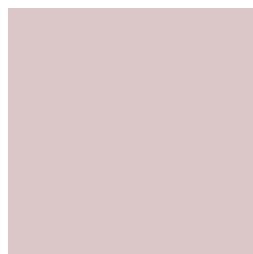
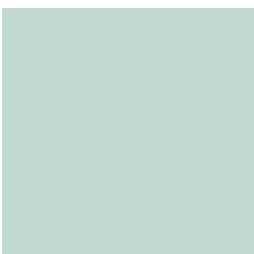
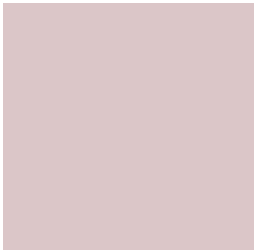


Training the Trainers-An Innovative and Successful Model for Capacity Building in Animal Genetic Resource Utilization in Sub-Saharan Africa and Asia





Training the Trainers—An Innovative
and Successful Model for Capacity
Building in Animal Genetic Resource
Utilization in Sub-Saharan Africa and
Asia

Ojango J.M.K.,^{1*} Malmfors B.,²
Mwai O.¹ and Philipsson J.²

¹International Livestock Research Institute (ILRI)
²Swedish University of Agricultural Sciences (SLU)

2011




Corresponding author: *Ojango J.M.K. j.ojango@cgiar.org

ILRI works with partners worldwide to help poor people keep their farm animals alive and productive, increase and sustain their livestock and farm productivity, and find profitable markets for their animal products. ILRI's headquarters are in Nairobi, Kenya; we have a principal campus in Addis Ababa, Ethiopia, and 14 offices in other regions of Africa and Asia. ILRI is part of the Consultative Group on International Agricultural Research (www.cgiar.org), which works to reduce hunger, poverty and environmental degradation in developing countries by generating and sharing relevant agricultural knowledge, technologies and policies.

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P O Box 30709, Nairobi 00100, Kenya
Phone + 254 20 422 3000
Email ILRI-Kenya@cgiar.org

P O Box 5689, Addis Ababa, Ethiopia
Phone + 251 11 617 2000
Email ILRI-Ethiopia@cgiar.org

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Abbreviations

ABG	Animal Breeding and Genetics
Afrib	African Breeders
AGTR	Animal Genetics Training Resource
AnGR	Animal Genetic Resources
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CAADP	Comprehensive Africa Agriculture Development Program
FARA	Forum for Agricultural research in Africa
FAO	Food and Agriculture Organization
GPA	Global Plan of Action
HEI	Higher Education Institutions
IAGRA	Indonesian Animal Genetic Resources & Breeder Association
ILRI	International Livestock Research Institute
MDG	Millennium Development Goals
NARS	National Agriculture Research Scientists
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organizations
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
SA	South Asia
SAARC	South Asian Association for Regional Cooperation
SADC	Southern African Development Community
SEA	South-East Asia
Sida	Swedish International Development Cooperation Agency
SLU	Swedish University of Agricultural Sciences
SSA	Sub-Saharan Africa



Acknowledgements

This report was made possible through the contributions, support and feedback from all the national scientists and researchers in developing countries that have been actively involved in the ILRI-SLU project activities. Invaluable advice and inputs provided by the FAO Animal Genetic Resources group are gratefully acknowledged.

We also extend our thanks to all the countries that have participated and hosted activities of the ILRI-SLU project, and to various peer reviewers and commentators.

Guidance and contributions by K. Bromham in the drafting and editing of this report is greatly appreciated.

Financial support to ILRI by Sida (Swedish International Development Cooperation Agency) has enabled ILRI to run this capacity building project in collaboration with SLU and to produce this report. This is highly appreciated.



Brief

Since 1999, the International Livestock Research Institute (ILRI) in partnership with the Swedish University of Agricultural Sciences (SLU) have been providing capacity building on the sustainable use of Animal Genetic Resources (AnGR) through the novel approach of “training the trainers”.

Scientists from 46 developing countries in Sub-Saharan Africa and Asia have been trained on animal breeding and genetics developments, implementation of breeding strategies, and on teaching and communication methods.

Livestock accounts on average for about 30% of the agricultural GDP in developing countries, yet the productivity of many livestock populations is inadequate due to a complexity of factors. The genetic variability between and within species and breeds is largely unexploited at the same time as a continuous loss of genetic diversity takes place. Livestock productivity must increase to meet the projected demand for doubled meat and milk production within a few decades in developing countries, while minimizing environmental impact. These challenges require highly skilled people to lead the development in the desired direction. Unfortunately, developing countries suffer from a shortage of trained people, not least in the area of animal breeding and genetics, both at research and higher education institutions and in organizations responsible for livestock development.

It is in this context that the ILRI-SLU project has developed its philosophy of “training the trainers” to effectively multiply knowledge and concepts to new generations of students, researchers and policy makers. This synthesis report provides insights and reflections on the project’s outputs and outcomes, and informs on the ways forward in terms of further investment in developing and strengthening human capacity in the field of AnGR.

A decorative graphic consisting of several small squares in shades of green and maroon, arranged in a cluster to the left of the word 'Background'.

Background

The role of livestock in developing countries

Domestic livestock production is crucial for sustainable agricultural production systems and for future food security and poverty alleviation in developing countries.

“Livestock contribute 40% of the global value of agricultural output and support the livelihoods and food security of almost a billion people” (FAO, 2010). The livestock sector is one of the most dynamic sectors of the agricultural economy. It has expanded rapidly in recent decades and the demand for livestock products is expected to continue growing strongly, driven by population growth, rising affluence and urbanization (FAO, 2009).

The World Bank Development Report (World Bank, 2008) and FAO Report on the State of Food and Agriculture: Livestock in the Balance (FAO, 2009) clearly indicate that farm Animal Genetic Resources (AnGR) play a crucial and multi-faceted role in supporting agricultural production systems in developing countries. AnGR contribute to livelihoods by providing nutrients, draft power, socio-cultural needs of households and communities, and food security (Rege et al., 2011). Within these countries, a diversity of species and breeds is found, however, their potential has neither been fully explored nor exploited. In addition, outputs from individual animals are kept low due to harsh climates, inadequate feed resources, diseases, inappropriate breeding practices, unfavourable policies and poor infrastructure (Seré et al., 2008).

The demand for domestic livestock as a food source in developing countries, dubbed the *livestock revolution* (Delgado et al., 1999a; Delgado et al., 1999b) is still increasing more rapidly than production levels. This provides a real need for information and understanding of AnGR, with a shift in emphasis from increasing the number of

animals to improving the productivity per animal, so as to lessen their impacts on the environment, and control competitions with the human population (Philipsson and Okeyo, 2006; Rege et al., 2011). The Global Plan of Action, as internationally agreed upon in the Interlaken Declaration (FAO, 2007b), stresses the need for improved productivity and long-term breeding strategies to enable sustainable management of livestock.

The livestock revolution in developing countries is projected to continue beyond 2020 and will increasingly drive world markets for meat, milk and feed grains to ensure favourable growth, poverty alleviation and preservation of the environment. Public investments that facilitate economic, sustainable, and small-operator forms of market-oriented livestock production are required (Delgado et al., 2001).

Actions needed for conservation and development of sustainable livestock breeding programmes

Approximately 20% of the world's livestock breeds, most of which are only found in developing countries are currently under threat of extinction. No effective conservation programs are in place for more than 75% of these threatened breeds. FAO emphasises the need to conserve the world's biological diversity, including farm AnGR, for present and future use (FAO, 2007a, 2007b). However, conservation is not enough. The livestock populations must continuously improve their productivity by means of both genetic and management interventions to meet future demands of food while minimizing the environmental impact.

In 2001, FAO invited all member countries to submit reports on the status and trends of their animal genetic resources; the current and potential contributions of farm animals to food, agriculture and rural development; and the state of national capacity to manage these resources; and provide priority action lists (FAO, 2007a). The reports submitted demonstrated the significant and irreplaceable contribution of farm animal biodiversity to food security and development of nations. It was, however, also clear that the full potential of AnGR was far from being realized and confirmed the serious erosion of genetic diversity in both developed and developing countries.

Three broad groups of threats to AnGR distinguished in the State of the World AnGR (FAO, 2007a) were: *i.* unfavourable livestock-sector trends: economic, social and policy

factors; *ii.* disasters and emergencies; and *iii.* epidemics and lack of disease control measures. In addition, within developing countries, the breeding and crossbreeding of high-yielding exotic livestock breeds with indigenous livestock breeds, though with the intention of increasing productivity, has contributed to the erosion of indigenous genetic resources and loss of some breeds (FAO, 2007a; Hanotte et al., 2010; Rege et al., 2011). However, opportunities do exist for utilizing more productive genotypes in developing countries, so long as such genotypes are better matched to prevailing production systems (Philipsson and Okeyo, 2006; Rege et al., 2011).

Databases and systems for inventory, characterization, conservation, monitoring of population trends and threats, as well as evaluation and genetic improvement of the AnGR are currently either non-existent or inadequate in developing countries (Kosgey et al., 2011). Supportive and effective institutions, policies and infrastructure are highly needed. Solutions to the various challenges within countries will only come from people within these countries ready to make a difference.

