Saharan Africa it has spread in the last 10 years to the Northern Caucasus and keeps expanding primarily to the West and North. The disease creates severe economic hardship for pig farmers and due to lack of a vaccine, culling and quarantine measures are the only tools available to control disease. As pig production is in many cases on a small scale, farmers do often lack the means and education how to fend off disease. Similarly the diagnostic tools so far available have their limitations and a number of epidemiological as well as virological issues are not understood.

This CRP will address the missing information by evaluating the existing diagnostic tools, broadening the availability of genetic information by whole genome sequencing and testing different control measures on the ground to prepare guidelines for wider application. Specific research tasks of applicants can be accommodated as well when found suitable for the scope of the project.

General information applicable to all coordinated research projects

Submission of Proposals

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

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

Complementary FAO/IAEA Support

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

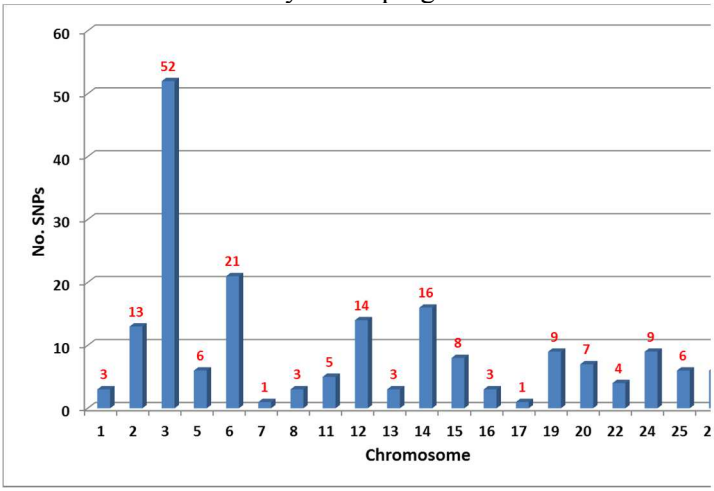
Activities of the Animal Production and Health Laboratory

Animal genetics

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

Field testing of DNA markers for parasite resistance in sheep

Gastro-intestinal nematode infection is one of the major constraints affecting the sheep and goat industry, of which Haemonchosis is a serious menace in tropical countries. Breeding sheep and goats for enhanced host resistance would be a long term and sustainable strategy in managing and controlling these parasites. In continuation of its efforts in identifying DNA markers for parasite resistance, APHL developed genotyping assays for 194 novel SNP (single nucleotide polymorphism) markers identified in several candidate genes related to immune pathways, pattern recognition receptors, Major Histocompatibility Complex, etc. All the newly identified SNP markers will be tested in around 3000 phenotype recorded animals which are part of the field trial in six countries. The genotyping of the first set of 1536 animals at 194 SNP loci is currently under progress.



Distribution of newly identified SNPs across sheep genome

Molecular epidemiology and characterization of Haemonchus variants

Ruminant livestock in tropical countries including sheep, goat, cattle and camel are infected by different sympatric species of Haemonchus parasites like Haemonchus contortus, Haemonchus placei, Haemonchus longistipes, etc. Differences in the epidemiological distribution of these species/variants exist in different regions within and across countries. The level of anthelminthic resistance differs among various species/variants and the fact that the process of genetic recombination among the parasites transfers anthelminthic resistance to susceptible worms further adds complexity to the problem. Also, the level of host resistance amongst indigenous breeds varies for different species/variants of Haemonchus parasites. Hence, the correct identification of various species/variants, as well as information on epidemiology and genetic characteristics of the principal circulating species/variant is essential for establishing sustainable control strategies. APHL initiated targeted sequencing of parasite genomes to characterize the genetic diversity of Haemonchus variants. Three different regions of Haemonchus genome viz. nuclear internal transcribed spacer 2 (ITS2), mitochondrial cytochrome oxidase subunit 1 (COI) and mitochondrial nicotinamide dehydrogenase subunit4 (NAD4) were optimized for epidemiological screening and genetic diversity analysis. The genotyping protocol for identifying anthelminth resistant alleles within beta tubulin isotype 1 gene was also optimized. Sequencing and genotyping of Haemonchus samples collected from different regions of Pakistan are currently under progress.

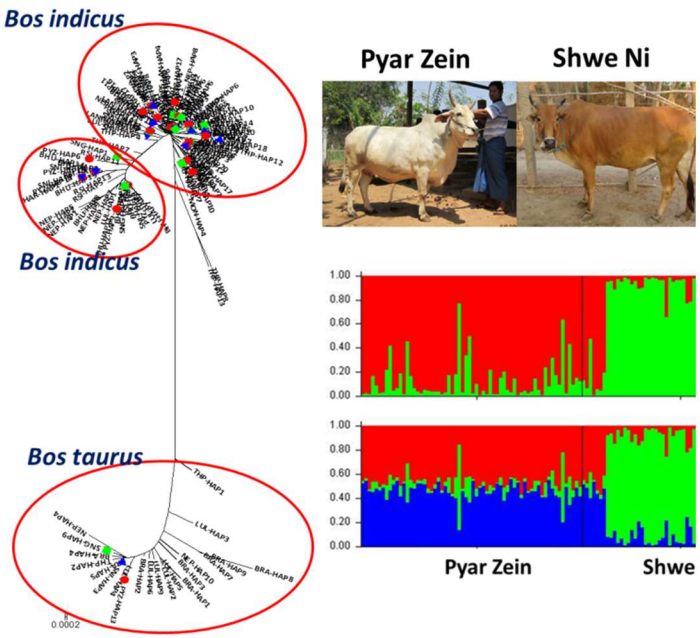
Genetic characterization of indigenous native cattle from Myanmar and Zambia

In continuation of agency's support in implementing FAO's Global Plan of Action on animal genetic resources (AnGR), APHL supported genetic characterization of native cattle from Myanmar and Zambia. Two fellows Ms Ei Thandar from Myanmar and Ms Ireen Mbeule from Zambia were trained on molecular genetic characterization of cattle breeds using nuclear and extra-nuclear DNA markers.

