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This picture shows a Myanmar producer delivering feed to his animals (N. Odongo)

To Our Readers

Dear Colleagues,

Once again the year is rushing by and already we have entered into the second half of 2010. The first phase of this year has been a busy time for all personnel in the subprogramme. Apart from our regular Coordinated Research Project (CRP) activities and our technical support given to national and regional Technical Cooperation (TC) projects, we were also involved in the technical planning of project concepts for new TC projects by Member States for the 2012/2013 biennial project cycle. We were occupied with preparing the IAEA's 2012/2013 Work and Budget Programme. It is hoped that our inputs will serve the best interests of our Member States. Please look at our web site (http://www-naweb.iaea.org/nafa/aph/index.html) and our newsletter to familiarize yourselves with the activities of the subprogramme.

As is customary, I want to introduce "Climate warming and the expansion of animal and zoonotic diseases" as a topic for discussion and debate in this section. The average temperature in the world has increased in the last few years compared to the previous century and it is expected to continue rising if measures are not taken, particularly by the industrialized countries, to reduce their greenhouse gas emissions.

IAEA International Atomic Energy Agency

Ironically, the countries that have contributed least to global warming — mainly the developing countries — are the most vulnerable to its impact especially from diseases that higher temperatures can bring.

Globalization and climate change have had an unprecedented worldwide impact on emerging and re-emerging animal diseases and zoonoses. Climate change is disrupting natural ecosystems by providing more suitable environments for infectious diseases allowing disease-causing bacteria, viruses, and fungi to move into new areas where they may harm wild life and domestic species, as well as humans. Diseases that were previously limited only to tropical areas are now spreading to other previously cooler areas, e.g. malaria. Pathogens that were restricted by seasonal weather patterns can invade new areas and find new susceptible species as the climate warms and/or the winters get milder. There is evidence that the increasing occurrence of tropical infectious diseases in the mid latitudes is linked to global warming or climatic variations. Insect-borne diseases are now present in temperate areas where the vector insects were non-existent in the past, e.g. trypanosomosis, anaplasmosis, bluetongue. Humans are also at an increased risk from insect-borne diseases such as malaria, dengue, and yellow fever. Vector-borne diseases are particularly affected by weather patterns and long term climatic factors strongly influence the incidence of outbreaks. Most of these diseases are caused by insects and their population dynamics is dependent on the prevailing weather conditions, specifically temperature and humidity. Climate change influences local weather conditions and therefore has a significant impact on the presence of insects and their geographical distribution.

Warmer temperatures are already enabling insects and microorganisms to invade and reproduce in areas where they once could not due to severely low temperatures and seasonal chills. A small rise in temperatures can produce a 10-fold increase in a mosquito population causing an increase of malaria cases, and hence, malaria is now occurring in several Eastern European countries as well as in the highland areas of countries like Kenya where historically cooler climatic conditions had prevented the breeding of populations of disease-carrying mosquitoes. Freshwater snails, intermediate hosts for fascioliasis, a disease that affects millions of herbivorous animals and humans can now be observed in areas above 4200 meters above sea level in the highlands of Peru and Bolivia as milder temperatures and altered environment conditions are more favourable to their survival

Important zoonotic diseases such as avian influenza, Lyme disease and Rift Valley fever are also likely to spread due to global warming and climatic variations. Avian influenza viruses occur naturally in wild birds, though often with no dire consequences, however, a highly pathogenic strain of the disease (subtype H5N1) is currently a major concern because it can affect humans. This is mainly because severe winter conditions and droughts, occasioned by climate change can disrupt the normal migration pathways of wild birds and thereby bring both wild and domestic bird populations into greater contact at remaining water sources.

The role of tick vectors in diseases like babesiosis in animals and Lyme disease in humans, and of mosquitoes in the transmission of viruses (Rift Valley fever, Dengue fever, African horse sickness, bluetongue) and parasites (malaria) are well known but the geographical distribution of these diseases is expanding as changes in climate continue. The dreadful impact of these diseases on health and the economy affects entire animal and human populations but the poorest communities are the most disadvantaged. The increased incidence in deadly infectious diseases in wildlife, livestock, and people may be one of the most important immediate consequences of global warming.

It is now evident that diseases carried by insects and ticks are likely to be affected by environmental changes because these creatures are themselves very sensitive to vegetation type, temperature, humidity etc. However, the degree of expansion of diseases is much more difficult to predict, because disease transmission involves many other factors, and not all will be affected to the same extent by environmental change. Therefore, by using historical disease records, present-day ground-based surveillance, remotely sensed (satellite) and other data, mathematical models are being developed that will describe the past, explain the present, and predict the future of vector-borne infectious diseases. The world needs to act effectively to ensure that the various procedures required to prevent and control emerging and re-emerging diseases are fully enabled and also to develop new techniques for their early, rapid, and accurate diagnosis.

The IAEA is assisting Member States through our subprogramme to develop and validate early and rapid diagnostic techniques that are simple to use, inexpensive and can be applied in a 'laboratory limited' environment. Most of this work has been done by the utilization of nuclear and nuclear-related technologies that are adapted to more user friendly non-nuclear applications for implementation at field level. Amongst these technologies are the use of $^{13/14}C$, ^{125}I, ^{3}H, ^{32}P, ^{35}S to label protein and nucleic acid molecules for specific and sensitive detection, monitoring, and characterization of harmful pathogens that have made a critical contribution towards the development of e.g. ELISA, PCR, real-time PCR and sequencing. The subprogramme, furthermore, ensures the deployment and widespread use of applicable technologies in countries most at risk from climatically influenced infectious diseases. This technical support and guidance to countries (e.g. which test to use, when and for what purpose, equipment needs, staff training and proficiency, and quality management) played a vital role in building developing countries' capacities during recent outbreaks of avian influenza and Rift Valley Fever. The subprogramme has developed, implemented, and trans-

ferred immuno and molecular assays that are rapid, inexpensive and capable of being used to process large numbers of samples to detect infectious disease agents that adversely affect livestock productivity and prevent international trade.

I also want to mention four exciting new CRPs that started this year: The use of enzymes and nuclear technologies to improve the utilization of fibrous feeds and reduce greenhouse gas emission from livestock, control of foot-and-mouth disease, the use of irradiated vaccines in the control of infectious transboundary diseases of livestock and genetic variation on the control of resistance to infectious diseases in small ruminants for improving animal productivity. Please see more information in this newsletter. It would be great if one of the topics could fit into your activity plans.

Looking back at the activities of the past six months, we had several workshops, training courses, research coordination meetings (RCMs) and consultants meetings. Activities scheduled for the next half-year include project review meetings, RCMs, inter-regional training courses and regional workshops. Both past and future activities are discussed in further detail in this newsletter and are also accessible at our website. Let us know if you have any ideas, comments, concerns or questions. We thank all those who have responded to our request to update their contact and mailing address details and urge those who haven't to please do so by replying to R.Schellander@iaea.org. This will ensure that the next copy of our newsletter will be received. By also sending us the addresses of unsubscribed colleagues we will be able to widen our network. 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 so as to optimally serve our Member States. We will therefore continue to encourage project teams to keep abreast of current technological developments and to promote their implementation where feasible. This would allow a better positioning of our Member States with respect to international trade and other livestock-related issues. In turn, this would promote improved quality assurance of animal husbandry and health practices, and also lead to a greater autonomy for Member States.

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

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Forthcoming Events

Research Coordination Meeting on the Early and Sensitive Diagnosis and Control of Peste des Petits Ruminants

Technical Officers: Diallo Adama; Hermann Unger

The second meeting of the CRP on Peste des Petits Ruminants (PPR) will be held in Ouagadougou, Burkina Faso, 19–22 July 2010. The purpose of this meeting is to evaluate the work done in the past two years and establish work plans for next year. At that meeting participants will report on the results of the ring test, hat took place in June for PPR diagnosis by PCR.

Consultants Meeting to Develop a Roadmap for the Implementation of Modern OIE Principles and Methods of Diagnostic Test Validation

Technical Officer: Gerrit Viljoen

The meeting will be held 6–9 September 2010 in Vienna, Austria. The objectives of this meeting are (1) To develop a strategy for a module-type course manual based on the new OIE concept, e.g. chapter and annexes including a layout for an answer and question section, which can be used to assess the quality of the course and pass/fail criteria for individual participants; (2) To develop an implementation plan for regional training courses and (3) To identify regional laboratories and individuals, who can be trained as trainers.

Research Coordination Meeting on the Control of Contagious Bovine Pleuropneumonia

Technical Officer: Hermann Unger

The Final Research Coordinated Meeting on Control of Contagious Bovine Pleuropneumonia (CBPP) will take place 13–17 September 2010 in Zanzibar, the United Republic of Tanzania. The purpose of the meeting is to review the work done and results achieved in the course of the project and the preparation of the final project report. Specific focus will be on the finalization of the validation results of the two ELISA's for publication and the indication and application of LLOP mediated isothermal amplification for CBPP recently developed. At this meeting a plan should be prepared for future requirements and research to support control activities against CBPP which should guide interested parties after this CRP has finished.

Regional (AFRA) Training Course on Surveillance Technology, ELISA, GIS (RAF5057 005)

Technical Officer: Hermann Unger

The regional training course will take place 20–24 September 2010 in Accra, Ghana.

The main objective of this training course is the integration of different epidemiological techniques presented in the last two AFRA training courses together with the interpretation and data management of ELISA results. During the course, tools to depict spatial distribution of disease events and meaningful reporting will be covered. The interpretation and analysis of serological data including QA will be trained using Excel spreadsheet functions. This course is open to 25 participants from the AFRA region.

Regional Training Course on Animal Health in Molecular Diagnosis, Genotyping and Phylogenetic Analyses of Avian Influenza (Bird Flu) and Other Mammalian Influenza A Subtypes (RER5015)

Technical Officer: Adama Diallo

The regional training course will take place 20 September–1 October 2010 at the Animal Production and Health Laboratory in Seibersdorf, Austria and aims at enhancing knowledge on early diagnosis and epidemiology tools of highly pathogenic avian influenza (AI) and other mammalian influenza A subtypes (involving the use of nuclear and nuclear-related and molecular technologies), and bioinformatics tools that are required to analyse their data.

The expected outputs are partners trained on early and rapid diagnosis, genotyping and phylogentic of AI and other mammalian influenza A subtypes; the ability to use molecular and nuclear-related tools for the diagnosis and differentiation of AI and other mammalian influenza A subtypes and the capacity of the partners to troubleshoot and interpret their results are strengthened; as well as enhanced capacity of animal disease diagnosis in participating laboratories.

EU FMD Week 2010

Technical Officer: Gerrit Viljoen

The EUFMD Week 2010 will take place 27 September–1 October in Vienna, Austria.

The FMD Week 2010 will bring together around 200 FMD persons involved in FMD science and control issues, and will be used for side meetings of four other projects and networks. It is also held 'back to back' with the OIE/FAO Annual FMD Reference Labs Network meeting (at Pirbright, UK) to maximize the opportunity and cross-over to bring international surveillance experts together.

A side event on 28 September will cover the new CRP on FMD.

Official EuFMD-Website:
www.fao.org/ag/againfo/commissions/en/eufmd/eufmd.html
Conference Website: http://www.ages.at/eufmd-week2010/index.html

First Research Coordination Meeting on the Use of Irradiated Vaccines in the Control of Infectious Transboundary Diseases of Livestock

Technical Officers: Antony Luckins; Adama Diallo
The meeting will be held 11–15 October 2010 in Vienna, Austria.
We shall shortly be informing all individuals who applied to join this CRP on the outcome of the peer review of their research proposals. Successful applicants will be invited to attend this meeting.
Research Agreement holders will present an up-to-date analysis of the use of radiation attenuation for vaccine usage. Research Contract holders will be expected to present a comprehensive and detailed overview of their research proposals and the work plans for the first year. These will be critically evaluated by the experts, revised if necessary and any modifications to the research programme agreed and accepted at the meeting.

Consultants Meeting on the Effect of Climatic Change on Animal Production and Health — Way Forward

Technical Officer: Nicholas Odongo
The meeting will be held 11–13 October 2010 in Vienna, Austria.
Abnormalities in weather and climate not only affect agriculture through droughts and flooding but also through changing patterns of disease occurrence and distribution. The direct influence of climate changes on vector-borne diseases is obvious, but inherent factors specifying such changes are still widely unknown. Additionally, the extreme weather conditions also interfere with productivity and disease resistance in livestock. The consultants meeting will evaluate future trends of climatic change, its impact on livestock production in general and more specific on vector-borne diseases and on genetic traits supporting increased performance under harsh or changing climatic conditions. The meeting should result in guidelines on issues and/or activities the Joint FAO/IAEA division should focus on to alleviate constraints arising from global warming and climatic changes.

Consultants Meeting to Determine the Effects of Strategic Nutritional Supplementation and Genotype on Milk and Meat Production and Fertility of Cattle in Developing Countries

Technical Officers: Nicholas Odongo and Mario Garcia
The meeting will be held 22–24 November 2010 in Vienna, Austria. The objective of this meeting is to determine the effects of strategic nutritional supplementation and genotype on milk and meat production and fertility of cattle in developing countries.

Regional Training Course on Animal Genetics in Bioinformatics Tools and Microsatellite Analyses and Sequencing (RER5015)

Technical Officer: Adama Diallo
The regional training course will take place 22 November–3 December 2010 at the Animal Production and Health Laboratory in Seibersdorf, Austria and aims at enhancing knowledge on highly pathogenic avian influenza (advanced molecular genetics tools by use of nuclear and nuclear related and molecular technologies), in bioinformatics tools and microsatellite analyses and sequencing. The ultimate goal is to train partners in molecular genetic analyses.
The course will be open to 15 participants from RER5015 participating countries (Albania, Armenia, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Hungary, Kazakhstan, The Former Yugoslav Republic of Macedonia, Montenegro, Moldova, Romania, Russian Federation, Turkey, and Serbia) which are considered at risk regarding avian flu outbreaks. This advanced molecular course is intended for participants with an academic background equivalent to a Bachelor's degree in veterinary, animal or biological science, and with experience in basic molecular biology techniques. Participants must be actively involved in molecular genetic laboratory work. The training course will be conducted in English; participants should be capable of freely expressing themselves and following lectures.

Past Events

Regional Training Course (RTC) on Genomic DNA Preparation, Microsatellite Analyses and Sequencing (RER5015)

Technical Officer: Massoud Malek

The RTC took place 7–18 December 2009 at the Animal Production and Health Laboratory in Seibersdorf.