The livestock sector in developing countries requires renewed attention and investment from the agricultural research and development communities and robust institutional and governance mechanisms that reflect the diversity within the sector. The sector can contribute more effectively to improving food security and reducing poverty, but policy measures are required to ensure that it does so in ways that are environmentally sustainable and safe for human health (FAO, 2009).

Based on the SoW AnGR report of the FAO(2007a) four strategic priorities for action were identified and adopted into the Global Plan of Action for AnGR (Box 1).

Box 1:

Strategic Priority Areas in the Global Plan of Action for AnGR

- 1: Characterization, Inventory and Monitoring of Trends and Associated Risks
- 2: Sustainable Use and Development
- 3: Conservation
- 4: Policies, Institutions and Capacity-building

(Source: FAO, 2007b)

Human capacity building required

Sustaining socio-economic growth in developing countries in the backdrop of recent economic challenges for nations dependent upon agriculture demands a dynamic human capital: *knowledgeable, flexible, innovative, passionate and able to adapt technologies to local realities* (Adipala et al., 2009). However, many developing countries lack the technical, physical, institutional and sustainable finance and human resource capacities to design and implement conservation and breeding programs for AnGR (Rege et al., 2011). Limited trained personnel—both in terms of numbers and in skills—are also a major impediment (Mwai et al., 2005).

The pace of global scientific progress and development of *new knowledge* increase rapidly – not least in animal breeding and genetics. Each graduate with either a BSc, MSc or PhD degree must continuously update his/her knowledge and skills (Figure 1). Possibilities for continuing education and refresher training courses (not just for students, but also for faculties) are even more critical to developing countries, where access to the Internet and scientific journals is often quite limited.

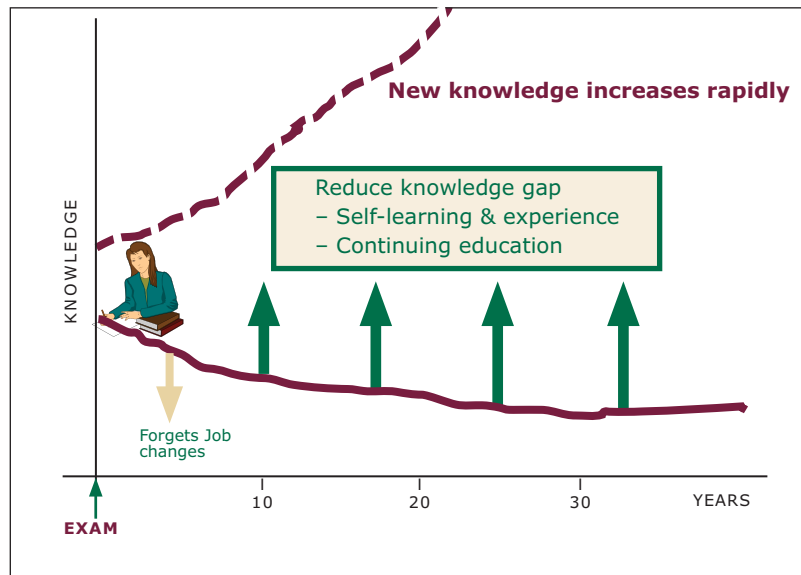


Figure 1. Life-long learning is a necessity

Developing countries need to devote attention to establishing and building up the relevant institutions in order to increase the impact of agricultural productivity and achieve sustainable use, development and conservation of AnGR. In addition, the development of innovative platforms to support and disseminate technology generation, and a strong human resource base are required to “spur” innovation (Adipala and Blackie, 2010; Batte et al., 2010; FARA, 2010). Greater investments to “link research, education and outreach to development activities” are required (FARA, 2010). Developing countries need to adopt and implement appropriate policies and effective regulatory frameworks, as well as build and strengthen the required human capacity (CAADP; FAO, 2007b; FARA, 2010). The intensification of human capital development for agricultural research development by means of regional capacity strengthening and scaling up of initiatives is paramount for these countries to be able to implement changes that would facilitate their progress in addressing the Millennium Development Goal (MDG) of halving poverty by 2015 (UN Millennium Project, 2004).

One of the most cost-effective ways of creating the critical mass of trained individuals required in any field is to implement programmes within the developing countries, responding to the situation and needs of both the existing and the perceived future industry. National universities and agricultural research institutes are the primary source of current and future generations of researchers, teachers, extension personnel and policy makers and are therefore the ‘engines’ in capacity building for sustainable food production in developing countries. The field of Animal Breeding and Genetics (ABG), notably sustainable breeding programmes and conservation of AnGR, needs to be given greater emphasis in university curricula. Additionally, methods of teaching need increased attention as students often find ABG difficult to understand. National Agricultural Research Scientists (NARS) need opportunities to strengthen both their subject knowledge and their didactic skills.

A prohibitive factor to consider in training students and the continued education of their teachers is that most university literature is produced in and for the developed part of the world, and is not adapted to issues relevant for low input systems often found in developing countries. There is thus also a great need for development of course materials adapted to the tropics and prevailing developing country situations.

To promote a sustainable and improved use of AnGR in developing countries, ILRI (International Livestock Research Institute) - in collaboration with SLU (Swedish University of Agricultural Sciences) and supported by Sida (Sweden) – launched a project in 1999 aiming at strengthening higher education (teaching and research) in ABG. The project activities and the achievements from the start to 2010 are presented in this report.





The ILRI-SLU capacity building project: A novel approach

The project “Capacity Building for Sustainable Use of Animal Genetic Resources in Developing Countries” is an integrated component of the ILRI research agenda on improving management of AnGR, and the SLU agenda for human capacity development.

It also provides opportunities for collaboration with and strengthening of NARS institutions and scientists in the area of ABG and in communication and teaching skills (Malmfors et al., 2002; Mwai et al., 2005; Ojango et al., 2009).

Project concept and objectives

The main concept of the ILRI-SLU project is based on the principle ‘**Training the Trainers**’, primarily targeting national university lecturers and researchers in developing countries who are actively involved in teaching and supervising research in ABG.

Training the trainers is assumed to have a large impact because each teacher/researcher given refresher training within the project should, with the improved knowledge, awareness and skills, reach out to a large number of students, and also to colleagues, in their home institutions. The effect is thereby effectively multiplied (Figure 2).

One of the greatest advantages of “training the trainers” is that it contributes towards sustainability by creating a pool of regional experts who can take the training further incorporating regional perspectives. Today’s university students are tomorrow’s researchers, lecturers, animal breeders and policy makers: through enhancing the knowledge base of trainers, students will be better equipped to rise to the challenge of the need to effectively utilize AnGR within their countries.

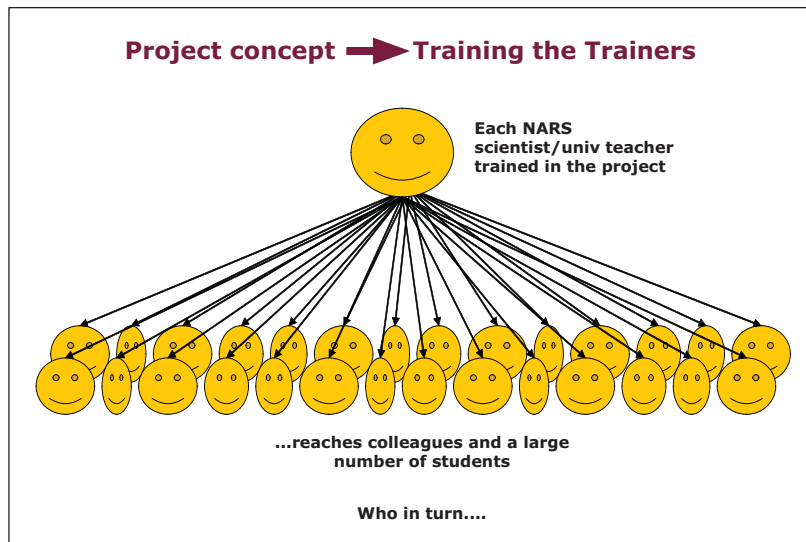


Figure 2. Illustration of concept of the ILRI-SLU capacity building project

The overall aim of the ILRI-SLU project and approach is to contribute to food security and poverty alleviation, specifically by achieving the following objectives:

- 1) Strengthen subject knowledge and skills of NARS scientists in teaching, research and supervision of animal breeding and genetics;
- 2) Strengthen communication skills of these teachers and researchers;
- 3) Catalyze curriculum development, review of course contents, and use of new and expanded teaching methods in university education;
- 4) Develop computer-based training resources relevant for use by NARS teachers and researchers;
- 5) Stimulate contacts and exchange of experiences and ideas between teachers/researchers from developing countries on research and training of students in ABG; and
- 6) Strengthen the human capacity base for work on AnGR in developing countries.