Characterization of Myanmar native cattle

Most of the indigenous cattle from Myanmar are draught type breeds which can work for long hours in agricultural fields and pull carts with heavy loads. Much required information on genetic potential of these animals especially genetic variability, level of inbreeding, physical and phenotypic characteristics, etc. were lacking. A total of 162 samples collected from three major cattle breeds of Myanmar (Pyar Zein, Shwe Ni and Shwe Ni Gyi) were analysed by sequencing control region (D-loop) of mitochondrial genome and genotyping 27 microsatellite marker loci.

Microsatellite genotypes revealed moderate levels of within breed genetic diversity and relatively low levels of inbreeding in Myanmar cattle breeds.



Phylogeny and genetic structure of Myanmar native cattle

Only 1.5% of total variance was due to between breed differences and more than 98% of variation was found within breeds. Although morphologically similar, genetic analysis showed Shwe Ni and Shwe Ni Gyi breeds to be quite distinct from each other. This finding will have significant implication on decisions related to future breeding management of these cattle breeds. Mitochondrial DNA sequencing revealed three maternal lineages in Myanmar cattle, two Bos indicus lineages and one Bos taurus lineage. mtDNA haplotypes of Myanmar cattle were closely related to Vietnamese as well as Indian zebu cattle.

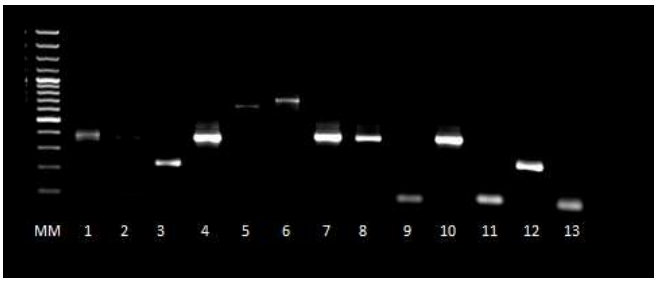
Characterization of Zambian native cattle

Cattle in Zambia are reared primarily for meat as well as for milk. Smallholder farmers are the major keepers of livestock including cattle owning 70–80% of total population. Crossbreeding of local Zambian cattle is practiced in rural as well as peri-urban areas to improve productivity which resulted in replacement of local breeds by exotic or graded animals. Most local livestock populations in Zambia including cattle are not yet classified into discrete breeds. Considering the strong and urgent need to evaluate and characterize indigenous cattle, three populations Angoni, Barotse and Tonga were analysed using microsatellite and mitochondrial DNA markers. High level of within breed genetic diversity was observed in all the three Zambian cattle breeds, with low levels of estimated inbreeding. Genetic structure analysis revealed complete admixture of all three Zambian native cattle breeds although the centroid of Angoni was marginally distinct from Barotse and Tonga. Genetic evaluation indicated high level of gene flow among different native cattle breeds of Zambia. Two mitochondrial haplotype lineages both belonging to Bos indicus type were observed among Zambian cattle breeds. Further comparative analysis of Zambian breeds with cattle from the region is under progress.

Animal Health

Molecular epidemiology of African swine fever virus (ASFV)

APHL has been involved in the characterization of ASFV isolates from DRC. More than 140 samples collected during outbreaks that occurred at various geographical locations in DRC between 2003 and 2012 were screened by real time PCR. Positive samples were further characterized to determine their genotype by sequencing the appropriate target of the P72 gene. Furthermore, intra-genotypic characterization was undertaken by sequencing the full P54 gene and partial 9RL gene of the central variable region (CVR) to determine the profile of this region. The results showed that ASVF of at least 3 different p72 genotypes were involved in various outbreaks in DRC from 2003 to 2012. Also several CRV profiles were found.



Amplification of the 9RL gene in the CVR showing product with different sizes.

Additionally, analyses of the amplified P54 gene have shown 4 different P54 profiles.

Capacity building

Ms Ei Thandar from Livestock Breeding and Veterinary Department, Yangon, Myanmar, was trained on genetic characterization and phylogeography of indigenous Zebu cattle from Myanmar at APHL for three months (15 July to 11 October 2013) under TC fellowship (MYA/13001).

Ms Ireen Mbeule from National Institute for Scientific and Industrial Research, Lusaka, Zambia, was trained on molecular genetic characterization of Zambian native Zebu cattle using DNA markers at APHL for two months (2 September to 31 October 2013) under TC fellowship (ZAM/13004).

Mr Tanveer Hussain from University of Veterinary and Animal Sciences, Lahore, Pakistan, was trained on molecular epidemiology and genetic characterization of Haemonchus variants infecting domestic ruminants in Pakistan at APHL for two months (1 November to 31

December 2013) under BMENA fellowship sponsored by American Association for the Advancement of Science (AAAS) (Grant No. S-LMAQM-12-GR-1145).