In recent years, avian influenza (IA) has been considered a serious health and economic threat in Europe and Asia. This is threatening the livelihood of hundreds of millions of poor livestock farmers, jeopardizing smallholder entrepreneurship and commercial poultry production, and seriously impeding regional and international trade and market opportunities. The rapid spread of bird flu in several countries in South-East Europe and Asia fully justifies regional collaboration of early diagnosis of the disease. Therefore, the IAEA Technical Cooperation Programme initiated a new TC Regional project RER5015 entitled Supporting Early Warning and Surveillance of Avian Influenza Infection in Wild and Domestic Birds and Assessing Genetic Markets for Bird Resistance which consists of 17 research institutes, state agencies for veterinary control services, universities and other institutions from 13 Member States, to establish early bird flu diagnosis and assessment of genetic markers for AI resistance with nuclear molecular methods in the region to prevent spread of AI for better animal health and economic benefits.

Trained personnel are the key element for the successful handling of such a project. This course aimed at enhancing knowledge on highly pathogenic avian influenza (molecular genetics tools by use of nuclear and nuclear related and molecular technologies), in genomic DNA preparation, microsatellite analyses and sequencing. The ultimate goal is to train partners in molecular genetic analyses.

The course was attended by 18 participants from 12 Member States from RER5015 participating countries (Albania, Armenia, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Hungary, Kazakhstan, The Former Yugoslav Republic of Macedonia, Montenegro, Moldova, Romania, Russian Federation, Serbia, and Turkey) which are considered at risk regarding avian flu outbreaks. In addition, one participant from Ghana joined the training course by support from a relevant national project of the TC programme for Africa. Two participants from India and Azerbaijan were able to participate with the support of FAO. The two-week course had both theoretical and practical aspects. Six internationally recognized experts from China, Germany, Italy and the United Kingdom and members of the Joint FAO/IAEA division presented the lectures. Exercises were carried out by participants at the laboratory setting under supervision and guidance of the experts. The course developed methodologies, generated information and formulated decision support systems for defining phenotypic and molecular genetic diversity, using microsatellite DNA marker and related technologies, and enabled the development and implementation of national, international and regional strategies for optimum use, improvement and conservation of poultry genetic resource. A presentation by technical officers also covered the activities of IAEA which was an excellent opportunity to increase the awareness of the IAEA's current participation in the field of livestock breeding and genetics. The manual A Practical Approach to Microsatellite Genotyping with Special Reference to Livestock Population Genetics was used as one of the resource materials for the training.

Consultants Meeting on Genetic Variation on the Control of Resistance to Infectious Diseases

Technical Officer: Mario García Podestá

The meeting was held 8–10 February 2010 in Vienna, Austria.

Six experts in animal genomics, genetic resistance to parasites, population genetics, and livestock parasitology from universities in Austria, Brazil, Italy, Sweden, UK, and USA attended the meeting, along with IAEA and FAO staff to review the work plan and devise standard operating procedures (SOP) and recommendations for the CRP on Genetic Variation on the Control of Resistance to Infectious Diseases in Small Ruminants for Improving Animal Productivity.

Sheep and goats constitute an important livestock resource in most developing countries and are essential for the livelihood of millions of small-scale farmers. However, infectious diseases, such as gastrointestinal nematodes impose severe constraints on animal production in pastoral systems worldwide. Losses occur through mortalities, reduced productivity due to subclinical diseases and direct costs associated with pest control. There is well documented evidence for within and between breed genetic variations in resistance to gastrointestinal nematode infections and therefore, there is an opportunity for selecting animals for disease resistance among other important traits.

Genetic disease resistance is particularly relevant in developing countries, as indigenous breeds usually display enhanced resistance to local diseases as compared to exotic ones when reared in the same environment. However, little is known about the genetic composition controlling this condition. The CRP aims to standardize procedures and methods for phenotypic characterization of parasite resistance, standardize and

validate protocols and SOP for DNA analysis and genetic studies, and generate information on genes and markers associated with gastrointestinal parasite resistance in small ruminants, which may allow at a later stage to identify and select for animals resistant to helminth parasites.

The original CRP work plan was discussed and revised according to current single-nucleotide polymorphism (SNP) developments for sheep and goats, the availability of the goat Radiation Hybrid Map (RH Map) in the next few months, the need to standardize procedures for the identification of breeds which are 'resistant' to parasite infection, and the importance of sampling a large number of animals under controlled and uniform procedures across countries to ensure valid results. Also, guidelines and protocols were devised for sample collection for DNA analyses, DNA extraction, and procedures for checking DNA amount, concentration, and integrity. The crucial role of nuclear technology in this CRP was fully discussed, including the contribution of the radiation hybrid mapping for goats using SNP markers and the southern blot analysis with radioactive [α-32P] ATP labelling in achieving the main goals of the project.

The group of experts recommended that the first phase of the CRP should be devoted to the phenotypical evaluation of resistance to gastrointestinal parasites of various sheep and goat breeds and DNA sample collection for genome-wide association studies. For this purpose, an artificial challenge trial with a fixed dose of gastrointestinal parasites needs to be conducted in a limited number of lambs and kids to quantify the relative resistance of the studied breeds to gastrointestinal parasites. This should be followed by field trials using several hundreds of young animals to determine genetic associations between DNA markers and parasite resistance. Blood samples for DNA extraction will be collected and body weight, faecal egg counts, packed cell volume (PCV) values, and FAMACHA© scores will be monitored using experimental protocols devised during the meeting. Training on DNA quality, phenotype collection, and experimental design should be provided during the first research coordination meeting.

The panel of experts recommended that the IAEA Laboratories at Seibersdorf operates as a Repository DNA Bank for all DNA samples to centralize activities for SNP genotyping and for providing advice on the quality of DNA purified by each participating team. The laboratory will also have to supervise the research work on the goat RH Map and the validation of the southern blot technique.

The second phase of the CRP 2013–2015 would involve genotyping strategies, validation of SNP markers, gene sequencing, use of a low density SNP panel, and data analysis. Training on genomic analysis and bioinformatics is an important component and should be provided; especially after receiving the genotyping results in order to perform SNP x phenotype association studies.

At the time of the meeting, 37 Research Contract proposals had been received from 26 Member States. Most proposals were of high caliber but with marked differences in number of animals to be used, ways of identifying breeds which are 'susceptible' or 'resistant' to parasite infection, infectious disease to be tackled, and therefore a great dissimilarity of work plans and implementation procedures. These proposals, although technically feasible and well prepared as stand-alone proposals, do not necessarily fit the purpose of a coordinated research project where individual projects have to operate on a common theme to achieve a common goal. Therefore, it was recommended that potential Research Contract holders must agree and be able to undertake the revised work plan irrespectively of their originally proposed plan of activities. Consequently, 13 proposals from equal number of countries in Africa, Asia, and Latin America were pre-selected based on the expertise of the project team on DNA-base technologies, presence of established laboratories for molecular genetic analyses, access to farms and animals, transportation capabilities to field sites and the necessary resources to conduct field work, to perform data and sample collection and for computerized data recording and analysis. The final selection will be conducted by the technical officer responsible for the project after receiving additional data from project counterparts.

Conclusions

- The objectives of the consultants meeting to review the work plan and devise standard operating procedures and recommendations for the CRP on Genetic Variation on the Control of Resistance to Infectious Diseases in Small Ruminants for Improving Animal Productivity were achieved.
- The CRP, based on the planned activities and existing resources can substantially contribute to sound scientific outputs on genes and markers associated with gastrointestinal parasite resistance in small ruminants, which will enhance breeding programmes for improving livestock production in developing countries.
- A detailed work plan including experimental protocols for the phenotypical evaluation of resistance to gastrointestinal parasites of various sheep and goat breeds was developed.
- The completion of radiation hybrid mapping for the goat will be of great benefit for the project and it will constitute an important tool for goat genomic studies and for genetic improvement of important traits.
- Precise procedures for DNA sample collection for genome-wide association studies were formulated.
- Outsourcing SNP genotyping should be considered and the specific commercial laboratory and SNP type should be selected based on available options in two years.

- IAEA Laboratories at Seibersdorf should operate as a Repository DNA Bank for this and other related studies.
- Research Contract proposals that were received (n=35) were of high caliber and 13 were preselected for their participation in the CRP.

Recommendations

- All research groups participating in the CRP should follow the revised and standardized work plan to achieve the objectives of the CRP, the expected research outputs and outcomes.
- Training on DNA quality, phenotype collection, experimental design, genomic analysis, and bioinformatics should be provided during the planned RCM and/or in an ad-hoc workshop to facilitate hands-on experience.

Final Coordination Meeting of the Regional TC Project on 'Integrated Control of Fascioliasis in Latin America (in support of national programmes) (RLA5049)

Technical Officer: Kathrin Schaten

The final coordination meeting was held in La Paz, Bolivia, 22–25 February 2010, in cooperation with the Ministry of Health and Sports and the University of San Andres. The meeting was attended by participants from Argentina, Bolivia, Cuba, Mexico, Peru and Uruguay. The results generated during the project were reviewed and the participants prepared a final report for submission to the IAEA.

The meeting agenda allowed for intensive discussion and analysis of the outputs of the programme but also highlighted the specific problems encountered in the different participating countries in fulfilling the defined objectives of the project. It was agreed that epidemiological studies carried out in each of the countries had provided an overall improvement in knowledge and understanding of fascioliasis in the region. Data generated during the epidemiological surveys had relied primarily on two serological diagnostic tests (Fascidig, FAS2-ELISA) and both tests will be available to the participants for further studies in the foreseeable future. The surveys revealed a prevalence in animals in some regions up to 85% and an existing disease risk in humans in areas that were formerly known to be free from fascioliasis. A diagnostic manual was prepared to enable standardization of traditional, serological and nuclear-related techniques to ensure their correct usage and validation and to harmonize their application in the Latin American region. Characterization of the snail vectors of fascioliasis using both morphological and molecular techniques revealed the existence of several new species of snail intermediate hosts of *Fasciola hepatica*, as well as wider distribution of the vector species than had been previously reported. A book reviewing fascioliasis in Latin America is being prepared for publication and seven related peer reviewed scientific papers have been published.

During the meeting, the participants visited the Altiplano, an area that is known to have one of the highest endemicity for human and animal fascioliasis in the world. The visit provided the delegates with an opportunity to see the conditions, e.g. humid area with a lot of snails and extensive livestock production close to human dwellings, that have allowed this high prevalence to develop and to meet with the agricultural authorities, veterinarians and local health service professionals dealing with the problem, as well as researchers at the veterinary university.

The results of the project demonstrating the unexpected high prevalence in humans and animals have emphasised the importance of *Fasciola hepatica* due to the high risks it poses to human and animal health in the region, and the related socio-economic impact. The technologies utilized in this project, particularly the nuclear-related molecular and immunological tools, should provide more effective surveillance to assist in the diagnosis and control of the disease. This will lead to a greater understanding of the epidemiology of fascioliasis, thereby developing more effective control.

The International Technical Conference on Agricultural Biotechnologies in Developing Countries

Technical Officer: Adama Diallo

The international technical conference on Agricultural Biotechnologies in Developing Countries: Options and Opportunities in Crops, Forestry, Livestock, Fisheries and Agro-industry to Face the Challenges of Food Insecurity and Climate Change, took place 1–4 March 2010 in Guadalajara, Mexico. This conference was attended by about 300 delegates and representatives of international organisation and non governmental organisations.

At the beginning of this conference, the FAO Secretariat presented a document entitled Policy Options for Agricultural Biotechnologies in Developing Countries. This provided a framework for targeting biotechnologies to the poor, emphasizing the importance of placing biotechnologies in the context of wider policies for

national agricultural and rural development and science and technology while also stressing the international dimensions of these policies and the importance of priority-setting.

The conference stressed that diverse situations occur among and within countries as do issues, and that situation analysis of the current use and application of biotechnologies would greatly assist targeting of biotechnologies in developing countries. It also noted that sound biotechnology policies, regulations, management strategies, risk assessments, cost-benefit analysis and communication strategies would contribute to the further development and application of biotechnologies, and that national biotechnologies strategies should be prepared within the overall development strategy context of the country. It stressed the need of involving, along with scientist, different stakeholders namely farmers, farmer organizations, producers, local communities. Farmers in developing countries, in particular small farmers, should be informed and understand their particular challenges and needs, and to determine appropriate use of biotechnologies to assist them. Involving different stakeholder will facilitate the integration modern biotechnologies with traditional knowledge and practices to better help farmers and producers to continue their ecologically sustainable practices. It also noted that farmer willingness to adopt new tools and practices depended on their understanding of, and participation in, the resulting benefits, such as increased production, productivity or, for example, increasing the shelf life of farm products.

The conference agreed that the further development and application of biotechnologies in many developing countries would benefit from international and regional cooperation and technical and other assistance from international organizations. Developing countries, possibly working in regional groups, should build up indigenous research, development, and advisory capacities for generation, assessment and adoption of appropriate biotechnologies.

Further information can be found at
http://www.fao.org/biotech/abdc/en/

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

Technical Officer: Nicholas Odongo

The meeting was held 26–28 April 2010 in Vienna, Austria.

Five experts in ruminant nutrition from Agricultural Research Organisations and Universities in Argentina, Canada, China, Spain and the USA attended the meeting, along with IAEA staff to discuss the CRP on The Use of Enzymes and Nuclear Technologies to Improve the Utilization of Fibrous Feeds and Reduce Greenhouse Gas Emission from Livestock. The consultants presented state of the art reviews on the use of enzymes to improve ruminant livestock productivity and/or their on-going research in the area of enzymology. These presentations were followed by brainstorming sessions to discuss and review planned activities and a CRP work plan and devise SOP, draw conclusions and make recommendations for the CRP.

The consultants acknowledged and discussed several potential challenges to the successful completion of the research and dissemination of the findings. Nevertheless, there was unanimous agreement about proceeding with the project because if the CRP was successful, it has tremendous potential to improve fibre digestion and poor quality roughage utilization in many developing countries. No other agencies are currently interested in funding projects with these objectives and the available alternative strategies to improve the performance of ruminants fed poor quality forages have various limitations, e.g. breed improvement programmes are potentially successful but will take several years for completion, chemical treatment with alkalis is effective but also extremely hazardous to farmers and corrosive on equipment, and supplementation with grains although effective, is costly and unsustainable for small-scale producers. Therefore, the consultants felt that fibrolytic enzyme application is the only safe and potentially effective technology to improve the digestion and utilization of low quality roughages in developing countries. Furthermore, the IAEA has the comparative advantage of using nuclear and nuclear related techniques for the intensification of livestock production. The original CRP work plan and activities were discussed and revised to standardize the methodologies to be used and experimental protocols. Ten research contracts will be awarded to Member States submitting appropriate research proposals. Institutions interested in participating on the CRP should be (i) linked with national livestock development authorities and be engaged in programmes of national importance in animal production; (ii) have some level of local and/or external financial support; (iii) have access to well established animal nutrition laboratories with basic expertise in molecular technologies; (iv) have transportation capabilities for field experimentation, data and

sample collection and (v) have computerized data management and analysis capabilities. Furthermore, the project will be integrated into on-going development activities and will work closely with farmers and farmers' organizations.