The project commenced in 1999. In the same year, FAO received the mandate from the Commission on Genetic Resources for Food and Agriculture to support a country-driven state of the world process, leading to the launch in 2007 of the State of the World's AnGR (FAO, 2007a) and the adoption of the Global Plan of Action for Animal Genetic Resources (FAO, 2007b) by all FAO member countries. An overview of the project model is presented in Figure 3.

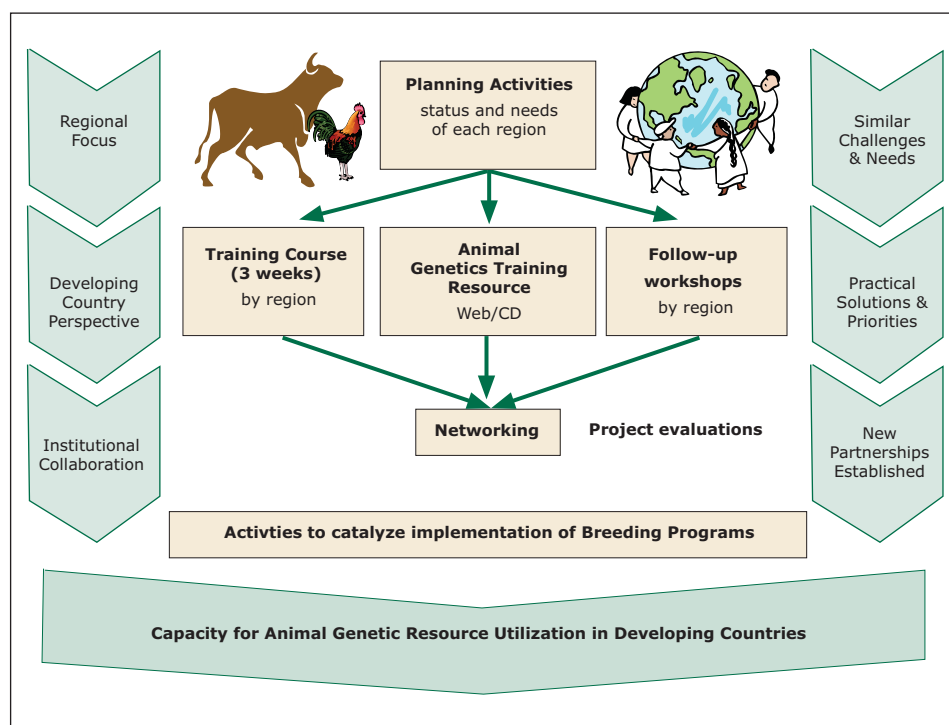


Figure 3. Overview of the ILRI-SLU Project

By design, the ILRI-SLU project had a regional focus i.e. Sub-Saharan Africa (SSA – divided into East-South and West-Central sub-regions); South-East Asia (SEA); South Asia (SA); and Latin America (LA). Unfortunately, language constraints in Latin America (Spanish and Portuguese) made it prohibitively expensive to include that region in the project. Focus was put on the African and Asian regions with a possible re-visiting of the Latin American region at a later date.

An advantage of the ILRI-SLU capacity building model is that once refined it can be replicated and extended to a number of different disciplines in the field of scientific research and study.

Funding

Funding for this project was provided by the Swedish International Development Cooperation Agency (Sida), a government agency under the Ministry of Foreign Affairs, Sweden.

Sida's goal is to contribute to making it possible for poor people to improve their living conditions (<http://www.sida.se/English/>). In order to solve the major challenges of our era – poverty, environmental degradation, and conflict – great collaborative efforts are necessary. The specific pathways to achieve this include support of economic growth and reforms, research, education and health, human rights and democracy, and humanitarian aid, as well as long-term sustainable use of natural resources and protection of the environment.

Sida's task is to create conditions conducive to change and sustainable development, while partner countries remain responsible for their own development. Sida thus contributes resources and develops skills and competence and its activities span a wide variety of fields. The agency is characterized by a holistic approach, clarity and adaptability.

The way in which Sida provided the funding for the capacity building project for sustainable use of AnGR in developing countries was unique in the following aspects:

- It allowed ILRI to expand its research agenda on AnGR with a related capacity building program in partnership with SLU;
- Long-term outlook, providing an opportunity for adequate planning and follow-up;

- *Flexibility*, allowing the team to make innovative changes depending on the needs identified in various countries. Flexibility also enabled the team to make changes to schedules when countries were faced with challenges beyond the control of the project (e.g., the tsunami in Asia; violence in Kenya);
- *Adoptability*, the generic principle 'training the trainers' and strategy adopted by the team could serve as a model to be applied by any CGIAR centre or research institution;
- Provided opportunities for enhancing partnerships through *short-term exchanges and visits*, and support for graduate students;
- *Joint teaching and research* on projects that addressed the ILRI agenda and involved SLU scientists.

Box 2:

Comment on Project

"In comparison to other projects, this project is configured as a long-term project with a monitoring and evaluation component. This is highly appreciated as it allows for learning within the project. I think in future, outcome and impact monitoring will become even more important."

Irene Hoffmann, Animal Production and Health Division, FAO

Project team

The project was first conceived by Dr Michael Smalley and Dr Birgitta Malmfors of ILRI and SLU, respectively, and funding approved by Sida in 1999.

The core project team consists of:

ILRI: Dr Julie Ojango (project leader) and Dr Mwai Okeyo
Web development: Daniel Haile-Michael and
Apollo Habtamu and Emaelaf Kebede

SLU: Dr Birgitta Malmfors (project leader) and Dr Jan Philipsson

The following persons also made major contributions to the project:

ILRI: Drs Michael Smalley, Ed Rege, Olivier Hanotte,
Habib Ibrahim and Ntombizakhe Mpofu, as well as
Mr Richard Fulss and Asefa Senai (web development)

SLU: Dr Lena Andersson-Eklund

Participation of scientists of many NARS in sub-Saharan Africa, South Asia and South-East Asia has been essential, as well as the support from the Food and Agriculture Organization of the United Nations (FAO), and the contribution by reviewers of materials produced in the project.





Main activities of the ILRI-SLU capacity building project

The ILRI-SLU capacity building project was designed to directly target NARS scientists in developing countries who are responsible for research on and training of animal breeding and genetics.

Planning activities

Much emphasis was given to planning activities to involve the target groups in each region from the beginning, and to assess conditions with regard to AnGR, human capacity, higher education, research and farm practices.

Questionnaires and country visits

A questionnaire was the first tool used to solicit information and interest in the project from higher education institutions and research institutes. Within each of the three-targeted regions (SSA, SEA, SA), questionnaires were sent to all institutions in each country involved in post-graduate training (MSc, PhD) and research in animal breeding and genetics (ABG). These questionnaires covered a broad range of topics related to ABG (i.e., number and qualifications of the teaching staff, courses and course contents, teaching methods and materials, availability of lab facilities and computers for teaching, and number of students, etc.).

In addition to the questionnaire, the project team carried out a number of “ground-truthing” country visits to further enhance their understanding of the local production systems and assess the real AnGR needs and requirements of the higher education institutions and research institutes. Countries visited are listed in Table 1. The responses from questionnaires and information gleaned during country visits were collated and used to inform the subsequent development of the training activities and materials.

Table 1. Countries visited by ILRI-SLU project team

<i>Sub-Saharan Africa</i>	<i>Southeast Asia</i>
Ethiopia	Lao PDR
Ghana	Malaysia
Kenya	South China
Lesotho	Thailand
Senegal	Vietnam
South Africa	<i>South Asia</i>
Tanzania	Bangladesh
Uganda	India
Zimbabwe	Nepal
	Sri Lanka

From the questionnaires and country visits to Sub-Saharan Africa, Southeast Asia and South Asia, constraints in AnGR training that were identified are presented in Box 3. It should be noted, however, that every constraint listed is not relevant for every country included in the planning activities.

Further details on the design and format of planning activities are outlined in an earlier report on the project by Mwai et al. (2005).

Planning workshop

Following the country visits, a three-day planning workshop was organised for each region. Participants were the key individuals in positions of authority in AnGR from the regional countries, the FAO regional representative and the ILRI-SLU project team. Through a facilitated process, the ILRI-SLU project provided equal opportunities for workshop participants to contribute to the regional planning and supported their travel and accommodation. The purpose of the planning workshops was to:

- Assess the strengths and weaknesses, and opportunities and constraints of higher education institutions and research institutions in AnGR within the target regions;

Box 3:

Constraints in AnGR training and research within countries in SSA, SEA and SA

Staff

Very few lecturers teaching animal breeding and genetics
Inadequate skills in the areas of biometrics, applications of molecular methods, and the design of sustainable breeding programs

No formal training in teaching methods, pedagogies, and science communication

Facilities

Scarce to no equipment for training

Limited availability of computers, No or limited Internet connectivity

Limited access to scientific journals and up-to-date textbooks

Limited access to information on AnGR relevant to developing countries

Teaching

Heavy teaching loads and large (BSc) class sizes

Very low numbers of students at the MSc level

Huge variation in the quality and relevance of course contents and curricula offered

Lectures with little or no practical classes

Research

Weak research-industry linkages

Poor or no national animal performance and pedigree data recording systems

Lack of data for research

Collaboration

Need for collaboration between higher education institutions, research and extension institutions within and between countries
Separation of teaching and research institutions within countries hindered collaboration

- Assess existing human capacity levels, teaching resources and ongoing research in AnGR; and
- Identify the interests and scope in strengthening knowledge and skills among NARS teachers/researchers.