Mr. Woma Yusufu from the National Veterinary Research, Institute, Vom, Nigeria, is being trained in APHL for PPR diagnosis: gene amplification and sequencing molecular epidemiology and virus isolation. During his stay in APHL, Mr. Woma is analysing about 70 pathological samples that were collected from suspected infected goats and sheep throughout Nigeria from 2009 to 2013. Molecular epidemiological analysis of the positive samples has already revealed that there are viruses from two distinct lineages of PPRV (lineage IV and II) presently circulating in the country. His internship is expected to end in March 2014.

Mr. Curé Georges Tshilenge Mbuyi, from the veterinary laboratory of Kinshasa, Democratic Republic of Congo, was trained in APHL on molecular epidemiology analysis. He stayed in APHL from 2 September to 29 November 2013 during which period he analysed samples collected in his country.

Cost-free experts

Ms. Jenna Achenbach joined APHL last September as an USA-supported cost-free expert. MSc in Veterinary Science PhD in Microbiology/Immunology/Pathology from Colorado State University, she has over 20 years of experience in animal science and veterinary diagnostics working specifically with PRV, BVDV, BRSV and avian and human influenza. She also has experience in vaccine development and immunological analysis of experimental vaccines. In APHL she is working on African swine fever (ASF).

Mr. YU Daojin, from Fujian Agriculture and Forestry University (FAFU), China, joined the Animal Production and Health Laboratory in July as a Chinese-supported cost-free expert. DVM and PhD, his research activities in FAFU were focused on study of antibiotic resistant genes in environment, antibiotic residues and pharmacokinetic of antibiotic and traditional Chinese herb in animals like pig and fish. In APHL he is working on peste des petits ruminants (PPR).

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 bios.	M. Shamsuddin I. Naletoski
ANG/5/010	Characterizing Indigenous Animal Breeds for Improving the Genetic Quality of Local Cattle Breeds and Small Ruminants **Objective:** To undertake phenotype and genotype characterization of indigenous animal breeds for improving the genetic quality of local and adapted cattle breeds.	M. Shamsuddin
BDI/0/001	Supporting Human Resource Development and Nuclar Technology Support including Radiation Safety O**bjective**: 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/5/006	Improving Animal Health and Productivity **Objective**: To strengthen, diagnose, and control African swine fever, and increase animal productivity.	H. Unger A. Diallo
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 G. Viljoen M.L. Nguyen
BKF/5/011	Improving the Health and Productivity of Small Ruminants through Efficient Animal Feeding, Identification of Genetic Markers for Breeding Programmes and Better Health and Reproductive Management **Objective:** To improve small ruminants productivity through efficient use of local plant resources in animal feeding and health, identification of genetic markers for use in breeding programmes and better health and reproductive management.	M. Shamsuddin
BKF/5/014	Improving the Productivity of Small Ruminants through Diet, Health and Identification of Genetic Markers for Selection and Breeding Management **Objective**: To contribute to improving the productivity and profitability of small ruminant farms in Burkina Faso by applying genetic characterization and artificial insemination for breeding and utilizing local feed resources to improve nutrition and medicinal plants to control parasites	M. Garcia M. Shamsuddin K. Periasamy
BOH/5/001	Reducing the Incidence of Brucellosis in Animals and Humans by Surveillance and Control **Objective:** To reduce the incidence of brucellosis in animals and humans in Bosnia and Herzegovina	I. Naletoski

TC Project	Description	Technical Officer(s)
BOT/5/008	Using Nuclear and Molecular Diagnostic Techniques for Improved Diagnosis of Animal Diseases **Objective**: To employ nuclear and molecular diagnostic techniques to improve diagnosis of animal diseases.	G. Viljoen A. Diallo
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
BZE/5/006	Establishing Early and Rapid Diagnosis of Transboundary Animal Diseases to Support Food Security **Objective:** To establish an early and rapid nuclear/nuclear related serological/molecular diagnostic and control capability for transboundary animal diseases:- Building capacity, strengthening of a national diagnosis and surveillance system for transboundary/zoonotic.	G. Viljoen
BZE/5/007	Supporting Sustainable Capacity Building through Distance Learning for Laboratory Personnel of the National Agricultural Health Authority **Objective**: To increase and sustain the level of trained qualified staff in the laboratory, and thus the sustainability of the laboratory as a whole by providing an avenue for technical laboratory staff to pursue educational advancement while retaining their services.	G. Viljoen B. Maestroni
CAF/5/005	Enhancing Livestock Productivity through the Improvement of Selection and Use of Artificial Insemination for Increased Meat and Milk Production **Objective:** Improve cattle productivity by implementing a reliable artificial insemination (AI) programme in the country.	M. Shamsuddin
CHD/5/004	Improving Cattle Productivity through Genetic Improvement, Including Artificial Insemination, to Contribute to Reducing Poverty and Combating Food Insecurity **Objective:** Improve the productivity of local cattle breeds by means of artificial insemination.	M. Shamsuddin
CMR/5/018	Improving Productivity of Indigenous Breeds and Animal Health **Objective:** Improved productivity of indigenous breeds and animal health.	H. Unger
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.	H. Unger K. Periasamy
ELS/5/011	Enhancing Livestock Productivity and Decreasing Environmental Pollution through Balanced Feeding and Proper Manure Management **Objective:** Enhance livestock productivity and decrease environment pollution through balanced feeding and proper manure management.	M. Shamsuddin