The group of experts recommended that the first phase of the CRP should be devoted to the incorporation of at least one of the core forages (i.e. rice straw, sorghum and/or maize stover, tropical grass, and lucerne hay as a control). Additional locally grown forages may also be evaluated in individual contracts. Up to 10 candidate enzyme (those used in the first technical contract) will be evaluated at recommended dose rates (none, low, medium, high), with the possibility of incorporating other locally available enzyme products when available. All enzyme candidates will need to be assayed locally for enzyme activity using standardized methodology before initiating the *in vitro* research. The initial 9-months will focus on batch culture incubations of the forage substrates in buffered rumen fluid plus enzymes to determine effects on 24 and 48 h NDF degradation. The objective is to identify enzyme candidates and optimum dose rates for the forages of interest. In the subsequent 9-months, continuous culture or batch culture assays will be used to determine enzyme effects on other variables of interest, such as digestibility, kinetics of digestion, methane production, microbial protein synthesis, rate of gas production, volatile fatty acid production and concentrations, microbial ecology of the rumen, or other variables.

Two technical contracts will be awarded. The first contract will be awarded early in Phase 1 of the project to assess enzyme products and dose rates for subsequent evaluation in the research contracts. The second technical contract will be awarded in Phase 2 of the project to characterize the mode of action of enzyme feed additives, with specific emphasis on evaluating effects on microbial ecology of the rumen including quantifying populations of methanogens, fibre degrading bacteria, protozoa, and fungi as a function of enzyme application. Training on enzyme activity assays (SOP implemented), batch cultures incubations, enzyme handling and storage, enzyme application methods, *in vitro* methane measurements, microbial protein synthesis using 15N & purine derivatives, VFA measurements, safety aspects, SF6 for measuring methane production *in vivo* and experimental designs should be provided during the first RCM and/or in an ad-hoc workshop to facilitate hands-on experience.

The second phase of the CRP 2013–2015 and will involve *in vivo* evaluation of best-bet candidate fibrolytic enzymes to determine effects on animal productivity and to establish possible mode of action. Firstly, animal production studies will assess the effects of the enzyme candidates (and dose rates) established in Phase 1 on dry matter intake (of individual animals or on replicated pens of animals), body weight gain, and milk production and milk composition. Studies can be conducted in a research setting or on commercial farms, but preference will be given to studies that incorporate sufficient replication to enable a valid statistical assessment of the treatment effects on production variables. The enzyme products will need to be diluted in tap water and then applied to the target forage (comprising at least 30% of the dietary dry matter) or to the animal's diet prior to feeding. All enzyme candidates evaluated in this phase will need to have been evaluated and selected based on results from *in vitro* screening conducted in Phase 1. Secondly, *in vivo* studies will evaluate best-bet candidate fibrolytic enzymes on ruminal fermentation, efficiency of microbial protein synthesis, nitrogen balance, microbial diversity and populations, methane production, nutrient intake, in sacco disappearance, and total tract diet digestibility. Measurements of enteric methane will be conducted using either sulphur hexafluoride (SF6) tracer or simple respiratory chamber (gas mask or head box) techniques. Efficiency of microbial protein synthesis will be measured using N15 or urinary purine derivatives as a marker. Methanogens, fibre degrading bacteria, fungi and protozoa, as groups will be monitored through quantitative RT-PCR and probing approaches. Finally, collective data will be studied using meta-analysis approaches and final reports will be peer-reviewed, and prepared for publication as an IAEA TECDOC or Special Issue or Supplement of a journal in 2015.

Research Coordination Meeting on the Early and Rapid Diagnosis of Transboundary Animal Diseases: Phase 1 — Avian Influenza

Technical Officer: Gerrit Viljoen

The Final Research Coordinated Meeting on The Early and Rapid Diagnosis of Transboundary Animal Diseases: Phase I — Avian Influenza was held 10–14 May 2010, in Rome, Italy. Seasoned veterinary laboratory practitioners and diagnostic experts shared their knowledge and expertise as to the scientific and technical basis for developing or modifying the early and rapid diagnosis of avian influenzas.

The rapid molecular technology platforms developed and fine tuned by the CRP has allowed improved turnaround time; early, rapid, and confirmed diagnosis has moved from weeks to a day or two, which has in-turn improved field cooperation with surveillance programmes. This has been key to rapid and effective AI control in a country with a confirmed incursion of AI H5N1 (e.g. Nigeria). The infrastructure developed with the AI CRP has allowed future development and growth of other laboratory services (the capability is generic in nature and can be utilized laterally). The AI technology has been shared with public health laboratories where possible and this has allowed new cooperation and collaboration between the public health and veterinary diagnostic community.

The associated molecular diagnostic training has allowed improvements to lab capability and capacity. The

sharing of information between the CRP members has assisted in the development of a better understanding of AI diagnosis through molecular techniques including an increased knowledge about the disease's epidemiology, spread and risks. The project has improved the profile of surveillance programmes, including wildlife surveillance, and the capability of the laboratory to carry-out the diagnostic components of surveillance efforts.

The CRP provided laboratory networking and harmonization of training, facilitated validation and standardization of the techniques and has enhanced on-site training of bench technicians in their own laboratories as well as in other host laboratories in CRP counterpart's countries. Diagnosis of AI in the laboratory has improved with additional approaches and additional skills and improved the competency of the technical staff. Once competency was developed for AI diagnosis, the development of this competency and the use of molecular techniques were expanded to other Transboundary Animal Diseases (TADs).

The CRP has identified that there are gaps in the ability of CRP counterparts to utilize molecular techniques for the diagnosis of AI. Gaps exist in general laboratory technician proficiency and interpretation of ELISA and PCR diagnostic results. Furthermore, key disease knowledge gaps were identified in all the aspects of AI diagnosis and control (epidemiology, transmission, appropriate sampling and targeted surveillance strategies, risk factors) and this has led to a better understanding of the spread and infection potential of AI. Applying the technology used in this project provides better understanding of migratory patterns and infection cycles, transmission patterns, and may help explain/understand additional emerging pathogens. AI has been a good model (One Health involvement) for improving research and diagnostic work and collaborations.

The RCH's and ACH's will participate in an AI OIE/FAO laboratory proficiency testing exercise (ring-test) in December 2010 where the molecular platforms and procedures will be evaluated and an inter-laboratory proficiency conducted.

Regional (AFRA) Training Course on TAD Epidemiological Surveillance (RAF5057/004)

Technical Officer: Hermann Unger

The IAEA in cooperation with the Government of Morocco through the Laboratoire National d'Epidémiologie et des Zoonoses organized the Advanced Regional (AFRA) Training Course on TAD Epidemiological Surveillance from 31 May–4 June 2010 in Rabat, Morocco.

The course built on the material presented in the first course in Uganda in December 2009, which had covered mainly survey design and analysis and the use of diagnostic and screening tests. However since only six of the participants had attended the first course, some aspects of this were revised. In addition, time was given for participants to apply the theory using various free computer software programs. Additional topics covered were the design and analysis of observational studies and two-stage surveys to determine freedom from disease, both accompanied by computer exercises. A major focus of this course was on the use of participatory methods for disease surveillance – several methods were taught and group exercises were conducted that proved very popular.

Two lecturers from South Africa trained 29 participants from Algeria, Angola, Burkina Faso, Botswana, Central African Republic, Chad, Cameroon, Ethiopia, Gabon, Ghana, Cote d'Ivoire, Kenya, Libya, Mauretania, Mali, Malawi, Morocco, Namibia, Niger, Sierra Leone, Sudan, Tunisia, Uganda, Zaire, Zambia and Zimbabwe.

Stories

Climate Change and the Expansion of Animal and Zoonotic Diseases — What is the IAEA's Contribution?

The average temperature in the world has increased in the last few years compared to the previous century and is expected to continue rising if measures are not taken, particularly by highly industrialized countries, to reduce greenhouse gases emissions. Ironically, the countries that have contributed least to global warming — mainly the developing countries — are the most vulnerable to its impact especially from diseases that higher temperatures can bring.

Globalization and climate change have had an unprecedented worldwide impact on emerging and re-emerging animal diseases and zoonoses. Climate change is disrupting natural ecosystems by providing more suitable environments for infectious diseases allowing disease-causing bacteria, viruses, and fungi to move into new areas where they may harm wild life and domestic species, as well as humans. Diseases that were previously limited only to tropical areas are now spreading to other previously cooler areas, e.g. malaria. Pathogens that were restricted by seasonal weather patterns can invade new areas and find new susceptible species as the climate warms and/or the winters get milder. There is evidence that the increasing occurrence of tropical infectious diseases in the mid latitudes is linked to global warming. Insect-borne diseases are now present in temperate areas where the vector insects were non existent in the past, e.g. trypanosomosis, anaplasmosis. Humans are also at an increased risk from insect-born diseases such as malaria, dengue, and yellow fever.

A larval stage and adult Boophilus tick, a major livestock parasite that carries several diseases affecting animals and humans. Photo courtesy: Ms. Amanda Chávez (left), Ms. Karla Verástegui (right)

Vector borne diseases are particularly affected by weather patterns and long term climatic factors strongly influence the incidence of outbreaks. Most of these diseases are caused by insects and their population dynamics is dependent on the prevailing weather conditions, specifically temperature and humidity. Climate change influences local weather conditions and therefore has a significant impact on the presence of insects and their geographical distribution.

Warmer temperatures are already enabling insects and microorganisms to invade and reproduce in areas where once they could not due to severely low temperatures and seasonal chills. A small rise in temperatures can produce a 10-fold increase in a mosquito population causing an increase of malaria cases hence, malaria is now occurring in several Eastern European countries as well as in the highland areas of countries like Kenya where historically cooler climatic conditions had prevented the breeding of populations of disease-carrying mosquitoes. Freshwater snails, intermediate hosts for Fasciolosis, a disease that affects millions of herbivorous animals and can also affect humans can now be observed in areas above 4200 meters in the highlands of Peru and Bolivia as milder temperatures and altered environment conditions are more favourable to their survival.

Important zoonotic diseases such as avian influenza, Lyme disease and Rift Valley fever are also likely to spread due to global warming. Avian influenza viruses occur naturally in wild birds, though often with no dire consequences, however, a highly pathogenic strain of the disease-H5N1-is currently a major concern because it can affect humans. This is mainly because severe winter conditions and droughts, occasioned by climate change can disrupt the normal migration pathways of wild birds and thereby bring both wild and domestic bird populations into greater contact at remaining water sources.

The role of tick vectors in diseases like babesiosis in animals and Lyme disease in humans, and of mosquitoes in the transmission of viruses (Rift Valley fever, Dengue fever, African horse sickness, bluetongue) and parasites (malaria) are all well known but the geographical distribution of these diseases is expanding as changes in climate continue. The dreadful impact of these diseases on health and the economy affects entire animal and human populations but the poorest communities are the most disadvantaged. The increased incidence in deadly infectious diseases in wildlife, livestock, and people may be one of the most important immediate consequences of global warming.

It is now evident that diseases carried by insects and ticks are likely to be affected by environmental changes because these creatures are themselves very sensitive to vegetation type, temperature, humidity etc. However, the degree of expansion of diseases is much more difficult to predict, because disease transmission involves many other factors, and not all will be affected to the same extent by environmental change. Therefore, by using historical disease records, present-day ground-based surveillance, remotely sensed (satellite) and other

data, mathematical models are being developed that will describe the past, explain the present, and predict the future of vector-borne infectious diseases.

The world needs to act effectively to ensure that the various procedures required to prevent and control and also to develop new techniques for their early, rapid, and accurate diagnosis. The IAEA, through the Animal Production and Health Section, is at the forefront of developing and validating early and rapid diagnostic techniques that are simple to use, inexpensive and can be applied in a "laboratory limited" environment. Most of this work has been done by the application of nuclear, nuclear associated and nuclear-related technologies. Amongst these technologies are the use of 13/14C, 125I, 3H, 32P, 35S to label protein and nucleic acid molecules for specific and sensitive detection, monitoring, and characterization of harmful pathogens that have made a critical contribution towards the development of e.g. ELISA, PCR, real time PCR and sequencing. The section also ensures the deployment and widespread use of applicable technologies in countries most at risk from climatically influenced infectious diseases. This technical support and guidance to countries (which test to use, when and for what purpose, equipment needs, staff training and proficiency, and quality management) played a vital role in building developing countries' capacities during recent outbreaks of avian influenza and Rift Valley fever.

Visible colour changes in reaction tubes allow discrimination of positive and negative results when using the LAMP-PCR for diagnosing avian influenza

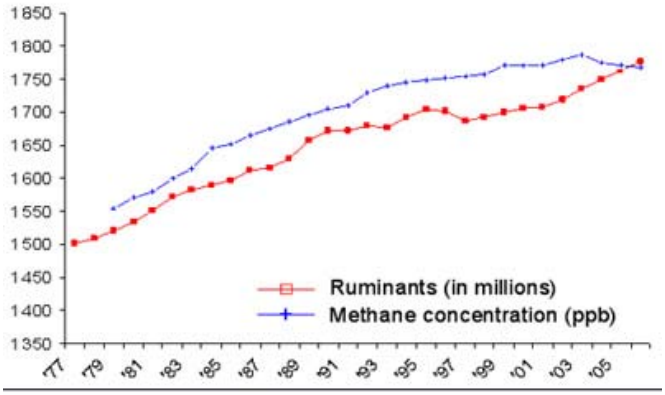
The Animal Production and Health Section has developed, implemented, and transferred immunoassays that are rapid, inexpensive and capable of being used to process large numbers of samples to detect infectious diseases that adversely affect livestock productivity and prevent international trade. The IAEA, through the FAO Joint Division of Nuclear techniques in Food and Agriculture, is working together with FAO, WHO and OIE to reinforce the "One Health" approach on interactions between human and animal health.

The IAEA is Assisting Member States to Reduce the Amount of Methane Produced by Ruminant Livestock

Over the past 300 years, atmospheric methane concentrations have increased by approximately 2.5 times those of the pre-industrialization era. Atmospheric methane concentrations increased by 10.8 ppb/year in samples collected between 1979 and 1999. This elevation has been attributed to the expansion in agricultural and industrial activities, including livestock farming, rice cultivation, mining of fossil fuels, reticulation of natural gas, and large scale burning of forest and grassland biomass.