In total, 4 such workshops have been held. Workshop discussions centred on the responses and comments obtained from the questionnaires and country visits. The workshops also provided platforms for discussions on what the training course content should include, as well as the criteria to be used in selecting possible participants for the planned training courses. Additionally, training resources for ABG and possible contributions from each region to case studies and breed information were discussed.

Training course on animal genetic resources and communication

The regional three-week training courses for university teachers and researchers facilitated by the core project team were pivotal for success of the ILRI-SLU AnGR capacity building project. The courses provided the means for creating awareness about the needs and strategies for improving higher education and research in the field of AnGR in developing countries. To ensure the courses were regionally responsive, representatives from regional organizations working on AnGR were invited to present on-going activities, areas of need and opportunities available within each region. The FAO AnGR team also actively participated and provided information on their AnGR related activities and the intergovernmental processes involved, particularly on how they link to specific countries and regions, including the areas that need collaboration. Objectives for the training course are presented in Table 2.



Table 2. *Main objectives of the ILRI-SLU training course*

- Share current principles of animal breeding and sustainable breeding programmes
- Increase exposure to appropriate experimental designs and statistical methods in livestock improvement
- Share new information, techniques and potential applications of molecular genetics
- Provide guidelines on effective use of modern information and communication technologies
- Enhance skills in communication, teaching and dissemination of scientific information
- Share and discuss current knowledge and understanding of animal genetic resources, their characterization and sustainable utilization

In order to achieve the objectives, the courses were carefully structured and comprised the following contents:

1. The importance and role of AnGR for sustainable agriculture in developing countries;
2. Characterization of indigenous farm animal genetic resources and design of sustainable breeding programs;
3. Methods for genetic and statistical analysis in teaching and research;
4. Computer exercises: use of software, databases and internet searches;
5. Group project work on the design of programs for conservation and sustainable use of indigenous breeds;
6. Field visits;

7. Teaching methods, including aspects on teaching and learning, examination methods, supervision of students' research, and how to stimulate educational development in universities;
8. Written and oral communication in the sciences, such as writing skills (scientific writing, popular science, research proposals), oral presentations and posters; and
9. A review of the structure and content of the training resources being developed by the project.

During the training, lecture notes, training CD's and reports relevant to AnGR produced by ILRI and FAO were distributed to course participants. The combination of subjects in ABG with teaching and communication methods was distinctive for the course. Additionally, the interactive approach adopted provided unique opportunities for discussion and exchange of ideas and experiences.

The countries represented in training courses from the targeted regions over the years are presented in Figure 4. Venues for the courses and the numbers of participants trained are presented in Table 3.

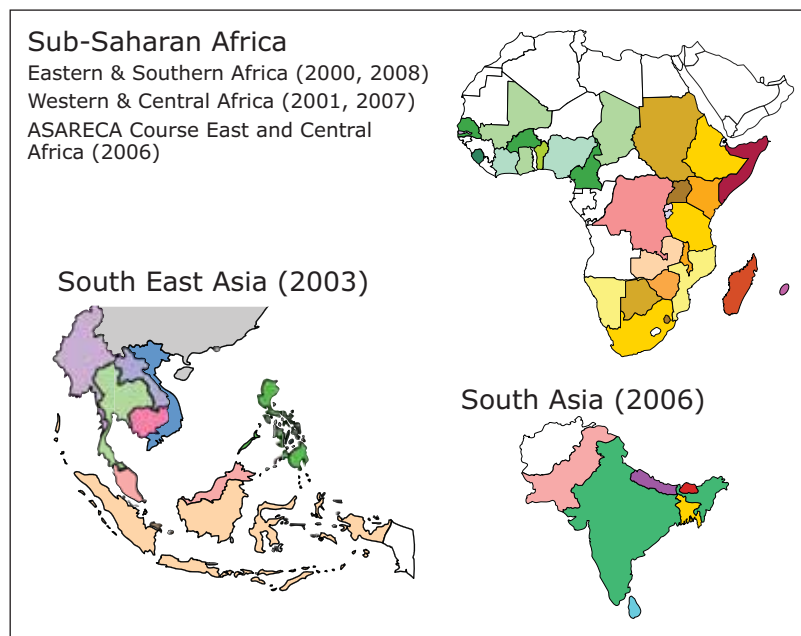


Figure 4. Countries represented (shaded) in the training courses given in the period 2000-2008

Table 3. *Regions, venues and number of people trained in the project 2000-2010*

<i>Region</i>	<i>Training courses: Year</i>	<i>Follow-up workshops: Year</i>
East and Southern Africa	2000: 20 participants from 10 countries ILRI -Addis Ababa, Ethiopia 2008: 23 participants from 14 countries ILRI -Addis Ababa, Ethiopia	2003: 20 participants from 18 countries in SSA (joint workshop for participants from the 2000 & 2001 courses ILRI -Addis Ababa, Ethiopia
West and Central Africa	2001: 18 Participants from 10 countries ILRI -Addis Ababa, Ethiopia 2007: 20 participants from 9 countries ILRI -Addis Ababa, Ethiopia	2003: SSA workshop (see above)
South East Asia	2003: 18 participants from 9 countries Kasetsart University, Bangkok, Thailand	2005:18 participants from 9 countries University of Putra, Serdang, Selangor, Malaysia
South Asia	2006: 20 Participants from 6 countries Kandy, Sri Lanka	2009: 19 participants from 6 countries Kathmandu, Nepal
Requested training by ASARECA	2006: 19 Participants from 9 countries ILRI -Addis Ababa, Ethiopia	

National as well as regional cooperation on both educational and research aspects on AnGR was promoted, as in most cases scientists from both a university and a research institute of the same country participated in each course.

Course evaluations show that the participants found the training course to be very useful, giving it an overall rank of 8.5 out of 9 points (Table 4)

Table 4. Average score for 'Overall impression' in participants' evaluation of the training course given in different regions and years (grading scale 1–9, where 9=very useful)

Eastern/Southern Africa		Western/Central Africa		East/Central Africa ¹	South-East Asia	South Asia
2000	2008	2001	2007	2006	2003	2006
7.7	8.9	8.5	8.8	8.4	8.4	8.7

¹ASARECA course on request

Further details related to implementation of the training course are outlined in Mwai et al. (2005).

Development of Animal Genetics Training Resource (AGTR)

An essential component and output of the ILRI-SLU project has been the development of a computer-based training resource, the Animal Genetics Training Resource (AGTR), available at: <http://AGTR.ilri.cgiar.org> and on CD from ILRI. The AGTR is a unique, 'one stop', user-friendly, interactive, multimedia resource, primarily targeted at researchers and scientists teaching and carrying out research in ABG. It is a dynamic training resource designed to help strengthen the capacity of NARS; inform the design and implementation of breeding programmes; and provide information that will empower countries and institutions to undertake their own research and apply available information and knowledge. It covers established and rapidly developing areas, such as genetic based technologies and their application in livestock breeding programmes.

Core to the AGTR are Modules on:

1. Global perspectives on animal genetic resources for sustainable agriculture and food production;
2. Improving our knowledge of tropical indigenous animal genetic resources;
3. Sustainable breeding programmes for tropical farming systems;

4. Quantitative methods to improve the understanding and utilisation of animal genetic resources; and
5. Teaching methods and science communication.

The modules are supported by over 40 case studies that summarize real-life experiences and capture indigenous knowledge and lessons learnt from developing countries. The case studies also illustrate principles and/or methodologies commonly applied in animal genetics, from real-life situations and highlight knowledge gaps appropriate for post-graduate theses or further research. A linked breed information tool incorporates all the breeds highlighted in the modules/case studies. Practical examples, exercises, compendia, a library with full-text articles in ABG, and links to relevant web resources are included.

The AGTR also has links to many other information sources on and related to AnGR, including the Domestic Animal Genetic Resources Information System (DAGRIS: <http://dagris.ilri.cgiar.org>) and the Domestic Animal Diversity Information System (DAD-IS: <http://dad.fao.org>). A high quality and accuracy of the contents of the AGTR is assured through an external review process by subject matter specialists.



Figure 5. Progression of the Animal Genetics Training Resource

The first version of the AGTR was released as a CD in October 2003. It included the first versions of the five training modules, case studies and breed information focused on livestock breeds mainly in Africa and to a small extent in Asia. It also included a few exercises, two video clips and a library of 50 documents. Links were given to some relevant web-resources. The CD was distributed free of charge to institutions carrying out teaching and research on ABG in Africa and Asia, and to all participants of the ILRI-SLU courses and workshops.