TC Project	Description	Technical Officer(s)
ERI/5/009	Enhancing Small Scale Market Oriented Dairy Production and Safety for Dairy Products through Improved Feeding and Cattle Management, Higher Conception Rates and Lower Calf Mortality **Objective:** To increase dairy production through improved feeding and cattle management and higher conception rate and lower calf mortality, and improve farmers livelihood in Eritrea.	M. Shamsuddin
ETH/5/017	Improving Livestock Productivity through Advances in Animal Health and Production **Objective:** Improvement of livestock productivity through advances in animal health and production.	A. Diallo
IVC/5/032	Establishing Epidemiological Surveillance of Peste des Petits Ruminants (PPR) and Studying Its Socio-Economic Impact on Rural Populations by Developing Diagnostic Tools and Providing Economic Data to Veterinary Services **Objective:** To develop diagnostic tools and provide economic data to assist veterinary services in developing a proper strategy to control peste des petits ruminants in Cote d'Ivoire.	G. Viljoen A. Diallo
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.	G. Viljoen A. Diallo I. Naletoski
KAM/5/002	Using Nuclear and Molecular Techniques to Improve Animal Productivity and Control Transboundary Animal Diseases **Objective:** To improve livestock productivity for food security by integrated management of animal nutrition, reproduction and health which includes: early pregnancy diagnosis for better reproductive management, metabolic profiles in livestock for assessing nutrition.	G. Viljoen M. Garcia M. Shamsuddin
KEN/5/033	Using an Integrated Approach towards Sustainable Livestock Health and Nutrition to Improve Their Production and Productivity for Enhanced Economic Development **Objective:** To use an integrated approach to manage both livestock health and nutrition in order to improve their production and productivity for enhanced economic development.	A. Diallo M. Shamsuddin
KEN/5/034	Using Irradiated Improved Brachiaria Grass and Dolichos Lablab Species for Increasing Quantity and Quality of Milk Production and Reproduction for Smallholder Dairy Farms in Drought Prone Areas **Objective**: To investigate and determine the feasibility of using gamma irradiation to improve Bracharia and Dolochos lablab forage for improbed production and reproduction in smallholder dairy farms in Kenya.	H. Unger A. Diallo B. Forster P. Lagoda
LES/5/002	Using Nuclear and Molecular Techniques for Improving Animal Productivity and Control of Transboundary Animal Diseases to Enhance Livestock Production and Health **Objective:** To improve livestock production and health.	G.Viljoen

TC Project	Description	Technical Officer(s)
LES/5/003	Using Nuclear and Molecular Techniques for Improving Animal Productivity **Objective:** To improve livestock production.	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
MAR/5/021	Improving Smallholder Dairy Productivity through Better Nutrition by Using Locally Available Forage and Browse Species **Objective:** To contribute to the improvement of smallholder dairy productivity through better nutrition using locally available forage and browse species.	M Shamsuddin
MAU/5/004	Supporting Genetic Improvement of Local Cattle Breeds and Strengthening the Control of Cross-Border Diseases **Objective**: To increase livestock productivity by reducing disease events and improving breeding programmes and genetic resources for food security.	H. Unger/ M. Shamsuddin
MLI/5/025	Improving National Capacities to Characterize Serotypes of Major Animal Diseases Using Molecular Biology Techniques for the Development of a National Disease Control Strategy **Objective**: The main objective is identification of the various serotypes of the foot and mouth disease virus. The project would help the elaboration of a national strategy for control of the disease by formulating vaccines which are currently imported from Botswana.	I. Naletoski
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
MLW/5/001	Strengthening the Essential Animal Health and Veterinary Infrastructure for Disease Control and Management Services in Urban and Rural Areas **Objective:** To develop capacity and strengthen infrastructure for animal disease control and management services in urban and rural areas of Malawi.	H. Unger
MON/5/020	Improving the Health Status of Livestock by Developing a Technology to Produce the Vaccine and Diagnostic Kit for Transboundary Animal Diseases **Objective:** To improve the health status of livestock by developing a technology to produce the vaccine and diagnostic kit of transboundary animal diseases.	G. Viljoen
MON/5/021	Improving the Productivity and Sustainability of Farms Using Nuclear Techniques in Combination with Molecular Marker Technology **Objective:** To improve the productivity and sustainability of livestock and crop integrated farms through utilization of high yield, disease resistant new wheat varieties and other cereal varieties developed by the combined application of nuclear and molecular marker.	M. Shamsuddin

TC Project	Description	Technical Officer(s)
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.	H. Unger I. Naletoski
MOZ/5/005	Strengthening the Sustainability of the Institution to Address Animal Diseases, Prevention, Food Safety and Animal Production Problems through Nuclear and Related Techniques **Objective:** To improve the productivity and sustainability of livestock and crop integrated farms through utilization of high yield, disease resistant new wheat varieties and other cereal varieties developed by the combined application of nuclear and molecular marker.	G.Viljoen
MYA/5/022	Improving Animal Productivity through the Use of DNA-Based Technology and Artificial Insemination **Objective:** To improve livestock productivity through the selection of superior breeding stock and to improve capacity in the use of molecular and related technologies for raising the genetic quality of local and adapted livestock breeds.	M. Shamsuddin
MYA/5/024	Supporting the National Foot-and-Mouth Disease Control Programme **Objective:** To increase productivity of the livestock sector by implementing sustainable strategies to control and eradicate Foot-and-Mouth Disease.	G. Viljoen
NAM/5/011	Establishing Research and Diagnostic Capacity for the Effective Control of Animal Diseases in the Northern Communal Areas and Improving Veterinary 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
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.	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	G.Viljoen I. Naletoski
RAF/5/057	Strengthening Capacities for the Diagnosis and Control of Transboundary Animal Diseases in Africa (AFRA) **Objective**: To strengthen the diagnostic capacity of national veterinary services to monitor and control major transboundary animal diseases, particularly foot and mouth disease, peste des petits ruminants and contagious bovine pleuropneumonia.	H. Unger A. Diallo