Increasing methane concentrations in the atmosphere have been identified as the second largest contributor to global warming after carbon dioxide. Thus, methane was included in the Kyoto Protocol with 1990 chosen as the base year for future decisions concerning the impact of mitigation strategies. However, the concentration of atmospheric methane has only increased 0.3 ppb/year since 1999 and presently, the level of methane emissions is equivalent to the removals of atmospheric concentrations.

The world population of ruminant livestock, in cattle equivalents, has steadily increased in the last 30 years despite a nearly 15% drop of sheep population in the 1990's as a result of the downturn of the wool industry. However, from 1979 to 1999 the population of ruminant livestock increased at the rate of 9 million head per year and is currently 11 million head per year since 1999 (see figure). In the global balance of methane production, ruminant livestock account for 15.7% of global and 25.7% of anthropogenic methane production.



Ruminant population (in cattle equivalent, where eight sheep or goats equal a large ruminant)(FAO database)

Methane is produced from a variety of sources — both human-related (anthropogenic) and natural. Human-related activities, which accounts for more than 60% of global methane emissions, include fossil fuel production, animal husbandry (enteric fermentation in livestock and manure management), rice cultivation, biomass burning, and waste management. Natural sources include wetlands, gas hydrates, permafrost, termites, oceans, freshwater bodies, non-wetland soils, and other sources such as wildfires.

Polytunnel chambers fitted around animal cages used to measure methane production in Colombia.
Inset: Sampling of gases within the chambers
(Photo courtesy: Ms. Olga Mayorga)

The Kyoto agreement and its subsequent outcomes placed significant pressure on the ruminant livestock industry to reduce the amount of methane produced.

Despite world-wide research efforts there are no profitable solutions in place that can be adopted by farmers for suppressing methane production for a given diet; nevertheless, it became quite clear that increasing the quality of the diet decreases the amount of methane produced per unit of product thus increasing the efficiency of production. In other words, animals fed better quality diets produce less methane than those fed more fibrous diets. Therefore, more efficient feeding systems using better quality feeds will not only result in higher profitability for the farmer but less atmospheric pollution.

The relative reduction in enteric methane production in the last 10 years has been probably due to improvements in animal husbandry and feeding practices, especially in developing countries. The increasing demand for animal products for human consumption has directed research, technology transfer and developmental work in favor of more integrated and efficient production systems including better feeding strategies using better quality feeds, resulting in the bonus side-effect of lower methane production per unit of product.

Reducing enteric methanogenesis is beneficial from the standpoint of increasing energy efficiency of the animal and from an environmental perspective. Methane production in ruminants is negatively correlated with energy utilization and it can range from two to 12% of the gross energy intake. Reduction of methane production can be achieved by use of feed additives, e.g. ionophores, probiotics, acetiogens, bacteriocins, essential oils, grains, and high-quality forages. However, it is also important to ensure that the additives do not adversely affect animal productivity.

The IAEA, through the Animal Production and Health Section, has strongly supported research and developmental work in developing countries in the last 30 years for improving quality and availability of local feeds and in the formulation of improved quality rations.

As an example, a recent CRP on Development and Use of Rumen Molecular Techniques for Predicting and Enhancing Productivity screened more than 200 plants and plant extracts comprising of browse, multi-purpose trees, medicinal plants, and spices from Asia, Africa and Latin America. The results indicated that *Acacia angustissima, Allium sativum, Canabis indica, Emblica Jambolana, E. officinalis, Eucalyptus globulus, Foeniculum vulgare, Mangifera indica, Mentha pipperita, Populus deltoides, Psidium guajava, Quercus incana, Sesbania sesban, Syzygium aromaticum, Terminalia belerica, Terminalia chebula, and Trachyspermum ammi* inhibited methane production by 25 to 100% and a large number of plants were also inhibitory for rumen ciliate protozoa. Methane production was reduced *in vitro* by between 10 and 100% and *in vivo* by 11 to 35%.

Actions taken by the IAEA through these projects have resulted in improved productivity of livestock, and are also contributing to reducing the impact of ruminants on the environment.

Water Resources and Livestock: An Increasing Constraint

Water is essential for life. More than half of all potable water is from rivers and lakes and more than one-sixth of the Earth's population rely on glaciers and seasonal snowfall for their water supply. However, the increase in surface temperatures is causing profound alterations in the hydrological cycle, particularly in regions where water supply is currently dominated by melting snow or ice.

Vanishing glaciers will negatively affect water supply in the next few decades in many parts of the world, for example in the Hindu Kush-Himalaya region covering parts of China, India, Afghanistan, Pakistan, and Myanmar, and in the South American Andes where Peru alone has lost 25% of its glacier-covered regions in the last 30 years. On the other hand, rivers currently fed by rainfall and snowmelt might instead pass to a rainfall-dominated regime resulting in an increase of water discharge in winter and a decrease in summer. This will have serious socioeconomic implications due to a reduction in water supply for industry, agriculture, and domestic use, as well as reduction of hydropower generation in summer.

Impressive waterfalls showing the abundance of water in southern Brazil and limited water availability for livestock production in Niger

Global warming is causing serious deleterious effects to the environment. The maintenance of stable water temperature in oceans, lakes, and rivers is extremely important for aquatic animals as small temperature variations can affect feed availability, egg hatchability, and survival; furthermore, elevated ambient temperatures prompt higher water consumption in humans and all terrestrial animals.

Changes in the hydrological cycle may cause more water to be deposited in the oceans at some periods of the year and an increased scarcity of water in others, while accelerated melting of glaciers and increasing use of fossil water will lead to severe shortages of water that will affect millions of people in the mid-term future unless governments jointly agree on and implement appropriate measures to reduce greenhouse gas emissions into the atmosphere.

The world is facing alarming food insecurity due to the adverse effects of climatic changes on crop and livestock productivity, increased demands from emerging markets in Asia and Latin America, use of grains in the production of biofuels, and reduction of arable land due to increasing urbanization. The Food and Agriculture Organization of the United Nations (FAO) has indicated that one billion of the world's 6.5 billion people face hunger and are 'food insecure'.

Humans, animals, and plants compete for water and it is by far the most important limiting factor in livestock production however, fresh water resources are not evenly distributed in the world and these resources are being increasingly depleted. Although much research is being done, it needs to be focused on overcoming the significant obstacles to sustainable food production in order to create the means to double the worlds' food production using less land, less water, fewer nutrients, and less technology to satisfy the expected demand.

There is increasing competition for irrigation water for both human consumption and the production of cereal crops that is likely to force a reduction in usage of irrigated pastures for livestock and a movement of livestock production into rainfall based grazing systems probably with the creation of feedlot finishing systems close to large cities.

Farmers herding their animals for long distances to access water holes, creeks and rivers are a common occurrence in several parts of Africa

The major area for improvement in water use efficiency and productivity for livestock is through improvements in livestock and feed base management to maximize production efficiency and ensure better livelihood to the rural population. The IAEA, through the Animal Production and Health Section, has continued to

support research and developmental work in developing countries over the last 30 years for improving quality and availability of local feeds and in the formulation of improved quality rations, and to genetically improve the local species and breeds for higher production while conserving their characteristics for adaptation to harsh environments and prevailing diseases. Large numbers of grasses and leguminous pasture species has been evaluated and proved to be resistant to high humidity or prolonged periods of dryness, to acid or saline soils, and to high altitude environments, and are currently being used for feeding livestock ruminants by farmers in developing countries.

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

Peste des Petits Ruminants (PPR)

Technical Officers: Adama Diallo, Hermann Unger

This CRP has been running for two years. The overall objective is to develop, validate and transfer to Member States sensitive, specific and rapid tests for the diagnosis of PPR to help them better manage and control this transboundary animal disease. The activity received from the different research contract holders indicate the widespread prevalence of PPR in the different countries. For this activity the competitive PPR ELISA based on the recombinant N-protein of the virus was tested in the different laboratories. Problems were faced with some of the kit components but at the moment the test is running fine and results of this evaluation are expected at the next RCM. The molecular diagnosis of PPR was addressed in a number of laboratories. Good results were reported using filter paper as the transport matrix of samples, specifically for nasal discharge and the PCR procedures are now established in most laboratories. Dr. Gang Li recently developed an isothermic loop-mediated amplification for PPR. This procedure is much more robust then the conventional PCR, does not depend on a PCR cycler and can be done without an RNA extraction before the amplification. At the same time the sensitivity of this procedure is similar or even better then conventional or nested PCR. In cooperation with the Veterinary University Vienna and APU this test will now be further developed into a kit format and should be ready for field testing in 2010.

The next RCM will be held 19–22 July 2010 in Ouagadougou, Burkina Faso.

The Early and Rapid Diagnosis of Transboundary Animal Diseases: Phase I — Avian Influenza

Technical Officer: Gerrit Viljoen

This CRP focuses on the early and rapid diagnosis and control of avian influenza (as a technological target) through the advantageous use of nuclear, nuclear associated and nuclear related technologies, in conjunction with non-nuclear technologies. In particular, the rapid, sensitive and specific detection of disease agent nucleic acids using molecular technologies (e.g. RT-PCR and PCR sequencing), and the use of isotopes (P32/33, S35 and S35Met) to label or trace virus nucleic acid or proteins during development and comparative phases of research, and for the evaluation or characterization of targeted genes.

The overall objective is to develop, evaluate and validate early and rapid detection technologies to provide Member States with the capacity to detect, monitor, contain and control TADs. The CRP is supporting the build up of competence in the use of modern biotechnology, including molecular and serological methods, to provide systems and technologies to be used in the field as well as in laboratories. A major target for diagnostic systems will be the highly pathogenic avian influenza viruses, but such systems are pertinent to all other TADs since the technologies addressed in this CRP form part of an early response diagnostic capability platform. The IAEA is supporting Member States in their efforts to control diseases of importance. This, amongst others, involves the development, evaluation and validation of the appropriate nuclear, nuclear associated and nuclear related technologies and the harmonization and dissemination of protocols and procedures. Technical advice is therefore given to Member States (or any other party) as to the diagnosis of a disease, the best 'fitness for purpose' tools and quality assured procedures, including prophylactic measures (e.g. vaccines), to use in close collaboration and consultation with experts in the field. In the case of avian influenza, it is important for the rapid and differential diagnosis to classify isolates as highly pathogenic or not, in order to activate appropriate control measures — this is seen as the bottleneck activity for most developing countries.

The final RCM took place from 10 to 14 may 2010 in Rome, Italy. A full report can be found under 'past events' in this newsletter.

Control of Contagious Bovine Pleuro-Pneumonia (CBPP)

Technical Officer: Hermann Unger

This CRP is now entering its last year. The validation of the CBPP c-ELISA is now completed and publications on the findings are under way. Currently a ring test for all CRP members and as well for RAF5057 MS is organized by F. Thiaucourt, CIRAD. Due to logistical problems, not all tests could be sent out in time, but it's hoped that the flowback of information will help to assess the capacity of the participating labs to diagnose CBPP by serology.

The re-development of the LPPQ ELISA was not met with the success necessary to promote a commercial production due to a relatively high background demanding a serum dilution of 1/400, which was not practical. The original test performed very well on a serum dilution of 1/10. The molecular diagnosis of CBPP is now well addressed and a number of laboratories are performing PCR and q-PCR. Recently an isothermic CBPP Loop-mediated Amplification was developed by the Veterinary University Vienna to-

gether with APU. First experiments in Mali ascertained the performance of the system but showed some intrinsic problems which now will be addressed by evaluating the best location for the outer primers and the sample preparation method.
The final RCM for this CRP is planned to be held 13–17 September in Zanzibar. All research contract holders are invited to come up with their research results in a format which will allow the publication in a book format tentatively titled 'CBPP control, the way forward'.

Veterinary Surveillance of Rift Valley Fever

Technical Officers: Gerrit Viljoen; Hermann Unger
Rift Valley Fever (RVF) is a zoonosis caused by a bunya virus inflicting great economic losses from reduced productivity, abortions in pregnant animals and high mortality in animals and humans. RVF is defined as one of the hemorrhagic fever viruses in the emerging diseases group. It was first isolated in 1930 in the Rift Valley of Kenya from sheep and is endemic in sub Saharan Africa. Periodic disease has been recorded in animals and humans with major outbreaks in Egypt, South Mauritania, Madagascar, Northern Kenya, South Africa, Sudan and Somalia. In September 2000, RVF was reported outside of the African Continent for the first time in Saudi Arabia and Yemen. These outbreaks lead to more than 2000 human cases killing nearly 300 people and 20 000 abortions in livestock in Yemen. This expansion in epidemic area to the Arabian Peninsula raises the possibility of threat of RVF to other parts of Asia and Europe.
Transmission of RVF is by mosquitoes or by contact. Many different species of mosquitoes are known to be vectors. There is, therefore, the potential for epizootics and associated human epidemics following the introduction of the virus.
RVF-vaccines for veterinary use are available, but live-attenuated vaccines have been shown to produce birth defects and abortions, while inactivated vaccines induce only short lived and incomplete protection. A live-attenuated vaccine for humans is under development and not yet commercially available. The diagnosis of RVF depends nowadays on serology. The existing enzyme linked immuno sobent assay (ELISA) is widely in use but lacks specificity and is produced from virus culture, potentially transporting the germ. Direct virus diagnosis demands high security labs not available in most countries.
The Polymerase Chain Reaction (PCR) is a quick, reliable and safe alternative molecular tool providing high sensitivity but is not yet a frequently used method in most laboratories. A competitive ELISA for RVF would have the additional advantage of being species un-specific and supporting research in the potential hosts of this disease.
The target of this CRP is to support countries in risk of major RVF outbreaks to gain the capacity for a quick and reliable diagnosis of this disease and by the evaluation of epidemiological patterns allow an early warning.
Specific research objectives:

- Evaluation of RT-PCR and PCR sequencing for early detection of virus and its use in molecular epidemiology
- Evaluation, validation and use of the existing and new ELISA's in serological surveys
- Evaluation of recombinant antigens for use in indirect and competition ELISA's (rC-ELISA).
- Harmonization of SOP's and introduction of quality assurance procedures for RVF-ELISA and RT-PCR.
- Set up of an epidemiological database supporting risk assessment for RVF outbreaks.