The second version of AGTR, released in 2006, was more expansive and comprehensive than Version 1. It was made available both as a CD and on the Web, and included additional information for Asia as well as for Africa. In general, modifications to Version 2 included: updating the core modules 1-4 with new and relevant information in ABG, and adding sections on teaching & science communication to module 5; new case studies and information on livestock breeds from Asia; several maps on the global distribution of livestock, and poverty levels; increased exercises, examples on statistical analyses and compendia; an additional 65 documents to the library; more terms in the Animal Genetics Glossary. Two thousand copies of Version 2 CD of the AGTR were produced and distributed to participants in ILRI-SLU activities, institutions carrying out teaching and research on ABG developing countries and other users.

Version 3 was launched in November 2011 on a fully Web-enabled platform, which allows for direct online revisions and content comments by authors. A CD version of AGTR 3 will be prepared in 2012. Significant changes have been made to the content of the Modules. All of the case studies in Version 2 were reviewed by external reviewers and subsequently revised, and new case studies have been added. Software manuals for word processing and presentation have been updated, and an example of using the statistical software 'R' (freely available) has been added. Other sections of the AGTR have also been improved by providing direct links to the Web on maps where available, and extending the library to a total of 121 documents. Links to other relevant web resources with special emphasis on those that are available at no cost, have been revised and updated. The greatly enhanced multimedia section now includes links to film and clips by ILRI, as well as pictures of numerous livestock breeds. Further additions have been made to the Animal Genetics Glossary to cover 121 terms, and links have been made to a Glossary developed by INTERBULL.

Follow-up activities

In order to monitor the project's progress and impacts on AnGR related activities within the regions targeted, follow-up of individual course participants are carried out using questionnaires and workshops for feedback. The questionnaires cover aspects on teaching, research and networking.

Two types of workshop were organized:

- A) *Follow-up Workshop* for previous course participants after about three years to share the experiences, impacts and outcomes from the training course; discuss the next key strategic steps that need to be taken to enable improved/optimal utilization of AnGR; identify priority areas for research teaching and curriculum development; and explore opportunities for future collaboration. To date, three such workshops have been held, one for Sub-Saharan Africa, one for South East Asia, and one for South Asia. Numbers of participants and venues are presented in Table 3.
- B) *Regional Outreach Workshop* focusing on institutional issues and development of innovative frameworks for sustainable use of AnGR. Outreach workshops involve a broad group of stakeholders in AnGR within a region together with participants from the ILRI-SLU training courses. The objectives are to:
 - Collate and share information on institutional programmes related to AnGR and animal identification and recording, and identify priority interventions to improve utilization of AnGR
 - Identify opportunities for collaborative research to support and transform development, working with both national and regional institutions to deliver sustainable livestock breeding services.

In 2007, a workshop was held to share experiences of the on-going project and to discuss future directions and possible collaborations for capacity building in AnGR, and in 2009 an outreach workshop was held for East and Southern Africa.



Outcomes of the project to-date

For purposes of this document, outcomes refer to the extent and kinds of impact the project has on its participants with impact being measured by the amount of change in behaviour, attitude, skills, and knowledge of project participants.

Many of the project's outcomes are a direct result of the collaborative processes that are at the very heart of the ILRI-SLU AnGR project. Given its numerous and diverse partners – ILRI, SLU, FAO and NARS in Sub-Saharan Africa, South Asia and Southeast Asia – the project has developed a targeted training programme with resources primarily designed for use in developing countries, but also contribute to broadening the knowledge base on AnGR of scientists in more developed countries.

The ILRI-SLU AnGR capacity training program at the time of this report has provided training to 138 university lecturers and researchers across 46 countries in Africa and Asia.

The outcomes of the ILRI-SLU project are graphically presented to show the principal components and their interactions to achieve the ultimate goals of sustainable utilization of animal genetic resources for enhanced food security and improved livelihoods in Figure 6.

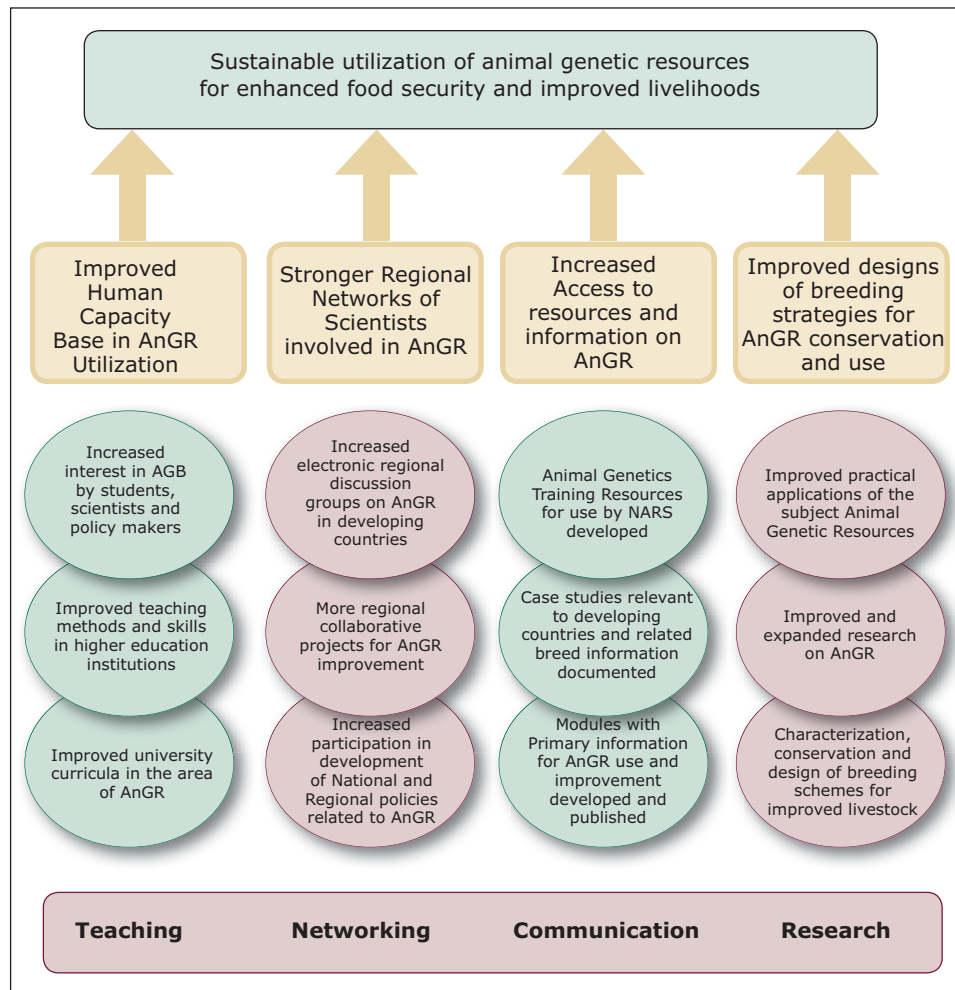


Figure 6. Key outcomes from ILRI-SLU Project

Outcomes aligning with the CGIAR agenda

The ILRI-SLU project contributes to two CGIAR priorities: (1C) the conservation of indigenous livestock and (5A) capacity building and knowledge management.

As a result, the project has strengthened the knowledge of livestock genetics in most developing countries in SSA and South and South-East Asia, as well as provided tools to teach and communicate the subject matter of AnGR in a powerful and effective manner.

As a result of the knowledge gained from the AnGR training, participants report improved research proposal writing and development of more competitive proposals. They also report greatly improved scientific communication skills evidenced by more papers being submitted and more papers being accepted for publication. Several participants have also been awarded for good oral presentations and posters. Additionally, following the training courses participants have been increasingly involved in research projects as researchers, co-ordinators and supervisors. There has also been an increased enrolment in PhD programs by course participants (Table 5).

Table 5. *Number of participants undertaking PhD in animal genetics and breeding following the ILRI-SLU training course*

Region	Number with PhD after training course		Number of scientific publications after training course
	On-going	Completed	
East and Southern Africa	5	2	25
West and Central Africa	4	2	21
South-East Asia		2	43
South Asia	3		77

The AGTR, primarily developed to consider knowledge adapted for use in developing countries, has been extensively used by many scientists, both course participants and their colleagues. It has been used for teaching purposes as well as for advice on research and as guidelines for development of livestock breeding policies and conservation and breeding programmes. The resource has also been adopted as the key animal breeding course material for courses on Tropical Animal Production in the developed part of the world.

Development of the web-based AGTR version in 2006 has given access to this resource to many more people and institutions worldwide. Numbers of visits to the website since 2006 are presented in Table 6. The largest proportion of site visits so far is from the United States and European Countries. Site visits from developing countries are expected to increase dramatically as internet connectivity in these areas improves. Access of the AGTR as a CD has added to the value of the resource in countries with limited internet connectivity.

Table 6. *Number of visits to the AGTR Website since 2006*

<i>Year</i>	<i>Number of visits</i>	<i>Monthly hits</i>
2006	8,878	992
2007	38,477	4,306
2008	43,376	5,295
2009	33,577	5,055
2010	181,851	8,958

Through the free access to the training resource and materials included the project contributes substantially to the knowledge sharing on AnGR and methods for their sustainable use at the global level. Thus, it actively promotes actions expressed by the CGIAR as essential for agricultural developments.