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

TC Project	Description	Technical Officer(s)
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.	R. Kashyap H. Unger
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 P. Lagoda F. Sarsu
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 G. Viljoen
THA/5/050	Emergency support to Thailand's flood relief and rehabilitation efforts in the fields of crop, soil and water resources management. **Objective**: To complement Thailand's flood relief and rehabilitation efforts including the detection of land degradation, development of conservation strategies and water usage effectiveness in agriculture, early detection and prevention of animal diseases outbreak and the development of crop varieties adaptable to social development and climate change.	G. Viljoen ML. Nguyen
THA/5/053	Enhancing Productivity and Control of Reproductive Diseases of Dairy Cattle and Buffaloes by Application of Nuclear-Based and Molecular Techniques **Objective**: To enhance productivity of dairy cattle and buffaloes in Thailand in order to obtain food security, poverty reduction and a good quality of life for farmers according to the national development programme for food and agriculture, with a focus on animal productivity and disease control.	G. Viljoen M Shamsuddin
TUN/5/028	Supporting Watering Strategies to Help Livestock Raised in Semiarid and Arid Regions Coping with Climate Change **Objective**: To characterize, analyse and to adjust watering strategies for livestock adopted in different production systems in the main agroecological areas of Tunisia. To enhance livestock performance, secure the sustainability of livestock-based production systems and contribute to the empowerment of livelihoods of rural communities.	I. Naletoski
UGA/5/032	Improving Animal Production and Productivity through Advanced Animal Disease Control and Animal Production Measures **Objective:** To improve animal production and productivity through advanced animal disease control and animal production measures.	H. Unger
UGA/5/035	Improving Food Safety through Surveillance of Fish Diseases **Objective**: To avail credible information about trace metals and aflatoxins in fish.	H. Unger C. Lamien
URT/5/027	Improving Livestock Production and Productivity through Sustainable Application of Nuclear and Related Techniques **Objective:** The broad objective of this project is to improve livestock production and productivity in the United Republic of Tanzania through sustainable application of various nuclear and nuclear related techniques.	M. Shamsuddin M. Garcia

TC Project	Description	Technical Officer(s)
URU/5/028	Improving the Diagnosis of Bacterial, Viral and Parasitic Zoonotic Diseases that Impact the National Economy and Human Health **Objective**: Improvement of the diagnosis of important zoonotic diseases (eg Newcastle Disease, Fascioliasis, Leptospirosis, Micobacterium and others).	G. Viljoen
YEM/5/012	Improving Diagnostic and Analytical Capabilities of the Central Veterinary Laboratory Including Residue Testing of Animal Products **Objective**: To enhance livestock productivity and quality by reducing the incidence of livestock diseases.	H. Unger
ZAI/5/021	Upgrading Laboratory Services for the Diagnosis of Animal Diseases and Building Capacity in Vaccine Production to Support the Sustainability of Food Security and Poverty Alleviation **Objective:** To support the sustainability of food security and poverty alleviation through animal diseases diagnosis and immunization.	G. Viljoen I. Naletoski
ZAI/5/022	Using Nuclear and Biotechnology Techniques for Genetic Adaptation and Improvement of Staple Crops for High Temperatures and Water Stress **Objective**: To develop climate resilient varieties for major staple crops with efficient water and nitrogen use to contribute to sustainable food security and the fight against poverty. To benefit from inputs already identified under previous TC projects to build capacity for mutation induction and plant biotechnology for advanced mutants lines and infrastructures.	G. Viljoen A. Diallo I. Naletoski
ZAI/5/023	Upgrading Laboratory Services for Capacity Building in Fish and Aquaculture Diseases as a Contribution to Sustainable Poverty Alleviation and Sanitary Security of Food **Objective**: To enhance advanced skills in the diagnosis and investigation of fish and aquaculture diseases as a contribution to sustainable poverty alleviation and sanitary security of food.	A. Diallo I. Naletoski
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 technologies.	I. Naletoski M. Shamsuddin M. Garcia
ZIM/5/016	Strengthening Food Security and Safety by Advancing Technologies for the Rapid Diagnosis of Diseases of Major Economic and Zoonotic Importance and for Residue/Pesticide Control in Animals and Animal Products **Objective:** Strengthening the existing technology and capacity to rapidly diagnose diseases of major economic and zoonotic importance and enable proper and timely response to disease outbreaks.	I. Naletoski

Publications

Classical and molecular characterization of pigeon paramyxovirus type 1 (PPMV-1) isolated from backyard poultry – first report in Macedonia

A. Dodovski, K. Krstevski., ***I. Naletoski***

Macedonian Veterinary Review (2013) 36(1): 33-39.