Expected research outputs:

- Validated diagnostic tools and descriptions of RVF tests based on fitness for purpose.
- Standard diagnostic procedures for surveillance and early diagnosis using PCR and ELISA, defined reference material available.
- An rC-ELISA developed to measure antibodies against RVF from all species (including non-ruminant species)
- An epidemiological databank established

The CRP will draw to a close in December 2010 and a follow-up CRP will be proposed for 2011

The Use of Enzymes and Nuclear Technologies to Improve the Utilization of Fibrous Feeds and Reduce Greenhouse Gas Emissions from Livestock

Technical Officer: Nicholas Odongo
The world's poorest people, about one billion, depend on livestock for their day-to-day livelihood: food, fibre, manure, draught power, transport, ready source of cash, etc. However, livestock production in many developing countries is constrained because of poor nutrition. Because of climatic conditions, animal feeds are in short supply and what is available is of poor quality. The problem is particularly critical during the dry season when farmers may suffer great animal losses. Furthermore, there is a lack of and/or limited use of commercial concentrate feeds, e.g. soybean, cottonseed and groundnut meals, etc because the resource poor farmers cannot afford them. The problem is also being exacerbated by the decreasing availability of arable land because of the rapidly increasing human population, soil/land degradation, urbanization and effects of global warming.
Furthermore, methane production from ruminants fed poor quality diets such as straw and stover is higher than those from animals fed better quality forages. The increased concentration of greenhouse gases (e.g. methane) in the troposphere has been implicated in climate change and global warming. Methane production is negatively correlated with energy utilization and it can range from two to 12% of the gross energy in-

take, thus, reduction of methane production through the use of enzymes and rechanneling the hydrogen to short-chain fatty acids and microbial mass is desirable. Reducing methane emission from ruminant animals has implications not only for global environmental protection but also for efficient animal production.

Recent research is showing that supplementing livestock diets with fibre degrading enzymes can improve the efficiency of feed utilization, resulting in improved animal performance and a reduction of methane emissions. For sustainable development of the livestock sector it is essential to secure sufficient supply of balanced feeds from resources that do not compete with human food — production of grain in developing countries is mostly for human consumption. Novel approaches through the utilization of tree leaves, agro-industrial by-products, feed additives and aquatic sources are required to bridge the gap between supply and demand of feeds.

This CRP will:-

(a) Determine the effects of supplementing livestock diets with enzymes on (i) fibre degradation *in vitro*, in situ and *in vivo*, (ii) feed intake and digestibility, (iii) ruminal fermentation and microbial protein synthesis and (iv) on milk production and composition and/or growth performance.

(b) Determine the mode of action, the critical enzymic activities and application method and rates needed to elicit the desired response.

(c) Determine the effects of supplementing livestock diets with enzymes on animal performance, enteric methane production and cost-benefit analysis.

(d) Build capacity in developing countries on the use of nuclear and related technologies to improve livestock productivity and to create opportunities for research collaboration internationally.

A consultants meeting was held 26–28 April 2010 in Vienna, Austria to discuss the CRP and prepare work plans. A full report of the meeting is available under 'past events' in this newsletter.

The Use of Irradiated Vaccines in the Control of Infectious Transboundary Diseases of Livestock

Technical Officer: Antony George Luckins

The livestock sector is an important source of income for small holder farmers in the developing world. The growing demand for livestock products driven by population growth will provide the rural poor additional opportunities to increase livelihoods. Paramount to meeting this demand will be the need for governments to improve animal health, particularly where it relates to control of infectious diseases since they are a major constraint on livestock productivity and there is an urgent need to tackle the problem in order to ensure food security. Although diseases caused by viruses and bacteria are of major concern, often causing serious epidemics and compromising international trade, parasitic diseases caused by helminths such as *Fasciola* and *Schistosoma* or protozoa like *Trypanosoma* and *Theileria* exert a persistent, debilitating effect on livestock productivity throughout Africa, Asia and South America. With one or two exceptions their control relies on chemotherapy, however, this approach has a number of disadvantages. Firstly, even though animals are cleared of infection rapidly after treatment, it often fails to prevent re-infection thereby requiring frequent administration of the drug. Secondly, parasites are able to adapt genetically to the action of the drugs, resulting in the development of drug resistance — a common cause of overuse or inaccurate administration. This latter problem is compounded by the widespread use of fake products in many Member States. Also, long term treatment brings with it the accumulation of drug residues in meat and milk, a situation that could compromise export of livestock products to the developed economies.

While this is a strong reason to develop vaccines against parasitic diseases, it will be necessary to apply innovative techniques to achieve this aim since in the past there has been only limited success in producing effective vaccines. Although a few attenuated, live vaccines are available they have a limited shelf life and it can be difficult to select appropriate, genetically attenuated organisms. Recombinant vaccines have also failed to live up to their promise, and there are a number of reasons for this. Parasites are complex organisms, comprising thousands of proteins, and identifying a single protective antigen is difficult, if not impossible since the immune response is multifaceted, requiring activation of several different immune pathways and it is synergy between different antigens that enables this to occur.

The way in which this can be achieved is through the use of gamma radiation attenuated organisms where there is strong evidence that both cellular and humoral immune responses are activated, simulating the response that occurs when live organisms are introduced into the host. Irradiation of whole organisms obviates the need to identify specific antigenic components required for subunit vaccines, or the time and resources to create genetically attenuated organisms. Moreover, although radiation attenuated organisms are metabolically active and follow a similar migration route to non-irradiated organisms in the host they fail to develop into a mature infection. Gamma irradiation is also practicable for use with those bacteria or viruses where there are currently no effective vaccines available — irradiation will more efficiently preserve the antigenic and adjuvant structures destroyed by conventional chemical or heat treatment. Effective storage and delivery of vaccines is an essential part of a strategy for control of animal diseases and developments in cryobiology enabling lyophilization of whole cells will make it possible freeze-dry vaccines, even those prepared from helminths or protozoa. Radiation attenuation would also expedite rapid emergency vaccine production

during epidemic outbreaks of microbial diseases and freeze-drying would enable such vaccines to be stored and transported without need for a cold chain, thereby benefiting resource-poor MS.

The CRP will: -

(a) Develop techniques for irradiation attenuation of, for example, *Trypanosoma, Theileria, Fasciola, Schistosoma* and RVF and FMD virus
(b) Use nuclear techniques to assess metabolic activity of irradiated organisms and follow their migration and establishment in the host from site of injection
(c) Test irradiated vaccines in experimental animals to determine protective dose and monitor level and duration of immunity
(d) Develop techniques for the lyophilization of irradiated vaccines and SOPs for their vitrification and lyoprotection and determine conditions for storage to preserve integrity of vaccine
(e) Develop flow-through irradiation techniques to enable fast preparation of vaccines.

The first research coordination meeting will take place 11–15 October 2010 in Vienna, Austria.

Development of Molecular and Nuclear Technologies for the Control of Foot-and-Mouth Disease (FMD)

Technical Officer: Gerrit Viljoen

Foot-and-mouth disease (FMD) 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 will 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-out procedures are therefore of paramount importance as it 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 1980's, but these are not standardized for international use. Many countries now produce FMD vaccines but often without effective consideration of their effectiveness. This CRP will investigate methods and possibly provide internationally acceptable guidelines for procedures which test a vaccine's ability to induce the production of protective antibodies in cattle without the need for animal challenge experiments.

In many developing countries, vaccination will continue to be an essential component for the progressive control of FMD. Maximising 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.

The CRP will:

(a) Establish methods and develop internationally agreed protocols for measuring the potency of FMD vaccines using *in vitro* methods;
(b) Establish guidelines for optimum population vaccination intervals based on *in vitro* measurements of potency and duration of the antibody response to structural proteins, after vaccination of cattle and small ruminants with commercially available FMD vaccines, including evaluation of reduced dose options such as intradermal administration of FMD vaccine;
(c) 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; and,
(d) Provide further global coordination of current research into FMD vaccines for use in endemic settings.

The first research coordination meeting is scheduled to be held early in 2011 in Vienna, Austria.

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

Technical Officer: Mario García Podestá

Infectious diseases, such as gastrointestinal nematodes impose severe constraints on sheep and goat production in pastoral systems worldwide. Losses occur through mortalities, reduced production due to sub clinical

diseases and direct costs associated with pest control. Widespread and indiscriminative use of drugs to alleviate parasite infestation has resulted in the emergence of strains which are resistant to them in many cases.

There is well-documented evidence for within and between breed genetic variation in resistance to gastrointestinal nematode infections and it is expected that disease resistance is a heritable trait. This offers the opportunity to select animals for enhanced resistance to the disease. There are concerted efforts to find genetic markers associated with resistance to nematode parasitism.

Genetic disease resistance is particularly relevant in developing countries, as indigenous breeds usually display enhanced resistance to local diseases as compared to exotic ones reared in the same environment. However, little is known on the genetic composition controlling this condition. The rapid and growing knowledge on genes and genomes in livestock such as the assessment of a large number of DNA markers in phenotypic recorded populations could be used to localize and further characterize candidate genes of economic interest.

The objectives of the CRP are to:

- Develop capacity in developing countries in the use of molecular and related technologies and create opportunities for international research collaboration.
- Establish or improve programmes for animal identification and data recording for small ruminants in developing countries, allowing for the monitoring of production, reproduction and health traits and generating populations suitable for molecular genetic studies.
- Collect phenotypic data and DNA samples from goat and sheep breeds or populations within-breeds with history of infectious disease resistance.
- Develop expertise on the use and development of bioinformatic tools for the analysis of large datasets if genomic data related to parasite resistance in various breeds.
- Provide valid data for the identification of genetic markers associated to infectious disease resistance and to initiate the development of tools for molecular diagnostics and assisted breeding.
- Contribute on the development and use of nuclear technology for genomic research in small ruminants, including radiation hybrid map, Southern Blot with radioactive [α-^{32}P] ATP labelling in genetic marker analysis, and PCR-RFLP.

Thirty-nine Research Contract proposals from 30 IAEA Member States were received, which made difficult the selection of 14 projects that were granted with a contract in the programme. All proposals were of high scientific calibre and most of the host institutes had sufficient equipment and adequate expertise to conduct the planned studies. On the other hand and based on the recommendations given by a group of experts that met in Vienna from 8 to 10 February 2008 to review the work plan and devise standard operating procedures for the CRP, part of the original methodology was modified. In general, all 14 Research Contract holders have agreed to do the following activities during the first phase of the programme:

- Phenotypical evaluation of the resistance to gastrointestinal parasites of sheep and goat breeds and DNA sample collection for genomic association studies.
- Conduct an 'artificial challenge' trial with a minimum of 20 dewormed animals per Samples for DNA extraction will be collected and animals challenged with infective L3 larvae. Body weight, fecal egg counts (FEC), packed cell volume (PCV), and FAMACHA scores taken at 28, 35, and 42 days after artificial infection.
- Conduct a 'Field' trial using only one breed (500 animals or more) or using two or more breeds (200 animals or more per breed in a common grazing environment). Animals will be dewormed and 28 days later body weight, FEC, PCV, and FAMACHA scores will be taken twice, one week apart. A blood sample for DNA extraction will be collected at the first sampling time.
- DNA samples will be sent to the IAEA Seibersdorf Laboratories (preferably) or at least to a commercial service provider for SNP genotyping.

The First Research Coordination Meeting will take place in early February 2011.

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/

For further information contact Anna Lyn Dimailig (a.dimailig@iaea.org)

Activities of the Animal Production and Health Laboratory

Sheep HapMap

HapMap (short for 'haplotype mapping') studies, in which a large number of members of a given species are genotyped for a large number of single nucleotide polymorphisms (SNP), have produced a great deal of genetic information. Using the information in the HapMap, researchers are able to find genes that affect health, disease, and individual responses to medications and environmental factors. For example, the goal of the International (human) HapMap Project was to compare the genetic sequences of different individuals to identify chromosomal regions where genetic variants are shared. The completion of this project has helped biomedical researchers find genes involved in disease and responses to therapeutic drugs.

A HapMap project in small ruminants (sheep and goats) is extremely important for IAEA developing Member States to enhance the ability of scientists to use genomics for improving productivity and other characteristics influenced by genetics, including adaptability and disease resistance. For this reason, a Sheep HapMap project has recently been proposed by the International Sheep Genomics Consortium, Australia, aimed to improve productivity and product quality for wool fibre and meat, improve reproduction and better host resistance to parasites. Stakeholders in global sheep production are being requested to submit samples of DNA from at least 24 sheep to undergo genotyping using a 60,000 SNP array. It is expected to include at least 50 breeds in this study from Africa, Asia, Europe, and the Americas. The Animal Production and Health Subprogramme had particular interest in the inclusion of the African Dorper breed in the HapMap study because (i) the breed is well adapted to tropical and sub-tropical regions and is also being used in cross-breeding programmes to improve the productivity of local sheep in many Member States and (ii) this breed is one of the constituents of the reference population of animals upon which the on-going IAEA collaborative study on helminth resistance (CRP on Genetic variation on the control of resistance to infectious diseases in small ruminants for improving animal productivity) is based. The IAEA, in collaboration with the International Livestock Research Institute (ILRI), awarded a contract to CSIRO Livestock industries to perform genotyping of selected breed from Africa using 60,000 SNP array. ILRI provided the International Sheep Genomics Consortium with samples of sheep DNA from the African Dorper breed and data from three generation pedigrees. These sets of samples included three sets of family trios (i.e. father, mother, and offspring) as it is important for pedigree status of the animals to be known to ensure animals are not closely related except the trios.

A total of 108 DNA purified DNA samples (concentration range, 50–500 ng/uL) derived from whole blood have been shipped from ILRI to CSIRO, Australia representing three diverse breeds of African animals. Each sample was entered into the International Sheep Genomics Consortium DNA repository and its associated sample management system. The 108 samples were arrayed into 96 well plates and an electronic manifest prepared describing the concentration, sample identifier and the origin of breed of each animal. The 108 DNA samples received as part of a contract from the IAEA were added to other breed samples to form the International Sheep Genomics Consortium 'HapMap and Breed Diversity Experiment' making the IAEA a formalized participant in the HapMap experiment.

The DNA samples have since been shipped from the DNA repository to the Illumina 'Fast Track' facility in California to facilitate genotyping of each sample using the Ovine SNP50 BeadChip. This is a high-density genotyping platform which generates genetic data from approximately 50 000 SNP markers located across the sheep genome from high quality data. For each breed, the average call-rate is exceptionally high indicating that the experiment was a success. For example, only 19 SNP markers out of a total of 49 034 SNP attempted failed for the African Dorper DNA samples i.e. 99.96% of SNP markers tested returned high quality data. The success rate for the other breeds was as high or higher.

The full set of genotypic data obtained under this contract was released for public analysis in March 2009 via the International Sheep Genomics Consortium website (www.sheephapmap.org) including the geno-

typic data from the 100 African animals as part of the HapMap Breedv1 data release. The full dataset contains information from over 2800 animals implying it is a large dataset and consists of > 140 million genotypic data points. To allow researchers world-wide access, the data was formatted and released as .PED and .MAP files which can be analysed using the program PLINK (http://pngu.mgh.harvard.edu/~purcell/plink/index.shtml) which is designed specifically for large SNP datasets and is freely available.