Outcomes supporting the NARS agendas

An objective of the project was to stimulate knowledge sharing and networks within regions. By linking NARS and university lecturers from different countries in the training courses, three virtual regional networks have been subsequently established:

1. Afrib Breeders in Africa
2. IAGRA in Southeast Asia
3. South Asia Genetic Group.

These animal breeding and genetics networks were created by the project participants to share knowledge and facilitate the development and review of collaborative proposals on the characterization, conservation and design of breeding schemes for improved livestock productivity and use.

Researchers and university lecturers in many developing countries across Africa and Asia are utilizing their new knowledge and skills from the ILRI-SLU training

programme and information from the AGTR to re-design their training courses, to influence their national livestock policies, and to develop breeding programs for livestock improvement in their countries. In addition, many university participants returned to their home institutions and revised or updated their ABG course syllabi. For example, the curricula in animal genetics at the University of Nairobi and at the University of Bhutan have been completely revised. University lecturers also implemented more student activating teaching methods, such as use of visuals, group discussions, computer exercises, case studies, study visits and project work. This resulted in increased interest in animal breeding among their students and improved examination results

At the regional level, another major outcome is the formation of new collaborations between universities within regions, for example, in eastern Africa to harmonize their post-graduate courses in ABG. As a result of the ILRI-SLU capacity building program, university lecturers from the countries involved in the program have taught ABG at different universities within and outside of their own countries. Individual scientists have also had one-month long exchange visits to ILRI where, through working with the ILRI-SLU scientists, their skills in writing and data analysis have been further strengthened. These exchange visits have also resulted in new case studies for the AGTR from the South and South East Asia region and increased breed information from different regions.

Exposure to the capacity building concept and methodology of the ILRI-SLU project has also influenced how NARS and regional organisations organize their own capacity building initiatives. For example, the Forum for Agricultural Research in Africa (FARA) adopted the ILRI-SLU approach as a model for a FARA initiative known as 'Building African Scientific and Institutional Capacity' (BASIC). There are numerous possibilities for other CGIAR centres and partners to adapt this approach in other fields of scientific research.

Outcomes aligning with the FAO agenda

Collaboration and involvement of the FAO AnGR Branch in various ILRI-SLU training courses and workshops helped to increase the effectiveness of communicating various regional needs for improving AnGR utilization. This has enabled participants to be exposed to both global issues and the work of FAO, as well as allowing FAO

officers to learn about the activities of NARS from several regions in the world and to integrate this practical experience in FAO's work. Interactions served to strengthen inter-institutional partnerships and pro-active participation by ILRI, SLU and the FAO in joint activities related to the Global Plan of Action (GPA) for AnGR (FAO, 2007b; FAO, 2007b).

In the regional ILRI-SLU-FAO Workshop held in 2009 for East and Southern Africa in collaboration with the East African Community, the participants were sensitized on the GPA and jointly developed a regional map of activities that could well lead to the desired GPA outcomes. This map is presented in Appendix of this report.

As many of the project participants come from the university and research fields, FAO's participation has also strengthened the link between education, research and policy making (the National Coordinators for AnGR). FAO has maintained contact with NARS scientists by inviting them to join the Domestic Animal Diversity Discussion Group (DAD-Net), and to subscribe to the journal of Animal Genetic Resources: <http://journals.cambridge.org/action/displayJournal?jid=AGR>. As a result, many NARS scientists now actively contribute to the discussion network and submit papers to the journal. Participants from the training course also take an active role in sharing information from their regions in various international fora and are pro-active in online e-mail discussions and conferences on AnGR co-ordinated by DAD-Net, FAO.

A number of NARS scientists trained in the ILRI-SLU project have contributed as members of their National Consultative Committees to the development of country reports for the State of the World AnGR Report, and to national activities on the strategic management of AnGR. Currently, a number of countries are in the process of preparing national strategies and action plans, which is yet another opportunity for these scientists to apply their enhanced knowledge and experience to advance efforts to manage AnGR in their respective countries.

The relationship with FAO has greatly assisted in improving the understanding among the participants' institutions of the challenges faced by FAO in mobilizing people in different countries to take action due to the FAO mandate of working with governments.

Impacts as reported by some project participants

Many previous course participants have reported their experiences from using the new knowledge gained at the courses held or by the contacts established through course participation. A few of these experiences and concrete actions are reported in Box 4 and Box 5.

Box 4:



I was motivated to document existing information on various indigenous farm animal genetic resources found in Nepal following presentations on challenges within South Asia at the ILRI-SLU training course.

Shreeram Neopane
Scientist working with
the Nepal Agricultural
Research Council



Through involvement with the ILRI-SLU project, the need to characterize existing indigenous AnGR prior to initiating conservation efforts was made clear. Documenting this information became a reality through efforts of a great team in Sri Lanka, and support extended by the UNEP/GEF ILRI project.

Pradeepa Silva
Senior lecturer, University
of Peradeniya Sri Lanka



S. K. Singh
Principal Scientist, Central Institute
for Research on Goats, India



Through the ILRI-SLU program I realized that though information on Animal Genetic Resources is not accessible to all the stakeholders, I could serve as an important link in availing information for farmers in India. I was thus inspired to translate both the Global plan of Action for AnGR, and the State of the Worlds animal genetic resources into Hindi.

Box 4. Impacts reported by ILRI-SLU project participants in Asia

Box 5:



Austin Nguetta Bosso
Project Coordinator at the African
Union Inter-African Bureau of Animal
Resources (AU-IBAR)

Following ILRI-SLU training course, I realized that there were great opportunities to contribute to the improvement of animal genetic resources beyond the borders of my home country Côte d'Ivoire. I shared the new knowledge acquired with colleagues and students at the University of Cocody in Abidjan, and when the opportunity arose, I successfully competed to be the Coordinator of the "Livestock for Livelihoods: Strengthening Climate Change Adaptation Strategies through Improved Management at the Livestock-Wildlife-Environment Interface" Project at the Animal Production Unit in AU-IBAR where I lead a team that responds to trans-boundary issues related to livestock and wildlife in 12 countries in Africa

Coming from a country where there were not many Animal Breeder and Geneticists (Malawi), the ILRI-SLU programme gave me hope that I was not a lone 'soldier' trying to march on – on an impossible mission. The program raised my level of understanding and enabled me enhance my efforts in the conservation of farm AnGRA in Africa. I got the opportunity to publish case studies and scientific papers. Although now I am based in the UK, I work with colleagues from Bunda and Mzuzu Universities in Malawi on 3 projects funded by the Scottish Government and DFID.

Mizech Chagunda
Senior Researcher, Scottish Agricultural College, UK



Donald Kugonza
Senior Lecturer,
Makerere University,
Uganda

The ILRI-SLU training programme virtually opened my eyes. My interaction with the project team enables me to look at breeding with the non-breeders' lenses and most especially taught me how to be an author. The training jump-started my critical reading skills. Between 2001 and November 2008 (when I had the training), I had authored only six papers (four in Uganda-based journals); since then, I have authored nine papers all in top-range journals based outside Africa. It's now usual for me to be asked to examine theses, vet proposals and review papers for a couple of journals. To jump from an assistant lecturer to a senior lecturer at Makerere University was a first time occurrence, and it says it all. Lately, I have been developing a bull scheme for Nganda cattle with support from ASARECA.

Box 5. Impacts reported by ILRI-SLU project participants in Africa



Key lessons learnt

- Throughout the ILRI-SLU project, the overwhelming need for enhanced capacity to implement improved utilisation of AnGR within developing countries has been clearly evident. The requirements for increased human capacity able to translate new knowledge into actions for sustainable use of AnGR are urgent in all regions and sub-regions included so far in the project. The institutional capacity and involvement of farmer organizations are equally important.
- The concept “Training the Trainers” has been found effective in multiplying the knowledge shared through selected course participants, and supported by the development of a web based training resource (AGTR). The number of students reached by the trained trainers is far more than would be possible through direct training of students.
- Animal breeding and genetics is considered a difficult subject to grasp by many students as it requires use of advanced mathematics and statistics. It is our experience that students get much more attracted by the subject if they are exposed also to practical examples and various types of case studies showing impact of alternative livestock breeding programmes on food security and livelihood of people.
- Training the trainers on subject issues mixed with training on science communication and teaching methodologies has been strategically important in order to effectively transfer new or basic knowledge to students as well as to various stakeholders of AnGR in easily understood ways, may it be orally or written for different types of audiences.