Aim of this study was to characterize pigeon variant of Newcastle disease virus (NDV) isolated from backyard poultry using classical and molecular methods. In standard hemagglutination inhibition (HI) test both polyclonal NDV antiserum and monoclonal antibodies 161/617 specific for pigeon variants of NDV showed inhibition of heamagglutination of the isolated virus. Intracerebral pathogenicity index (ICPI) has shown that the isolate is mesogenic virus (ICPI = 0.81). One-step RT-qPCR for detection of M gene was performed indicating a presence of NDV and RT-qPCR for discrimination between lentogenic and velogenic strains based on F gene was also performed indicating a presence of virulent NDV. A portion of the F gene was amplified and sequenced for determination of virulence and phylogenetic characterization. The F protein cleavage site sequence of the isolate had multiple basic amino acids at residues 112–116 and a phenyl alanine at residue 117 (112RRQKR*F117) which is typical for velogenic strains. The nucleotide sequence of 374 bp was aligned to begin at nt 47 and finish at 420 immediately after the cleavage site and compared with other reference strains from the region and worldwide. In the phylogenetic tree, the isolate clustered into genotype VIb, typical for PPMV-1. This strain is phylogenetically very similar to other PPMV-1 isolated from pigeons in Macedonia. Poultry infected with PPMV-1 can spread the virus in the absence of clinical signs, thus PPMV-1's are constant threat to domestic poultry. This is the first report of evidenced spillover of PPMV-1 into poultry in Macedonia.

Development of a cost-effective method for capripoxvirus genotyping using snapback primer and dsDNA intercalating dye

E. Gelaye, ***C. Lamien****, R. Silber, E. Tuppurainen, R. Grabherr, A.* ***Diallo***

PLOS One 8 (10): e75971. doi:10.1371/journal.pone.0075971

Sheep pox virus (SPPV), goat pox virus (GTPV) and lumpy skin disease virus (LSDV) are very closely related viruses of the Capripoxvirus (CaPV) genus of the Poxviridae family. They are responsible for sheep pox, goat pox and lumpy skin disease which affect sheep, goat and cattle, respectively. The epidemiology of capripox diseases is complex, as some CaPVs are not strictly host-specific. Additionally, the three forms of the disease co-exist in many sub-Saharan countries which complicates the identification of the virus responsible for an outbreak. Genotyping of CaPVs using a low-cost, rapid, highly specific, and easy to perform method allows a swift and accurate identification of the causative agent and significantly assists in selecting appropriate control and eradication measures, such as the most suitable vaccine against the virus during the outbreaks. The objective of this paper is to describe the design and analytical performances of a new molecular assay for CaPV genotyping using unlabelled snapback primers in the presence of dsDNA intercalating EvaGreen dye. This assay was able to simultaneously detect and genotype CaPVs in 63 samples with a sensitivity and specificity of 100%. The genotyping was achieved by observing the melting temperature of snapback stems of the hairpins and those of the full-length amplicons, respectively. Fourteen CaPVs were genotyped as SPPVs, 25 as GTPVs and 24 as LSDVs. The method is highly pathogen specific and cross platform compatible. It is also cost effective as it does not use fluorescently labelled probes, nor require high-resolution melting curve analysis software. Thus it can be easily performed in diagnostic and research laboratories with limited resources. This genotyping method will contribute significantly to the early detection and genotyping of CaPV infection and to epidemiological studies.

Isothermal loop-mediated amplification (lamp) for diagnosis of contagious bovine pleuro-pneumonia

G.Mair, E.M. Vilei, A.Wade, J. Frey, ***H. Unger***

BMC Veterinary Research 2013, 9**:108**

Contagious bovine pleuropneumonia (CBPP) is the most important chronic pulmonary disease of cattle on the African continent causing severe economic losses. The disease, caused by infection with *Mycoplasma mycoides subsp. mycoides* is transmitted by animal contact and develops slowly into a chronic form preventing an early clinical diagnosis. Because available vaccines confer a low protection rate and short-lived immunity, the rapid diagnosis of infected animals combined with traditional curbing measures is seen as the best way to control the disease. While traditional labour-intensive bacteriological methods for the detection of *M. mycoides subsp. mycoides* have been replaced by molecular genetic techniques in the last two decades, these latter approaches require well-equipped laboratories and specialized personnel for the diagnosis. This is a handicap in areas where CBPP is endemic and early diagnosis is essential.

We present a rapid, sensitive and specific diagnostic tool for *M. mycoides subsp. mycoides* detection based on isothermal loop-mediated amplification (LAMP) that is applicable to field conditions. The primer set developed is highly specific and sensitive enough to diagnose clinical cases without prior cultivation of the organism. The LAMP assay detects *M. mycoides subsp. mycoides* DNA directly from crude samples of pulmonary/pleural fluids and serum/plasma within an hour using a simple dilution protocol. A photometric detection of LAMP products allows the real-time visualisation of the amplification curve and the application of a melting curve/re-association analysis presents a means of quality assurance based on the predetermined strand-inherent temperature profile supporting the diagnosis.

The CBPP LAMP developed in a robust kit format can be run on a battery-driven mobile device to rapidly detect M. mycoides subsp. mycoides infections from clinical or post mortem samples. The stringent innate quality control allows a conclusive on-site diagnosis of CBPP such as during farm or slaughter house inspections.