To date, over 40 research groups have downloaded the dataset. In general, the process of receiving and genotyping the animals were very successful. Dr James Kijas and the International Sheep Genomics Consortium are in the process of preparing a manuscript which describes global sheep genetic diversity. This project yield information on the genetic biodiversity of sheep globally, the evolution of breeds with respect to global distribution, and genetic relationships among breeds. In addition, information regarding the genomic location of genes affecting important traits is expected to be obtained. On the other hand, the Bovine HapMap Consortium published a paper entitled 'Genome-Wide Survey of SNP Variation Uncovers the Genetic Structure of Cattle Breeds' in Science (Science 324: 528-532, 2009). More details about this are available here http://www-naweb.iaea.org/nafa/aph/stories/2009-bovine-genome.html.

Development of Diagnostic Tests: Improvement of the Isolation of PPR Virus (PPRV)

Peste des Petits Ruminants (PPR) is an acute and highly contagious disease of sheep, goats and small ruminant wildlife. It is the most economically important small ruminant infectious disease in developing countries. The rates of morbidity and mortality are variable but they can be as high as 90–100% and 70–80% respectively in susceptible flock. In the past 10 years, the incidence of PPR increased steadily to cover new areas in both Asia and Africa. In Africa, the spread of PPR south of the equator has been observed since 2005 with cases reported in the Democratic Republic of Congo, Uganda, Kenya and finally Tanzania in early 2009. In the northern part of the continent, this disease was reported on a few occasions only in Egypt. But in June 2008 a PPR outbreak started in Morocco which spread to nearly the whole country in a couple of months. A recent report has mentioned the presence of PPR antibodies in small ruminants in Tunisia. Thus, in the last decade, the geographical distribution of PPR has expanded considerably and this disease is threatening the production of about one billion small ruminants, animals which are an important economic resource relied upon by the poorest pastoralists and farmers. This expansion of the disease endemic area is certainly due to the increase in animal movements worldwide but is also probably brought about by the development and deployment of specific tests allowing better diagnosis, in particular the molecular-based techniques to detect nucleic acids of the causal agent, the PPR virus (PPRV). But only few virus isolations are made. Indeed the chance this virus is currently very low.

PPRV belongs to a small group of virus named the *Morbillivirus* genus. This includes also the measles virus affecting human, the canine distemper virus causing disease in dog and the rinderpest virus which was an important threat to cattle and buffalo production until its recent eradication. Central to the pathogenesis of morbillivirus infections is the transient but profound immunosuppression induced in the host. This effect on the host defence favours the establishment and aggravation of the course of opportunistic infections all of which contribute to the severity of the infection. This immunosuppressive effect is in part a result of the virus multiplication in lymphoid cells which are the main targets for its replication. This tropism is determined to a large extent by the presence of a protein on lymphoid cell surface which is used by the virus as a receptor for its entry in the cell. However, morbilliviruses infect and replicate in cells other than lymphoid cells but with very low efficiency. Because those other cells, such as kidney or lung cells, are easier to maintain in *in vitro* culture than lymphoid cells, they have been preferentially used for morbillivirus isolation even though they are not the most ideal cells. In the case of PPRV, bovine kidney cells, sheep kidney or lung cells, and monkey kidney cells (Vero cells) have been used. But with these cells, isolation is problematic and in most cases the appearance of the virus cytopathogenic effect; i.e. the virus isolation, needs many blind passages and can take 2 to 3 weeks if successful. In 2000, the lymphoid cells surface protein used by the morbilliviruses as receptor was identified. The gene of this protein, the Signalling Lymphocyte Activation Molecule (SLAM) or CD150, of human or canine origins has been inserted into the Vero cell genome. Such modified cells support readily the isolation of measles or canine distemper within 24 hours. Based on that result, in APHL we succeeded at the end of 2008 in modifying another monkey cell line, the CV1 cell, with the sheep SLAM gene. This stable modified cell, named CHS-20, has now been evaluated for its potential in isolating wild type PPRV. Included in this trial were the Vero cell which is the cell the most used currently for PPRV isolation, the original CV1 cell and finally Vero-DogSLAM (VDS) which is a modified Vero cell expressing the canine SLAM. Cells were infected with a 10% ground pathological suspension and incubated at 37°C. They were observed daily for the appearance of the virus cytopathic effect (cpe). One week after infection, cells which do not show any cpe are trypsinised and seeded into another flask, in a blind passage. This is repeated every seven days up to five weeks maximum. After this period, the virus isolation is considered unsuccessful if no cpe is observed and no PPRV nucleic acid is detected by PCR in the inoculated cell

medium. Table 1 summarizes the results obtained in the first trial with PPR suspected pathological samples that were collected in Nigeria and sent to APHL in 2009. The table shows the results obtained with 6 of these samples. It can be seen that PPRV is isolated in CHS-20 in 2 to 5 days after the cell inoculation, while at least 9 days with a blind passage are needed before for the observation of the cpe in VDS for sample 43. No cpe was detected in Vero and CV1 cells in a 3 weeks observation period. The culture medium from infected VDS, Vero and CV1 cells were tested for the presence of PPRV nucleic acid by polymerase chain reaction (PCR) amplification assay. As can be seen in figure 1A and 1B the presence of PPRV is detected in VDS after the first passage and also in CV1. For the sample 3, apart from the cell CHS 20 for which the isolation process was successful, the PCR assay has not been positive for the other cells (see Table 1).

In both the CHS-20 and VeroDogSLAM, the cells expressing the sheep and the dog morbillivirus receptor, the cpe is characterized by the development of syncytia, giant cells which result from the fusion of multiple virus-infected cells (see Figure 1).

The fact that PPRV can also be isolated in Vero-DogSLAM cells indicates that this virus can bind on the SLAM of animals other than small ruminants but probably at low efficiency since with the latter cells the cpe is evident only after one blind passage.

The preliminary results reported here indicate that the cell line we established, expressing the sheep SLAM, the protein used by PPRV as a receptor, is a promising cell culture system for efficient and rapid isolation of wild type PPR virus. This will be an important contribution to the diagnosis of the disease.

Table 1 Isolation of PPRV in CHS-20, VeroDogSLAM (VDS), Vero, and CV-1 cells

sample identification	Virus isolation [a]			
	CHS-20	VDS	Vero	CV-1
Lung n°3	3 days	_	_ [b]	_
Lung n° 27	2 days	-	-	-
Liver n° 28	3 days	-	-	-
Spleen n° 29	5 days	-	-	-
Lung n°43	2 days	9 days	-	_

[a]The day post-infection (dpi) at which time CPE was confirmed in the cell culture
[b]_, unsuccessful virus isolation during 21 days of the observation period after inoculation
ND, non determined

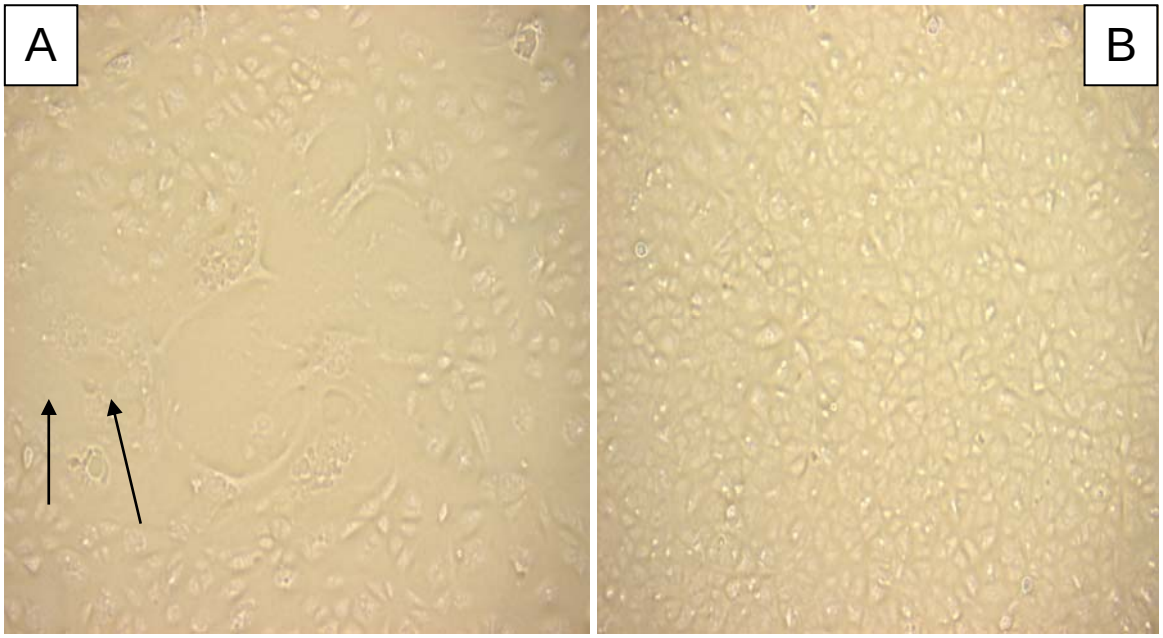


Figure 1. Isolation of PPRV on CV1 cells expressing the PPRV receptor: SLAM protein (CHS cells). Photo A: Syncytia indicated by the arrows in the cell layer infected with PPR suspected pathological sample. This virus cytopathic effect (cpe) appears 2 day.

Fellows and Consultants at APU

Fellow at APHL:
Mr Davaasuren BATDORJ, from Mongolia, is currently in APHL for a training on capripox molecular characterization for six months (15 January–16 July, 2010) with the support of IAEA TC Project MON08001.

Consultant at APHL:
Ms Anna Slawinska, from the University of Technology and Life Sciences in Bydgoszcz, Poland, has a contract in APHL to work on the standardization and validation of the single nucleotide polymorphisms (SNPs) in both sheep and poultry breeds within the scope of the CRP on gene-based technologies in livestock breeding: characterization of small ruminant genetic resources in Asia and TC project RER5015.

IAEA Collaborating Centre on Animal Genomics and Bioinformatics

The IAEA Collaborating Centre is composed of laboratories from three world class research and teaching Brazilian institutions Animal Biochemistry and Molecular Biology Laboratory (LBBMA), São Paulo State University, UNESP, Araçatuba; Laboratory of Computational and Systems Biology (LCSB), Instituto Oswaldo Cruz — FIOCRUZ (Oswaldo Cruz Foundation), Rio de Janeiro; and Animal Biotechnology Laboratory (ABL), Animal Sciences Department, Escola Superior de Agricultura Luiz de Queiroz, University of São Paulo, Piracicaba. The Liaison Officer or the Centre is Dr. Jose Fernando Garcia (UNESP).

- LBBMA is part of UNESP, one the three public universities funded by the State of São Paulo, and one of the largest institutions of higher education in Latin America. The relatively new Veterinary Medicine School is located in the Araçatuba campus and has a well equipped research infrastructure, especially for animal production and health. LBMMA focus its research activity on animal physiology, biochemistry, and molecular genetics with emphasis on important phenotypic characteristics in cattle such as early puberty, growth rate, milk production, and disease resistance. The main techniques developed by LBBMA are DNA cloning and sequencing, microsatellite analysis, and high throughput gene expression analysis.
- The LCSB is one of seventy-one laboratories of the Oswaldo Cruz Institute. Activities in the laboratory are focused to molecular characterization, functional and comparative genomics of trypanosomatids using bioinformatics tools. LCSB has created an international network discussion list (tryplink-1), a genomic database called ProtozoaDB (http://protozoadb.biowebdb.org), organized international Internet conferences on trypanosomatids, carried out a scientific journal (Kinetoplastid Biology and Disease) and organized meetings, training courses and individual training to Latin America and African scientists.
- The ABL is part of the Animal Sciences Department, University of Sao Paulo (USP). This university is the largest institution dedicated to higher education and research in Brazil, and the third in size in Latin America. ABL is also part of the Organization of Nucleotide Sequence and Analysis (ONSA) of the São Paulo State Research Foundation (FAPESP), that is involved in the sequencing of the complete genome of the first plan pathogen (Xilella fastidiosa) and other important agricultural organisms (other strains of Xilella, Xanthomonas), plants (sugar cane, coffee, eucalyptus) and livestock (chicken and cattle). The laboratory is currently involved in candidate gene research, quantitative trait loci mapping, transcriptomics, and gene expression projects in ruminants (cattle and sheep) and chicken.

The IAEA and the IAEA Collaborating Centre are working closely and in consultation with each other to increase capacity of NARS and Member States to use nuclear and nuclear related gene-based technologies in conjunction with conventional technologies to improve livestock productivity, and to enhance national and regional research and analytical capabilities in order to promote self-reliance and to accelerate national development. The programme for 2009–2012 includes:

Information collection and dissemination:

– Development and maintenance of an Internet-based application to liaise the specific participant laboratories (USP, UNESP, and Fiocruz) with the correspondent sectors of the IAEA (Animal Production and Health Section, Animal Production Unit at Seibersdorf Laboratories, and the Technical Cooperation Department).

Development, application, and evaluation of new technologies:

– Characterization of relevant indigenous and adapted livestock breeds, primarily cattle, sheep, and goats from tropical regions to establish a reference platform for molecular genetic research.
– Generation of phenotypic and genotypic DNA data banks to facilitate the evaluation of genetic diversity and the validation of markers for future livestock breeding strategies using molecular genetic information.
– Development and characterization of molecular tools for livestock genetic analysis.
– Application of molecular diagnostic tools and molecular markers for marker assisted selection for the improvement of animal production in the tropics.

Assistance to the IAEA's training programme:

– The Centre may host individual fellowships for scientists of IAEA Member States in the field of animal genetics, both for short term duration as well as for PhD degrees.
– The Centre staff may provide on-site training through expert assignments to national and regional TC projects and NAFA training courses.