- Linkages between universities and research institutions in the same developing country are often weak or non-existent, due to various reasons. It was, however, a striking experience to see how the dialogue at the courses between scientists of the two types of institutions was improved by just establishing personal contacts. A change of attitude to make better use of existing resources is essential. Change may be supported by policies for easy implementation of joint training courses and transfer of credits (partnerships between institutions); also a supportive environment is mandatory to facilitate research as part of teaching; and research carried out must reflect real needs and thus mainly be demand driven.
- More people in the developing countries still need to be trained and better informed on issues related to AnGR. The projects' training programme was limited to only a few people per country for each course, and usually one of them represented a university and one a research institution. Many of the trained scientists were subsequently promoted to senior administrative positions, as a result of their increased knowledge. This movement away from active teaching and research into administrative roles means that they have a great opportunity to strategically improve the conditions for academic training and research for development. New generations of animal geneticists must, however, continuously be trained.
- In several countries it was evident that the institutional capacity to absorb or to facilitate the application of new techniques learnt by participants was limited. In particular, access to facilities to enable active research by university faculty staff is important to improve. For greater impact and more effective utilization of available resources within countries, institutional learning and skills in adaptive leadership should be factored into future programmes.

A decorative graphic consisting of seven squares arranged in a cross-like pattern. The central square is dark green. It is surrounded by six other squares: one dark red square to the left, one dark green square to the right, one dark green square above, one dark green square below, one dark green square at the top-left, and one dark red square at the bottom-right.

Ways forward

At the international level, increased resources are being allocated to facilitate the implementation of the Global Plan of Action for AnGR. However, in developing countries there is still a huge need of trained scientists to lead the development of livestock resources to meet future food and agriculture demands. Sustainable solutions will only come from trained people within these countries ready and prepared to make a difference. A future challenge for the ILRI-SLU project is to adopt a long-term perspective, linking research agendas with what society needs for development. In particular, the following opportunities comprise major areas for consideration:

- In order to benefit from the past activities, some previous project course participants showing leadership ability (“champions”) should be utilized and equipped for future roles as regional trainers of trainers. There is need to organize *workshops for these “champions”* to support the dissemination of information and knowledge acquired through their training at both a local and regional level. Identified champions need support and guidance in establishing linkages to locate and tap into the necessary resources to support their activities. This is a critical component of the ‘training of trainers’ concept in order to enhance the multiplier effect and impact of the program.
- *Outreach workshops* targeting national and regional institutions representing animal breeding responsibilities, including implementation of the Global Plan of Action (GPA) for AnGR, are needed to bring together broad groups of stakeholders in AnGR with previous ILRI-SLU course participants. These could serve to: identify opportunities for collaborative research to deliver sustainable livestock breeding services; collate and share information on institutional programs related to AnGR and animal identification and recording; and, identify priority interventions to improve utilization of AnGR.

- ***Inventory and analysis of case studies*** that can be taken as models for future developments, i.e. lessons learnt from success stories in different regions. Case studies must continually be sought from all of those involved in the project's training courses and workshops, as well as from the wider scientific community. Examples of case studies include: identifying appropriate genotypes for the various environments; strategies for improving breeds; recording of phenotypes, environments and genotypes; databases and Bio-banks; and conservation needs.
- ***Studies on the role of alternative livestock recording schemes for management of livestock enterprises as well as of AnGR as part of value chains for various production systems.*** There is need to apply new information technologies and data base systems for effective use of information on individual farm animals and at farm level. Actors along the value chain in AnGR should be mapped in order to understand the nature and dynamics of the organizational culture. This could be achieved through consultative processes including actors from the education sector, research organizations, extension services, the private sector, and policy makers. It is also important to respond to the capacity needs, i.e. develop and build the capacity of targeted actors.
- ***Catalyze development of curricula for joint PhD programs*** in ABG between groups of 3-5 countries in a region, as well as initiating several joint PhD courses using models such as the NOVA Program, which has successfully been practised among the Nordic countries for several decades (<http://www.nova-university.org/>). This would require cooperation and mobility between institutions and within regions in higher education in animal genetics and breeding. In conjunction, the curricula for higher education institutions in developing countries should be adapted to address the future demands of the industry and knowledge society, while enhancing the attractiveness and visibility of ABG. Collaborative research projects developed are anticipated to promote dialogue, exchange of experiences and understanding between people and cultures.
- ***Improving communication of the science*** required for sustainable use of AnGR in developing countries. This implies improved communication skills for a variety of audiences, including NGOs, scientists and extension

staff; it also implies improved content, i.e. strategies of improving AnGR. This could be implemented through targeted training on science communication for scientists and extension agents. The ILRI-SLU project team members and partners play an important role in enhancing communication skills and knowledge brokering by assuming responsibility for the collation, storage and dissemination of AnGR information (Box 6).

Box 6:

Global Role of ILRI-SLU Project

“This project is particularly important, as it is the only international project focusing on capacity building in issues related to animal genetic resources. Thus the project supports the national implementation of the Global Plan of Action for Animal Genetic Resources. Its continuation, in the current or modified shape, would be much appreciated. FAO’s Animal Genetic Resources Branch stands ready to be associated with any further capacity buildings in this field.”

Irene Hoffmann, Animal Production and Health Division, FAO



Concluding Remarks

The landscape in developing countries is constantly changing and thus capacity requirements and needs must be adaptive.

There are, however, both existing and emerging opportunities that if exploited could greatly impact the capacity for sustainable utilization of AnGR in developing countries (Box 7).

Box 7:

Emerging opportunities for developing Capacity in AnGR

- Advances in computerization, communications and information technology.
- Regional platforms that facilitate information sharing and resource mobilization (ASARECA, SADC, AU-IBAR, RUFORUM, FARA and SAARC).
- The Global Plan of Action (GPA) for animal genetic resources.
- Increased co-operation among higher education institutions and research institutions within developing countries.

An exciting and challenging future lies ahead for the ILRI-SLU project, a project that has already made great inroads into strengthening AnGR in developing countries through its innovative programme and the stimulation of knowledge sharing and networks within selected regions. At the country level, partners have already used their newly acquired knowledge and skills to influence national and international policies and dialogue. Exposure to the project's capacity building methodology has also influenced how NARS and regional organisations conduct their own capacity building initiatives. CGIAR centres and partners could easily adapt this approach for building the capacity of NARS in other subject areas.

To benefit from the past experiences a further development of the capacity building model should be attained. This should capitalize on previously trained scientists, and stimulate networking and collaboration at the regional level in research and education, thereby addressing societal needs for improved livelihoods where improvement of existing AnGR will play an increasingly important role for future food security.





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Appendices

Appendix 1

Strategic Outcome Map for implementation of the Global Plan of Action on AnGR (East, Central and Southern Africa)

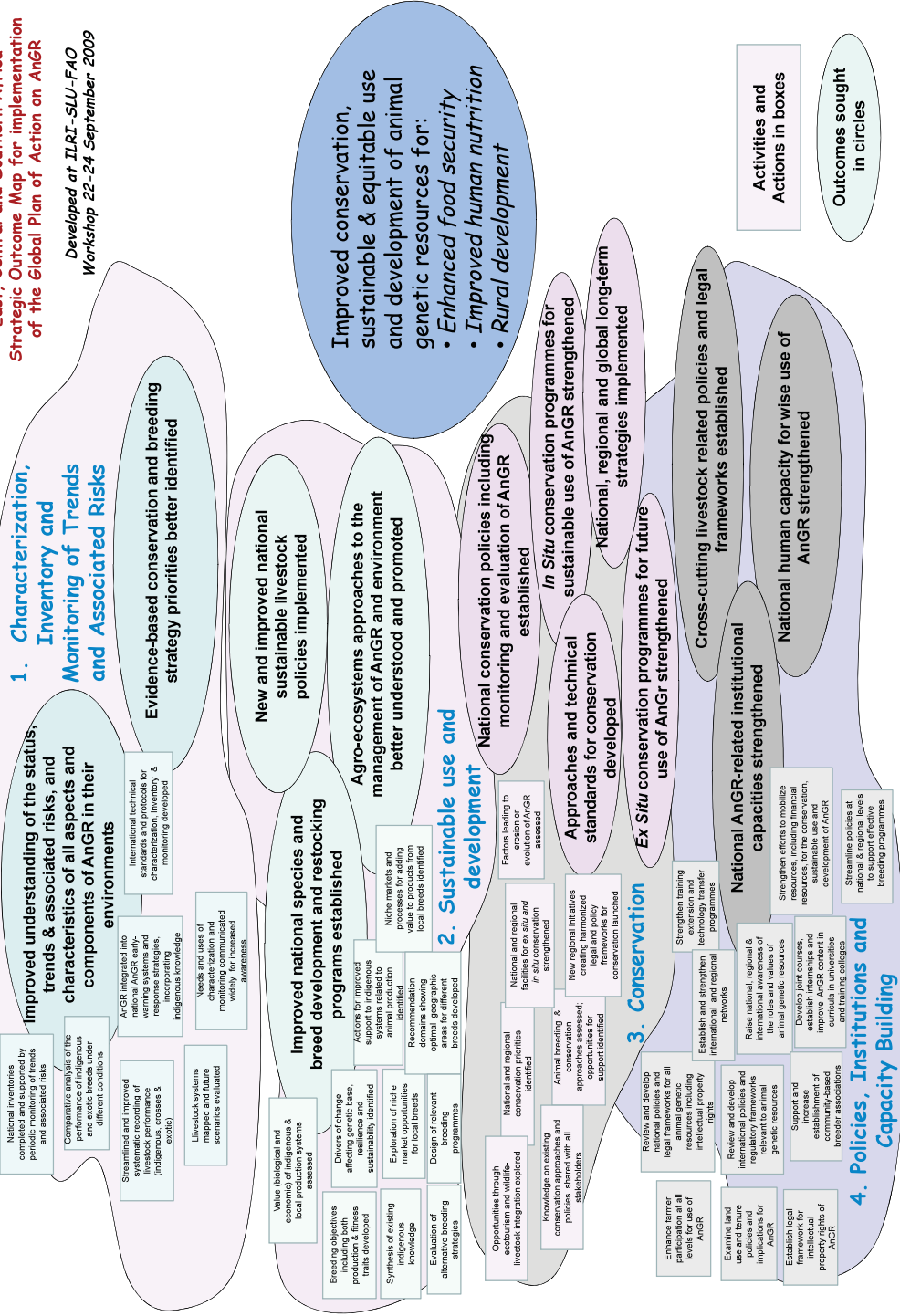
Appendix 2

ILRI-SLU Project Publications/Scientific Product

Appendix 1: East, Central and Southern Africa Strategic Outcome Map for implementation of the Global Plan of Action on AnGR