Fascioliasis and intestinal parasitoses affecting schoolchildren in Atlixco, Puebla state, Mexico: epidemiology and treatment with nitazoxanide

J.L. Zumaquero-Ríos, J. Sarracent-Pérez, R. Rojas-García, L. Rojas-Rivero, Y. Martínez-Tovilla, M.A. Valero, S. Mas-Coma

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The Atlixco municipality, Puebla State, at a mean altitude of 1840 m, was selected for a study of Fasciola hepatica infection in schoolchildren in Mexico. This area presents permanent water collections continuously receiving thaw water from Popocatepetl volcano (5426 m altitude) through the community supply channels, conforming an epidemiological scenario similar to those known in hyperendemic areas of Andean countries. A total of 865 6-14 year-old schoolchildren were analysed with FasciDIG coproantigen test and Lumbreras rapid sedimentation technique, and quantitatively assessed with Kato-Katz. Fascioliasis prevalences ranged 2.94–13.33% according to localities (mean 5.78%). Intensities were however low (24–384 epg). The association between fascioliasis and the habit of eating raw vegetables was identified, including watercress and radish with pronouncedly higher relative risk than lettuce, corncob, spinach, alfalfa juice, and broccoli. Many *F. hepatica*-infected children were coinfected by other parasites. *Entamoeba histolytica*/*dispar*, *Giardia intestinalis*, *Blastocystis hominis*, *Hymenolepis nana* and *Ascaris lumbricoides* infection resulted in risk factors for *F. hepatica* infection. Nitazoxanide efficacy against fascioliasis was 94.0% and 100% after first and second treatment courses, respectively. The few children, for whom a second treatment course was needed, were concomitantly infected by moderate ascariasis burdens. Its efficacy was also very high in the treatment of *E. histolytica*/*E. dispar*, *G. intestinalis*, *B. hominis*, *H. nana*, *A. lumbricoides*, *Trichuris trichiura*, and *Enterobius vermicularis*. A second treatment course was needed for all children affected by ancylostomatids. Fascioliasis prevalences indicate this area to be mesoendemic, with isolated hyperendemic foci. This is the first time that a human fascioliasis endemic area is described in North America. Nitazoxanide appears as an appropriate alternative to triclabendazole, the present drug of choice for chronic fascioliasis. Its wide spectrum efficacy against intestinal protozooses and helminthiasis, usually coinfecting liver fluke infected subjects in human endemic areas, represents an important added value.

Serological evidence indicates that foot-and-mouth disease virus serotype O, C and SAT1 are most dominant in Eritrea

T Tekleghiorghis, R.J. Moormann, K. Weerdmeester, A. Dekker

Transbound Emerg Dis. 2013 Mar 11. doi: 10.1111/tbed.12065

Foot-and-mouth disease (FMD) is endemic in Eritrea and in most parts of Africa. To be able to control FMD using vaccination, information on the occurrence of various foot-and-mouth disease serotypes in Eritrea is needed. In this cross-sectional study, 212 sera samples were collected from FMD infected and recovered animals in Eritrea. These samples were tested for the presence of antibodies against FMD non-structural proteins (NSP) and neutralizing antibodies against six of the seven (all but SAT 3) serotypes of FMD virus (FMDV). Of these, 67.0% tested positive to non-structural protein antibodies in the FMD NS ELISA. By virus neutralization, FMDV serotype O antibodies were shown to be the most dominant (approximately 50%). Virus neutralization test results indicate that infection with serotype C and SAT 1 might have occurred, although there are no reports of isolation of these two serotypes. Because the samples were not randomly selected, further random serological surveillance in all age group animals is necessary both to estimate the prevalence of FMD in the country and to confirm the serological results with serotype C and SAT 1.

Sequencing and automated whole-genome optical mapping of the genome of a domestic goat (Capra hircus)

Yang Dong, Min Xie, Yu Jiang, Nianqing Xiao, Xiaoyong Du, Wenguang Zhang, Gwenola Tosser-Klopp, Jinhuan Wang, Shuang Yang, Jie Liang, Wenbin Chen, Jing Chen, Peng Zeng, Yong Hou, Chao Bian, Shengkai Pan, Yuxiang Li, Xin Liu, Wenliang Wang, et al.

Nat Biotechnol. 2013 Feb;31(2):135-41

We report the ~2.66-Gb genome sequence of a female Yunnan black goat. The sequence was obtained by combining short-read sequencing data and optical mapping data from a high-throughput whole-genome mapping instrument. The whole-genome mapping data facilitated the assembly of super-scaffolds >5× longer by the N50 metric than scaffolds augmented by fosmid end sequencing (scaffold N50 = 3.06 Mb, super-scaffold N50 = 16.3 Mb). Super-scaffolds are anchored on chromosomes based on conserved synteny with cattle, and the assembly is well supported by two radiation hybrid maps of chromosome 1. We annotate 22,175 protein-coding genes, most of which were recovered in the RNA-seq data of ten tissues. Comparative transcriptomic analysis of the primary and secondary follicles of a cashmere goat reveals 51 genes that are differentially expressed between the two types of hair follicles. This study, whose results will facilitate goat genomics, shows that whole-genome mapping technology can be used for the de novo assembly of large genomes.

Use of artificial insemination in a community-based approach to deliver cattle production-related veterinary services in four dairy-producing areas of Bangladesh

M.M.U. Bhuiyan, M.T. Islam, ***M. Shamsuddin***

Biotechnologies at work for smallholders: Case studies from developing countries in crops, livestock and fish; http://www.fao.org/docrep/018/i3403e/i3403e00.htm

The coverage of artificial insemination (AI) in Bangladesh has increased over the last decade from 30 to 40%; however, the national average for milk production has remained far below expectations. Smallholder farmers obtain greater benefits from AI services if they are coupled with productivity veterinary service and milk-marketing opportunities. Organization of smallholders into private farmers' associations has proved itself a driving force for the development of dairying in Bangladesh by increasing bargaining power and skills in the management of farm economics. In the future, a holistic approach combining AI and productivity veterinary service with information technologies for performance recording of a critical number of animals as the future breeding stock, molecular technologies for genetic and genomic characterization of economically important traits, the application of reproductive biotechnologies such as ovulation synchronization guided by ultrasound, hormone assays and improvement of nutrition can provide new opportunities for the fast growing dairy industry in Bangladesh to provide milk to feed the people.