Technical Cooperation Projects

TC Project	Description	Technical Officer(s)
BEN/5/003	Veterinary Drug Residue Monitoring Programme **Objective**: To develop a capacity for veterinary drug residue monitoring in livestock products.	Unger / Diallo
BEN/5/006	Improving Animal Health and Productivity **Objective**: To strengthen, diagnose, and control African swine fever, and increase animal productivity.	Unger / Diallo
BKF/5/006	Establishment of Feeding Tables for Feedstuffs that are Locally Available to Stock-holders in Burkina Faso **Objective**: To improve the reproductive performance of local livestock bred through food supplementation strategies, develop feeding table for locally available food resources, characterize genetic types of cattle used for milk production, improve the effectiveness of artificial insemination on local cattle breeds, and train a qualified team on animal production (nutrition, feeding, reproduction and genetics).	Garcia Podesta / Odongo
BKF/5/008	Strengthening the Development of Small Ruminant Production **Objective**: To combat poverty in the rural environment in Burkina Faso by improving production by evaluating the productivity of different genetic types of small ruminants, improving productivity and reproduction performance of local small ruminants through improved feeding and management practises, and evaluating the impact of gastrointestinal and reproductive diseases in small ruminants and the effectiveness of the medicinal plants commonly used by breeders.	Garcia Podesta / Unger
BOL/5/019	Implementing Molecular Techniques to Upgrade the Diagnostic Facilities of National Animal Health Programmes **Objective**: To strengthen the diagnostic capacity of the animal health laboratories supporting programmes for the control and eradication of animal diseases in Bolivia through the use of molecular diagnostic techniques and training of staff in the use of the techniques; to provide rapid and precise diagnosis of animal diseases to allow better control of economically important diseases of livestock.	Luckins / Schaten
BOT/5/005	Improving Diagnosis of Animal Diseases **Objective**: To employ nuclear molecular diagnostic techniques for improved diagnosis of trans-boundary animal diseases, such as foot and mouth disease, contagious bovine pleuropneumonia, and avian influenza.	Viljoen
BUL/5/012	Developing and Validating Molecular Nuclear Technologies for Rapid Diagnostics of Foot and Mouth Disease and Genotyping of Indigenous Cattle Breeds **Objective**: To improve livestock by rapid diagnosis and effective control of foot and mouth disease, and genotyping of indigenous cattle breeds through development and validation of molecular nuclear methodologies.	Viljoen
BZE/5/004	Strengthening the Veterinary Diagnostic Laboratory with Capacities in Polymerase Chain Reaction Diagnosis (Not funded) **Objective**: To ensure food security through early detection of H5/H7 avian influenza, and other exotic diseases, and to ensure the capacity for quick response to disease outbreaks with epidemiological surveillance.	Viljoen
CAF/5/004	Improving Livestock Production Through Disease Control and Artificial Insemination **Objective**: To improve animal production in the Central African Republic through livestock disease control and improved breeding by use of artificial insemination.	Unger / Garcia Podesta

TC Project	Description	Technical Officer(s)
CMR/5/015	Use of Nuclear Techniques for Improving Ruminant Productivity & Disease Control **Objective**: Develop capability for improved breeding by disease control and artificial insemination.	Garcia Podesta / Unger
CMR/5/017	Improving Animal Productivity and Health **Objective**: To strengthen capacity and outreach regarding artificial insemination in ruminants, and to control livestock diseases impeding reproduction and productivity.	Garcia Podesta / Unger
ERI/5/005	Zoonotic (diseases that can be transmitted from animals to humans) Disease Control and Analysis of Veterinary Residues in Foods **Objective**: The objective of the project is to determine: 1. The epidemiological prevalence of brucellosis and tuberculosis in the major dairy producing areas; 2. Baseline data on veterinary drug residues in milk and meat products.	Cannavan / Unger / Patel
ERI/5/006	Controlling Major Epizootic Diseases and Other Mycoplasma Infections of Livestock **Objective**: To improve the control of transboundary animal diseases, and continue the eradication of tuberculosis and brucellosis.	Unger / Luckins
ETH/5/012	Integrating Sterile Insect Techniques for Tsetse Eradication **Objective**: To eradicate the tsetse fly from the southern Rift Valley, thereby creating an environment conducive to livestock development and improved agricultural production.	Feldman / Parker / Viljoen
ETH/5/014	Monitoring and Control of Major Animal Diseases **Objective**: To strengthen the diagnostic capacity of the National Veterinary Institute to monitor and control trans-boundary diseases, particularly foot and mouth disease and contagious bovine pleuropneumonia.	Viljoen
GAB/5/002	Diagnosis and Control of Animal Diseases **Objective**: To aid identification and control of livestock diseases.	Luckins / Unger
HON/5/004	Improving the Nutrition and Health Conditions of Livestock in Order to Increase Productivity and Reproductivity (Phase II) **Objective**: To strengthen and improve livestock production in Honduras.	Garcia Podesta / Odongo / Viljoen
HON/5/005	Improving the Nutrition and Health Conditions of Livestock in Order to Increase Productivity and Reproductivity (Phase II) **Objective:** To strengthen and improve livestock production in Honduras.	Garcia Podesta / Odongo / Viljoen
INS/5/034	Development of Environmentally Sound Livestock and Agricultural Production **Objective**: To improve livestock productivity without adversely affecting the environment through improved feed supplementation strategies, managing nutrient waste on farms and reducing methane emissions.	Odongo
IVC/5/030	Assessing the Genetic Profile for Improved Livestock Production **Objective**: To assess the genetic profile of livestock for the effective revival of stockbreeding in Côte d'Ivoire.	Garcia Podesta / Unger
KEN/5/027	Assessment of Local Feed Resources for Enhancing Fertility and Productivity of Smallholder Dairy Cattle **Objective**: To assess the potential of local feed resources for enhancing the fertility and productivity of smallholder dairy cattle in the Nakuru District of Kenya.	Odongo / Garcia Podesta
KEN/5/028	Applying Nuclear Based Techniques to Control Animal diseases **Objective**: To improve the capacity to diagnose and carry out surveillance of Contagious Bovine Pleuro-Pneumonia (CBPP), Brucellosis, Rift Valley Fever (RVF), Peste Des Petits Ruminantes (PPR) and Highly Pathogenic Avian Influenza (HPAI) using nuclear and related technologies.	Unger
MAG/5/016	Applying Nuclear Techniques to Optimize Animal Production **Objective:** To increase animal production through the improvement of animal health and control reproduction in the Amoron'i Mania region.	Garcia Podesta / Odongo / Luckins

TC Project	Description	Technical Officer(s)
MAU/5/002	Improving the National Capacity in Diagnostics for Animal Diseases (Infection and Parasitic Diseases) **Objective**: To strengthen the diagnostic capacity of the Centre National D'Elevage et de Recherches Veterinaires (CNERV) to monitor and control trans-boundary animal diseases, particularly foot and mouth disease and contagious bovine pleuropneumonia.	Luckins / Schaten
MAU/5/003	Improving the National Capacity in Diagnostics for Animal Diseases (Infection and Parasitic Diseases) **Objective**: To strengthen the diagnostic capacity of the Centre National D'Elevage et de Recherches Veterinaires (CNERV) to monitor and control trans-boundary animal diseases, particularly foot and mouth disease and contagious bovine pleuropneumonia.	Unger / Schaten
MLI/5/023	Improving National Capabilities for Characterization of Serotypes of Major Animal Diseases Using Molecular Biology Techniques **Objective**: To identify various serotypes present in Mali in order to improve animal health and increase productivity in milk and meat through increased capabilities for diagnosis and control of foot and mouth disease, trypanosomes and tuberculosis.	Unger / Viljoen / Schaten
MON/5/013	Diagnosis and Surveillance of Transboundary Animal Diseases and Production of Diagnostic Reagents **Objective**: To obtain international recognition of freedom from several transboundary animal diseases, to develop a capacity for the local production, standardization and validation of diagnostic reagents and diagnostic kits, and to establish a quality system for diagnosis of transboundary animal diseases using the local produced diagnostic kits.	Luckins / Viljoen
MON/5/016	Improving Productivity of Cattle, Camels and Yaks Through Better Nutrition and Reproductive Management **Objective**: To increase milk, meat and wool production of yaks, cattle and camels by improving the quality and quantity of feed with high nutritional value and tolerance to low temperature and improving the genetic potential using artificial insemination coupled with radio immunoassay for progesterone.	Odongo / Garcia Podesta
MON/5/017	Supporting the Sustainable Production and Supply of Vaccines and Diagnostic Kits for Transboundary Animal Diseases **Objective**: To produce vaccines and diagnostic kits for transboundary animal diseases.	Viljoen / Luckins
MOR/5/030	Improving Sheep and Goat Production in Morocco through Genomic and Reproductive Physiology Characterization with the Help of Radio-immunoassay and Molecular Techniques (Not yet funded) **Objective**: Increase sheep and goats for consumption and producers' revenue while preserving natural resources.	Garcia Podesta / Malek
MOZ/5/002	Promoting sustainable Animal Health, Reproduction and Productivity Through the Use of Nuclear and Related Techniques **Objective**: To obtain sustainable improvement in animal reproduction and breeding and animal health through the use of nuclear and nuclear related technologies.	Viljoen
MYA/5/013	Integrated Approach for Enhancing Cattle Productivity **Objective**: To improve smallholder dairy cattle production in Yangon and Mandalay regions.	Garcia Podesta / Odongo
MYA/5/015	Strengthening the National Capacity for the Production of Veterinary Vaccines **Objective**: To enhance the national capacity for quality vaccine production to support efforts to control infectious diseases in livestock production, particularly FMD.	Unger / Diallo

TC Project	Description	Technical Officer(s)
MYA/5/018	Enhancing the Lifetime Health and Performance of Offspring and Improving the Profitability of Livestock Production Systems Through Selective Breeding and Management of the Maternal Environment **Objective**: To improve livestock production and thereby increase profitability through improved management of the maternal environment and health care programmes; b) To train technicians in advanced technologies in the field of research and development, breeding, reproduction, dairy production, nutrition and waste management and train technical staff in livestock data analysis and data processing.	Garcia Podesta / Diallo / Unger
NER/5/013	An Integrated Approach for Improvement of Livestock Productivity **Objective**: To increase the productivity of livestock through implementation of an integrated programme dealing with nutrition and reproduction.	Odongo / Garcia Podesta / Diallo
PER/5/029	Genomics of the Alpaca: Identification of Expressed Genes and Genetic Markers Associated with Productivity and Embryonic Mortality **Objective**: To identify and characterize the factors associated with embryonic mortality in alpacas.	Garcia Podesta / Malek
RAF/5/055	Support to African Union's Regional Programmes for Control and Eradication of Major Epizootics **Objective**: To support within the framework of a strategic partnership with the African Union, the global effort of control and eradication of major trans-boundary animal diseases affecting livestock in the region led by the Inter-African Bureau for Animal Resources (AU/IBAR). This programme will aim at helping African countries to improve and produce livestock to ensure their role and participation in international markets that will lead to poverty alleviation and increased livelihoods. The specific objectives of the project are (i) to provide support to selected national veterinary laboratories to implement a quality assured disease control programme; (ii) to transfer appropriate and state-of-the-art technology to support diagnostic, surveillance and epidemiological activities relating to the control of major livestock diseases; and (iii) to support the establishment of a regional centre in Africa (Pan African Veterinary Vaccine Centre [PANVAC]) that would be responsible for (a) the production, assembly and distribution of diagnostic kits; (b) evaluating and monitoring the development of quality assured animal vaccines and (c) advising on the use of vaccines and vaccine strategies.	Viljoen / Lelenta
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.	Unger / Diallo
RER/5/015	Supporting Early Warning and Surveillance of Avian Influenza Infection in Wild and Domestic Birds and Assessing Genetic Markers for Bird Resistance **Objective**: To establish early bird flu diagnosis and assessment of genetic markers for AI resistance with nuclear molecular methods in the region of Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Montenegro, Serbia, Turkey, Uzbekistan, Kyrgyzstan and The Russian Federation.	Viljoen / Diallo
RLA/5/049	Integrated Control of Fascioliasis in Latin America (in support of National Programmes	Viljoen / Schaten
SIL/5/010	Improving the Productivity of Ndama Cattle In Sierra Leone **Objective**: To strengthen the diagnostic capacity to monitor and control animal diseases affecting cattle, (ii) to apply feeding strategies and supplementation packages, and (iii) to produce hydrids with greater potential for increased growth rate and milk yields.	Garcia Podesta / Odongo / Viljoen
SIL/5/011	Controlling Economically Important Livestock Diseases **Objective**: To design epidemiological surveys and adopt appropriate rapid laboratory techniques for the diagnosis of PPR and NCD in small ruminants and local chickens.	Unger

TC Project	Description	Technical Officer(s)
SRL/5/041	Maximizing Productivity on Goat Farms through Cost-Cutting and DNA-Based Technology in Selection for Breeding **Objective**: To improve the productivity of goats of small-holder farmers in Sri Lanka, by introducing new strategies such as supplementary feeding, improved management practices and disease control and by transferring genetic technologies to assist in proper selection of superior breeding animals.	Garcia Podesta / Odongo / Viljoen / Malek
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.	Kashyap (NAHU) / Unger
SUD/5/031	Setting up a National Network for the Control of Livestock Diseases that affect Exports **Objective**: To establish capacity to diagnose Brucellosis in ruminants to improve food safety and secure animal exports.	Unger
UGA/5/028	Improving the Capacity for Diagnostic of Animal Diseases **Objective**: To strengthen the diagnostic capacity of the Diagnostics and Epidemiology Laboratory of the Ministry of Agriculture, Animal Industry and fisheries to monitor and control transboundary animal diseases of importance (e.g. CBPP, FMD, AI, Rabies, Brucellosis and RVF) to Uganda.	Viljoen / Unger
UGA/5/030	Improving the Diagnostic Capacity in Animal Diseases (Phase II) **Objective**: To strengthen the diagnostic capacity of the National Animal Diseases Diagnostics and Epidemiology Laboratory in the detection of animal disease and food-borne pathogens including drug residues.	Unger / Luckins
URU/5/026	Increasing the Profitability of Dairy Producers by Improving Reproduction Efficiency, Rational Sustainable Use of Genetic Resources **Objective**: To implement integrated management strategies to improve the profitability of medium size grazing dairy farms by means of (a) integrated nutritional strategies; (b) strategic reproductive interventions; and (c) marker-assisted selection.	Garcia Podesta / Odongo
ZAM/5/025	Development of Feeding Strategies for Smallholder Dairy Animals in Njolwe and Palabana Dairy Tenant Schemes **Objective**: To improve household food security and income generation among small scale farmers through increased production and marketing of livestock by developing sustainable feeding and breeding strategies based on increased use of locally available resources.	Garcia Podesta / Odongo

Publications

Investigations into Human Serum Sensitivity Expressed by stocks of Trypanosoma brucei evansi

De-Hua Lai, Qiao-Ping Wanga, Zhi Li, A.G. Luckins, S.A. Reid, Zhao-Rong Lun

Trypanosoma brucei evansi, a widely distributed species of trypanosome infecting different livestock species in many countries in Africa, Asia and South America, has recently been reported as a pathogen causing a case of human trypanosomiasis in India. To date, there is little information regarding the natural resistance of animal-infective stocks of *T. b. evansi* to normal human serum (NHS). In this study, we investigated the degree of sensitivity to NHS of 15 stocks of *T. b. evansi* from different geographical origins and found that 10 of the stocks were completely susceptible to the action of NHS; parasites disappeared from the blood of infected mice within a few hours and the mice remained free from infection for more than 1 month. The remaining five stocks were partially resistant to NHS; although parasites initially disappeared from the circulation more than 50% of the mice showed relapse infection 10–18 days later. Studies on one stock, *T. b. evansi* STIB 810, showed that the changes in parasitaemia in the infected mice were correlated with the amount of NHS inoculated (correlation factor – 0.584 and P = 0.001). When this stock was passaged 25 times in mice in the presence of NHS it was found that the trypanosomes' serum resistance increased compared with the parent stock from which they were derived; 40% of the passaged parasites survived after *in vitro* incubation with 50% NHS for 7 h, while only 1% of individual trypanosomes of the parent stock survived under the same conditions. These findings show, to our knowledge for the first time, that human serum sensitivity varies amongst stocks of *T. b. evansi*, that some of them naturally display resistance to NHS and that, furthermore, *T. b. evansi* serum resistance can be increased by subpassage in the presence of NHS. *(International Journal for Parasitology (2010), 40: 705–710)*

Modelling Animal Systems: Evaluation of a Mechanistic Lactation Model using Cow, Goat and Sheep Data

J. Dijkstra, S. Lopez, A. Bannink, M.S. Dhanoa, E. Kebreab, N.E. Odongo, M.H. Fathi Nasri, U.K Behera, D. Hernandez-Ferrer and J. France

A mechanistic lactation model, based on a theory of mammary cell proliferation and cell death, was studied and compared to the equation of Wood (1967). Lactation curves of British Holstein Friesian cows (176 curves), Spanish Churra sheep (40 curves) and Spanish Murciano–Granadina goats (30 curves) were used for model evaluation. Both models were fitted in their original form using non-linear least squares estimation. The parameters were compared among species and among parity groups within species.