East, Central and Southern Africa
Strategic Outcome Map for implementation
of the Global Plan of Action on AnGR

Developed at ILRI-SLU-FAO
Workshop 22-24 September 2009



Appendix 2. ILRI-SLU Project Publications/Scientific Products

ILRI-SLU (International Livestock Research Institute-Swedish University of Agricultural Sciences). 2011. *Animal Genetics Training Resource, version 3*. Ojango, J.M., Malmfors, B. and Okeyo, A.M. (Eds). ILRI, Nairobi, Kenya, and SLU, Uppsala, Sweden.

Malmfors, B., Smalley, M., Philipsson, J., Ibrahim, H., Andersson-Eklund, L., Mwai, O., Mporu, N., Rege, J.E.O., 2002. Capacity building for sustainable use of animal genetic resources in developing countries-- A new approach. Proc. 7th WCGALP, Montpellier, France. Communication No 29-04.

Mwai, A.O., Malmfors, B., Andersson-Eklund, L., Philipsson, J., Rege, J.E.O., Hanotte, O., Fulss, R., 2005. Capacity building for sustainable use of animal genetic resources in developing countries. ILRI-SLU Project progress report for the period 1999-2003. SLU (Swedish University of Agricultural Sciences), Uppsala, Sweden and ILRI (International Livestock Research Institute), Nairobi, Kenya., pp. 65.

Ojango, J.M., Malmfors, B. and Okeyo, A.M. (Eds). 2006. *Animal Genetics Training Resource (AGTR)*. Version 2. International Livestock Research Institute (ILRI), Nairobi, Kenya, and Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden. CD-ROM. Available at: <http://agtr.ilri.cgiar.org/>

Ojango, J.M.K., Malmfors, B. Okeyo, A.M. Philipsson, J. 2009. Capacity building for sustainable use of animal genetic resources in developing countries, *Applied Animal Husbandry & Rural Development Journal*, Volume 2: 23-26.

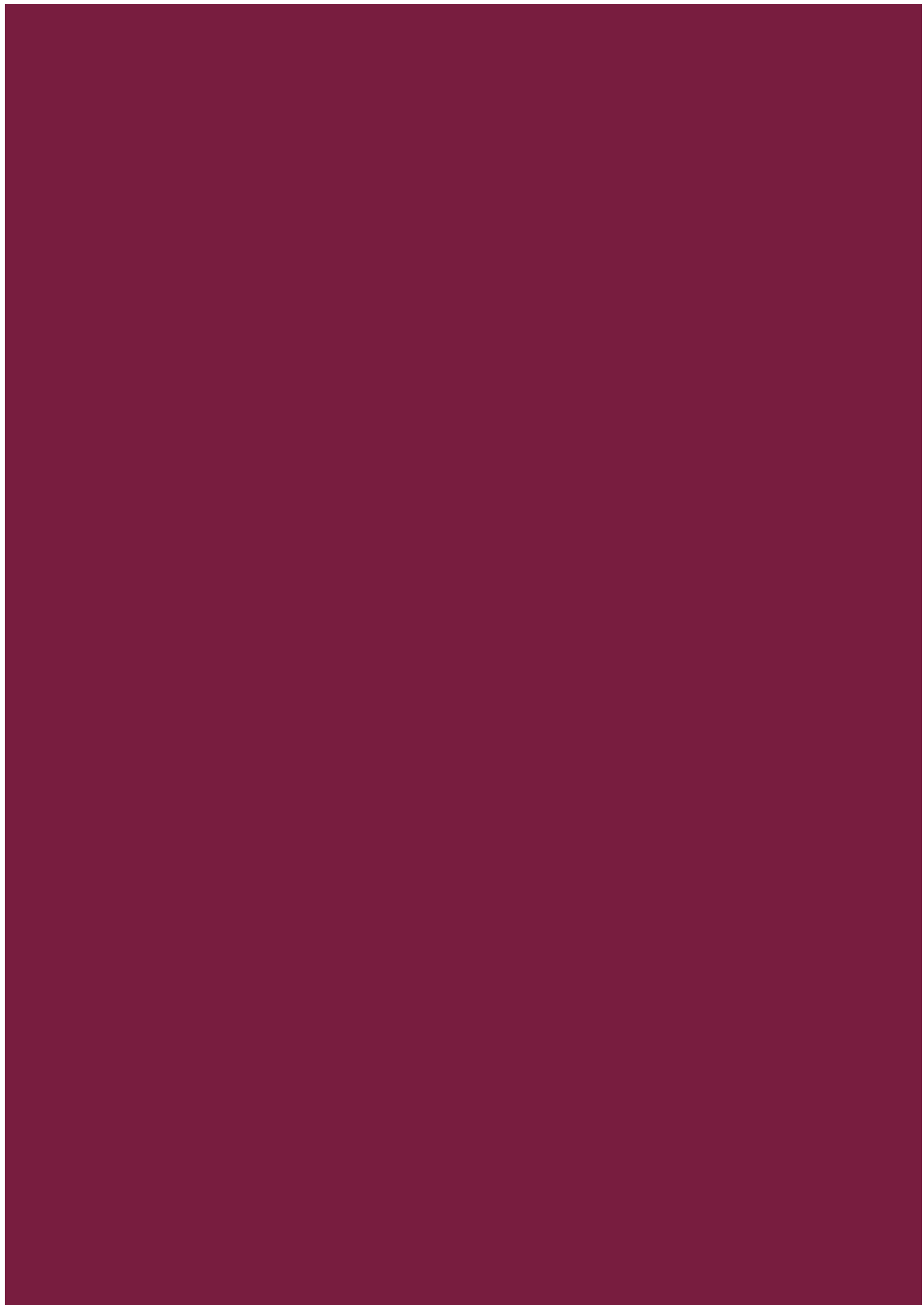
Ojango J.M., Panandam J.M., Bhuiyan A.K.F.H., Khan M.S., Kahi A.K., Imbayarwo-Chikosi V.E., Halimani T.E., Kosgey I.S. and Okeyo A.M. 2010. Higher Education In Animal Breeding In Developing Countries – Challenges And Opportunities. Proceedings 9th World

Congress on Genetics Applied to Livestock Production, 1st to 6th August 2010 Leipzig, Germany.

Ojango J.M.K., Malmfors B., Philipsson J., Okeyo A.M. 2010. Outcomes from Targeted Capacity Building to Enhance Sustainable use of Animal Genetic Resources in Developing Countries. African Women in Science and Engineering conference, 18th to 20th August 2010, Nairobi, Kenya.

E. Zonabend, A.M. Okeyo, J.M.K. Ojango, S. Moyo, J. Philipsson. 2010. Infrastructure for sustainable utilization of animal genetic resources in southern and eastern Africa. AACAA, 25-28 October 2010, Addis Ababa, Ethiopia.

Kosgey, I.S., Mbuku, S.M., Okeyo, A.M., Amimo, J., Philipsson, J., Ojango, J.M., 2011. Institutional and organizational frameworks for dairy and beef cattle recording in Kenya: a review and opportunities for improvement. Animal Genetic Resources, Food and Agriculture Organization of the United Nations 48, 1-11.



“The concept of this project is admirable: a University from a developed country joins forces with the world’s leading research organisation concerned with livestock research in and for the developing world, to provide cutting-edge training to key research and lecturing personnel from a large number of countries in the developing world. In providing this training, the project not only empowers the trainees to far greater achievements back home in their present jobs, but also greatly expands their horizons, providing them with invaluable networks of colleagues from other countries, all of whom face very similar challenges across a range of circumstances. One of the most important tools to have been created in the project is the Animal Genetics Training Resource (AGTR), especially in its most recent web-based form (<http://agtr.ilri.cgiar.org/>).

The project has provided a very successful “template” for similar projects in other areas of knowledge relevant to developing countries.”



Frank Nicholas

Emeritus Professor of Animal Genetics,
University of Sydney, Australia.
Science Advisor to ILRI Biotechnology
theme 2005-2009.