This FAO publication is available at http://www.fao.org/docrep/018/i3403e/i3403e00.htm Individual chapters can be downloaded (as PDF files) as well as the whole book, in low (4.6 MB) or in high (7.7 MB) resolution.

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CD-ROMs

A CD-ROM is available dealing with training material for the diagnosis of rinderpest and for the preparation for the OIE pathway. It was produced under an IAEA Technical Cooperation project RAF/0/013 ICT based training to strengthen LDC capacity. Contact Gerrit Viljoen at g.j.viljoen@iaea.org for further information.

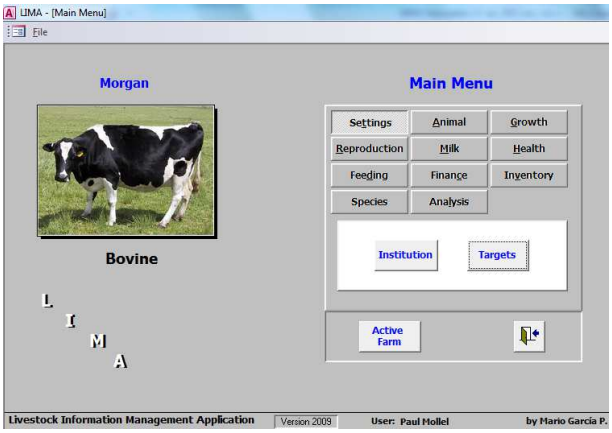
Database applications

Four computer database applications to monitor livestock reproductive performance can be downloaded (software and manuals) from the IAEA ftp server ftp://ftp.iaea.org/pub/NAFA/APH/Mario/Databases/.

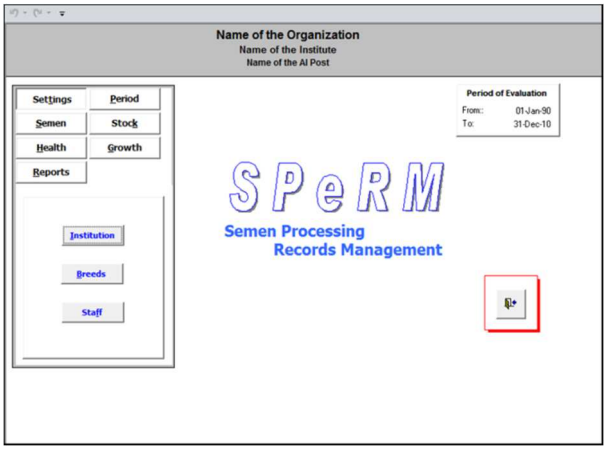
These applications were developed through the implementation of various regional TC projects and have been updated several times, especially LIMA and SPeRM thanks to the suggestions and recommendations of the database users. All are available in English for downloading but LIMA can also be available in Spanish. French versions for LIMA and SPeRM are under preparation. It is recommended to contact Mario Garcia (M.Garcia-Podesta@iaea.org; mggarciap@gmail.com) before installing the application for advice.

Livestock Information Management Application (LIMA)

LIMA is a computer application to store and analyse a full range of information from livestock farms. LIMA is suitable for six livestock species, i.e. bovine, bubaline, ovine, caprine, and South American camelids (alpacas and llamas) and is available in English and Spanish. The application contains convenient and easy-to-use data entry forms for the identification of the animal, productive records (body weight, milk yield, wool and fibre production), reproductive parameters (heats, services, parturitions), health data (individual cases and collective preventive treatment), and economical information (farm income and expenses). Moreover, there is a wide collection of predefined reports for the analysis of the data, and facilities for data verification and export.

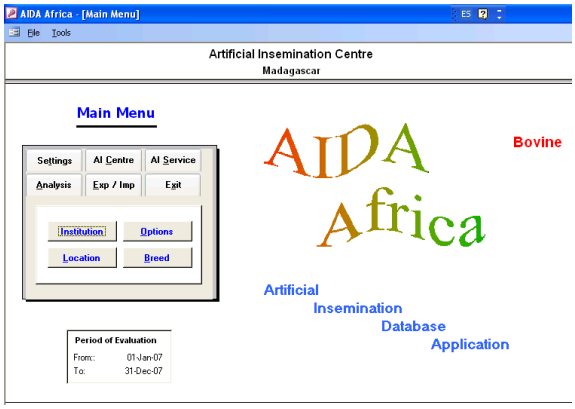


Semen Processing Records Management (SPeRM)



SPeRM is a computer application to store and analyse information from sires (bulls, bucks, and rams) that are used in semen processing or artificial insemination (AI) centres.

Artificial Insemination Database Application (AIDA Asia) / (AIDA Africa)



AIDA-Asia and AIDA-Africa are computer applications to store and analyse information from AI services (farms, females inseminated, semen, estrus characteristics, inseminator and pregnancy diagnosis data). Field data can be complemented with progesterone radioimmunoassay data from milk or blood samples collected at four key times during artificial insemination service and the oestrous cycle. Both applications are very similar; however, AIDA-Africa has two levels of data entry as compared to three levels for AIDA-Asia, due to the more complex structure of AI in most Asian countries.

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