In general, both models provided highly significant fits to lactation data and described the data accurately. The mechanistic model performed well against Wood's 1967 equation (hereafter referred to as Wood's equation), resulting in smaller residual mean square values in more than two-thirds of the datasets investigated, and producing parameter estimates that allowed appropriate comparisons and noticeable trends attributed to shape. Using Akaike or Bayesian information criteria, goodness-of-fit with the mechanistic model was superior to that with Wood's equation for the cow lactation curves, with no significant differences between models when fitted to goat or sheep lactation curves.

The rate parameters of the mechanistic model, representing specific proliferation rate of mammary secretory cells at parturition, decay associated with reduction in cell proliferation capacity with time and specific death rate of mammary secretory cells, were smaller for primiparous than for multiparous cows. Greater lactation persistency of cows compared to goats and sheep, and decrease in persistency with parity, were shown to be represented by different values of the specific secretory cell death rate parameter in the mechanistic model. The plausible biological interpretation and fitting properties of the mechanistic model enable it to be used in complex models of whole-cow digestion and metabolism and as a tool in selection programmes and by dairy producers for management decisions. (*Journal of Agricultural Science Cambridge (2010), 148: 249–262*).

Identification of Selection Signatures in Cattle Breeds Selected for Dairy Production

A. Stella, P. Ajmone-Marsan, B. Lazzari and P.J. Boettcher

The genomics revolution has spurred the undertaking of HapMap studies of numerous species, allowing for population genomics to increase the understanding of how selection has created genetic differences between subspecies populations. The objectives of this study were (1) to develop an approach to detect signatures of selection in subsets of phenotypically similar breeds of livestock by comparing SNP diversity between the subset and a larger population, (2) to verify this method in breeds selected for simply-inherited traits, and (3) apply this method to the dairy breeds in the International Bovine HapMap (IBHM) study. The data consisted of genotypes for 32,689 SNP of 497 animals

from 19 breeds. For a given subset of breeds, the test statistic was the parametric composite log likelihood (CLL) of the differences in allelic frequencies between the subset and the IBHM for a sliding window of SNP. The null distribution was obtained by calculating CLL for 50,000 random subsets (per chromosome) of individuals. The validity of this approach was confirmed by obtaining extremely large CLL at the sites of causative variation for polled (BTA1) and black-coat-color (BTA18) phenotypes. Across the 30 bovine chromosomes, 699 putative selection signatures were detected. The largest CLL was on BTA6 and corresponded to KIT, which is responsible for the piebald phenotype present in four of the five dairy breeds. Potassium channel-related genes were at the site of the largest CLL on three chromosomes (BTA14, 16 and 25) whereas integrins (BTA18 and 19) and serine/arginine rich splicing factors (BTA20 and 23) each had the largest CLL on two chromosomes. Based on the results of this study, the application of population genomics to farm animals seems quite promising. Comparisons between breed groups have the potential to identify genomic regions influencing complex traits with no need for complex equipment and the collection of extensive phenotypic records and can contribute to the identification of candidate genes and to the understanding of the biological mechanisms controlling complex traits. Genetics published 17 May 2010, 10.1534/genetics.110.116111
http://www.genetics.org/cgi/content/abstract/genetics.110.116111v1

A global View of Livestock Biodiversity and Conservation — GLOBALDIV

P. Ajmone-Marsan and the GLOBALDIV Consortium (http://www.globaldiv.eu) [M. Malek]

GLOBALDIV — a global view of livestock biodiversity and conservation — is a three-year project funded by the European commission in the framework of the AGRI GEN RES Initiative. It is formed by a core group of partners who participated in past EU or continental scale projects on FARM Animal Genetic Resources characterization and conservation. It also involves a much larger number of experts that are actively contributing to success of the initiative. The project aims at improving the conservation, characterization, collection and utilization of genetic resources in agriculture in EU and beyond, complementing and promoting work undertaken in the Member States a the Community level and facilitating coordination of international undertakings on genetic resources in agriculture. (*Animal Genetics (2010) 41 (Suppl 1): 1–5)*

Genetic Diversity in Farm Animals — A Review

L.F. Groeneveld, J.A. Lenstra, H. Edling, M.A. Toro, B Scherf, D. Pilling, R. Negrini, E.K. Finlay, H. Jianlin, E. Groeneveld, S. Weigend. and the GLOBALDIV Consortium (http://www.globaldiv.eu) [M. Malek]

Domestication of livestock species and a long history of migrations, selection and adaptation have created an enormous variety of breeds. Conservation of these genetic resources relies on demographic characterization, recording of production environments and effective data within and across breeds and a reconstruction of the history of breeds and ancestral populations. This has been summarized for cattle, yak, water buffalo, sheep, goats, camelids, pigs, horses and chickens. Further progress is expected to benefit from advances in molecular technology. *(Animal Genetics (2010), 41 (Suppl 1): 6-31)*

Integrating Geo-referenced Multiscale and Multidisciplinary Data for the Management of Biodiversity in Livestock Genetic Resources

S. Joost, L. Colli, P.V. Baret, J.F. Garcia, P.J. Boettcher, M. Tixier-Boichard, P. Ajmone-Marsan and the GLOBALDIV Consortium (http://www.globaldiv.eu) [M. Malek]

In livestock genetic resource conservation decision making about conservation priorities is based on the simultaneous analysis of several different criteria that may contribute to long term sustainable breeding conditions, such as genetic and demographic characteristics, environmental conditions, and role of the breed in the local or regional economy. Here we address methods to integrate different data sets and highlight problems related to interdisciplinary comparisons. Data integration is based on the use of geographic coordinated and Geographic Information Systems (GIS). In addition to technical problems related to projection systems, GIS have to face the challenging issue of non homogeneous scale of their data sets. We give examples of the successful use of GIS for data integration and examine the risk of obtaining biased results when integrating datasets that have been captured at different scales. *(Animal Genetics (2010), 41 (Suppl 1): 47–63)*

Objectives, Criteria and Methods for Using Molecular Genetic Data in Priority Setting for Conservation of Animal Genetic Resources

P.J. Boettcher, M. Tixier-Boichard, M.A. Toro, H. Simianer, H. Eding, G. Gandini, S. Joost, D. Garcia, L. Colli, P. Ajmone-Marsan and the GLOBALDIV Consortium (http://www.globaldiv.eu) [M. Malek]

The genetic diversity of the world's livestock populations is decreasing, both within and across breeds. A wide variety of factors has contributed to the loss, replacement or genetic dilution of many local breeds. Genetic variability within the more common commercial breeds has been greatly decreased by selectively intense breeding programmes. Conservation of livestock genetic variability is thus important, especially when considering possible future changes in production environments. The world has more than 7500 livestock breeds and conservation of all of them is not feasible. Therefore, prioritization is needed. The objective of this article is to review the state of the art in approaches for prioritization of breeds for conservation, particularly those approaches that consider molecular genetic information, and to identify any shortcomings that may restrict their application. The Weitzman method was among the first and most well-known approaches for utilization of molecular genetic information in conservation prioritization. This approach balances diversity and extinction probability to yield an objective measure of conservation potential. However, this approach was designed for decision making across species and measures diversity as distinctiveness. For livestock, prioritization will most commonly be performed among breeds with species, so alternatives that measure diversity as co-ancestry (i.e. also within-breed variability) have been proposed. Although these methods are technically sound, their application has generally been limited to research studies; most existing conservation programmes have effectively primarily based decision on extinction risk. The development of user-friendly software incorporating these approaches may increase their rate of utilization. *(Animal Genetics (2010), 41 (Suppl 1): 64–77)*

Beta-escin has Potent Anti-allergic Efficacy and Reduces Allergic Airway Inflammation

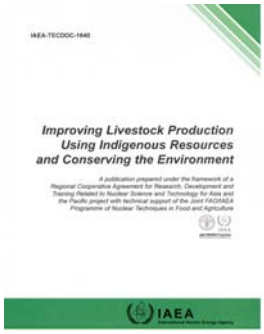
I. Lindner, C. Meier, A. Url, H. Unger, A. Grassauer, E. Prieschl-Grassauer and P. Doerfler

Type I hypersensitivity is characterized by the overreaction of the immune system against otherwise innocuous substances. It manifests as allergic rhinitis, allergic conjunctivitis, allergic asthma or atopic dermatitis if mast cells are activated in the respective organs. In case of systemic mast cell activation, life-threatening anaphylaxis may occur. Currently, type I hypersensitivities are treated either with glucocorticoids, anti-histamines, or mast cell stabilizers. Although these drugs exert a strong anti-allergic effect, their long term use may be problematic due to their side effects. In the course of a routine *in vitro* screening process, we identified beta-escin as a potentially anti-allergic compound. Here we tested beta-escin in two mouse models to confirm this anti-allergic effect *in vivo*. In a model of the early phase of allergic reactions, the murine passive cutaneous anaphylaxis model, beta-escin inhibited the effects of mast cell activation and degranulation in the skin and dose-dependently prevented the extravasation of fluids into the tissue. Beta-escin also significantly inhibited the late response after antigen challenge in a lung allergy model with ovalbumin-sensitized mice. Allergic airway inflammation was suppressed, which was exemplified by the reduction of leucocytes, eosinophils, IL-5 and IL-13 in the bronchoalveolar lavage fluid. Histopathological examinations further confirmed the reduced inflammation of the lung tissue. In both models, the inhibitory effect of betaescin was comparable to the benchmark dexamethasone. We demonstrated in two independent murine models of type I hypersensitivity that beta-escin has potent anti-allergic properties. These results and the excellent safety profile of beta-escin suggest a therapeutic potential of this compound for a novel treatment of allergic diseases. (*BMC Immunology (2010), 11:24*)

Recently Published

Improving Livestock Production Using Indigenous Resources and Conserving the Environment

IAEA-TECDOC-1640, Issued in March 2010



This publication contains research results presented by scientist during the final review meeting of the Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific (RCA) project entitled Integrated Approach for Improving Livestock Production using Indigenous Resources and conserving the Environment through better nutritional and reproduction strategies while conserving the environment.

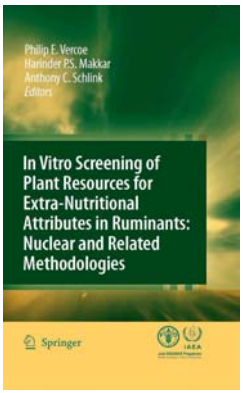
Selection and Breeding of Cattle and Buffalo in Asia: Strategies and Criteria for Improved Breeding.

IAEA-TECDOC-1620, Issued on 6 January 2010

This publication was produced in the framework of an IAEA technical cooperation project and presents the latest trends in livestock production and cattle breeding management in Asia. It includes information on traits for dairy and beef cattle, their selection criteria, and breeding objectives, proposed systems for operating a cattle breeding and genetic improvement programme in Asia, and an overview of current and future technologies for improvement of cattle breeding. The publication is intended for livestock specialists involved in all levels of cattle breeding in Asia, but also for representatives from agricultural ministries, universities, departments of livestock and veterinary services as well as public and private veterinarians and consultants.

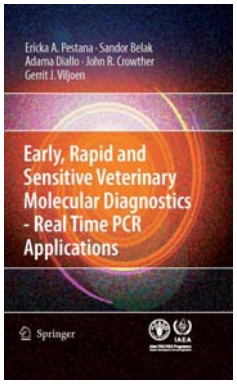
In vitro Screening of Plant Resources for Extranutritional Attributes in Ruminants: Nuclear and Related Methodologies

The aim of this manual is to provide a comprehensive guide to the methods involved in collecting, preparing and screening plants for bioactive properties for manipulating key ruminal fermentation pathways and against gastrointestinal pathogens. The manual will better equip the reader with methodological approaches to initiate screening programmes to test for bioactivity in native plants and find 'natural' alternatives to chemicals for manipulating ruminal fermentation and gut health. The manual provides isotopic and non-isotopic techniques to efficiently screen plants or plant parts for a range of potential bioactives for livestock production. Each chapter has been contributed by experts in the field and methods have been presented in a format that is easily reproducible in the laboratory. It is hoped that this manual will be of great value to students, researchers and those involved in developing efficient and environmentally friendly livestock production systems.



Veterinary Diagnostic Real-time PCR Handbook

This book gives a comprehensive account of the practical aspects of real time PCR and its application to veterinary diagnostic laboratories. The optimization of assays to help diagnose livestock diseases is stressed and exemplified through assembling standard operating procedures from many laboratory sources. Theoretical aspects of PCR are dealt with as well as quality control features necessary to maintain an assured testing system. The book will be helpful to all scientists involved in diagnostic applications of molecular techniques, but is designed primarily to offer developing country scientists a collection of working methods in a single source. The book is complimentary to the Molecular Diagnostic PCR Handbook published in 2005.



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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.
A new batch of CDs with a training package to help artificial insemination (AI) technicians to improve the performance of AI and field services provided to farmers was produced for users with a slow internet connection and is now available through the APHS. It is also accessible from the AP&H Section website:
http://www-naweb.iaea.org/nafa/aph/index.html

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