EDITORIAL - THE GLOBAL PLAN OF ACTION FOR ANIMAL GENETIC RESOURCES (GPA)

The Global Plan of Action for Animal Genetic Resources (GPA)\(^1\) is a rolling plan to improve management of livestock genetic resources on national, regional and international levels. The GPA was adopted by FAO member countries in September 2007 at International Technical Conference on Animal Genetic Resources (AnGR) in Interlaken, Switzerland. The GPA addresses four Strategic Priority Areas,

1) Characterization, Inventory and Monitoring of Trends and Associated Risks.
2) Sustainable Use and Development.
3) Conservation and
4) Policies, Institutions and Capacity Building, each of which have specific Strategic Priorities and corresponding Actions.

The main responsibility for GPA implementation rests with individual countries, but other institutions such as international organizations and intergovernmental agencies, including FAO, are expected to contribute, particularly by providing assistance to developing countries. One of the primary activities in which FAO is to play a major role is the development of technical standards and protocols for AnGR management. To this end, FAO is currently preparing a series of guidelines for national management of AnGR, in collaboration with members of the international scientific community. Included among these are Guidelines for Molecular Genetic Characterization of AnGR, which were developed in strict

\(^1\)ftp://ftp.fao.org/docrep/fao/010/a1404e/a1404e00.pdf
collaboration with members of GLOBALDIV. Hans Lenstra and Paolo Ajmone-Marsan served as the primary authors and other participants contributed to the review process.

The Guidelines have four chapters. The first chapter lays out the rationale for characterization of animal genetic resources, explaining how it can contribute to the informed management of AnGR. The second chapter addresses molecular characterization of diversity in particular, providing both some historical perspective and indicating issues of future importance. The third chapter is the bulk of the Guidelines, addressing the specifics of how to carry out molecular diversity studies. This chapter presents step-by-step details on:

1) What one needs to do before starting a molecular characterization study.
2) Procedures for collection of samples in the field.
3) Activities undertaken the laboratory.
4) The analysis of the data generated.
5) Publishing of results.
6) Translating the results into action, and
7) International coordination of molecular characterization studies.

The final chapter provides conclusions and recommendations on molecular characterization of AnGR and discusses changes that may be expected in the future, especially in light of the fast and continual development of genome-analysis technologies. A set of appendices provides more specific information, including a glossary of technical terms, examples of questionnaires for recording animal and breed-level information, protocols for blood sampling, an example material transfer agreement and a list and brief explanation of software for genetic analysis. In addition, the FAO-ISAG panels of recommended microsatellite markers for cattle, buffalo, goat, sheep, camelids, horses, donkeys, pigs, and chickens are presented.

One major dilemma in the preparation of these Guidelines was the previously mentioned rapid advancement of genomic analysis tools. For this reason, the emphasis on microsatellites, a popular but rather "mature" technology, was greatly decreased relative to previous versions of the Guidelines and discussion on the use of newer technologies, particularly SNP, was expanded. The current obstacles for SNP (e.g. possible ascertainment bias and variable levels of development across species) were noted and the research still required for the adoption of SNP panels for characterization was outlined. The main message on microsatellites was to avoid the use of markers that are not from the FAO-ISAG panels and to coordinate genotyping activities with other laboratories to facilitate data exchange. The non-laboratory activities of characterization, which are expected to be independent of marker type were given more attention. In particular, the benefits of collaboration and sharing of data were stressed.

The Guidelines were recently presented to the Intergovernmental Technical Working Group for AnGR of the FAO’s Commission on Genetic Resources for

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Food and Agriculture. The Working Group recommended adoption of the Guidelines at the next meeting of the Commission in July, although requested the opportunity to make final comments until 31 January 2011 (Comments can be submitted to paul.boettcher@fao.org). The Guidelines are expected to then be published in the fall of 2011.

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Article of the month: Are we ready for transition? New options are opening for agricultural systems

Recent crises have a very interesting output: they question our model of development. A debate is now open on the future of agriculture and more than one option are open.

The pursuit of the present model is strongly questioned. From some stakeholders, livestock is the culprit: contributing to greenhouse gases, bad for our health, unethical from an animal welfare point of view. Part of these assertions is based on scientific facts but we have to be aware of the diversity of the livestock systems. The impact of monogastric species on greenhouse gases emissions is different from the impact of ruminants. Grazing based systems provide more ecosystemic services than feedlot systems. Studies are required to precisely compare the different pathways but the recent State of Food and Agriculture 2009 report by FAO clearly shows than different ways of development of the livestock based systems will lead to various impacts. In consequence, our duty is to anticipate the evolution of our agricultural systems. Two foresight initiatives pave the way of this demarche.

On the one hand, a joint effort of INRA and CIRAD, called Agrimonde, compare two scenarios for the future of the food systems (www.international.inra.fr/the_institute/foresight/agrimonde). The first one, Global orchestration (GO), is based on a projection of the present trends. It assumes a meat consumption of 830 kcal/person and a disparity in the level of alimentation at the 2050 reference horizon. The second scenario (G1) is based on a greener option taking into account the pressures for a more environmental friendly agriculture. As there is no miracle, this scenario implies a restriction on our food consumption and a severe decrease of our meat consumption to reach a 500 kcal/person target. In both cases, an average availability of 3000 kcal/person is insured. The main differences are the requirements in terms of land availability and of yield increase as the GO requires an annual increase in productivity of 1.14 % vs. 0.14 % for the G1 scenario.
On the other hand, an ambitious international effort leads to the publication of the IAASTD report "Agriculture at the crossroad" ([www.agassessment.org](http://www.agassessment.org)). During two years, more than 400 participants, experts and stakeholders, compile information to write up a report on the state of agriculture. The International Panel on Climate Change inspired this initiative. It leads to the publication of one important global report and five continental volumes on the outlooks of agriculture. The overall conclusion is clear: due to the cost of the present agricultural systems in terms of resource consumption and climate change impact, "business as usual" is not an option.

Agriculture should consider an evolution towards more multifunctional systems. The effort of research and knowledge development should target the small farms where the efficiency in the use of resources is maximal. So doing, a triple objective may be reached: mitigate our negative impact on ecosystems, increase the food production and contribute to rural development. It is also in small systems than issues such a gender biased development are susceptible to be solved.

Agroecology is put forward as a scientific framework to guide this new developments of agriculture. The rationale of agroecology is to enhance beneficial biological interactions and synergies among the components of agrobiodiversity (Altieri, 1995, Gliesmann, 2007). Considering the primary dimension of agricultural systems, plant production, the management of organic matter and the improvement of soil biotic activity are key elements. The purpose is also to minimize losses of energy and other resources all along the food systems. A better integration of crop and livestock is viewed as the best option to reach these objectives as it mimicks the natural ecological cycles. Agroecology is a scientific discipline but also a movement and a practice (Wezel et al. 2009). Despite good clues on its potential of development, there is a lack of knowledge on agroecology due to an imbalance in terms of research investment (Vanloqueren & Baret 2009).

The way Farm Animal Genetic Resources are considered within the GLOBALDIV initiative is consistent with the agroecological framework. Indeed, it was shown by projects in the Globaldiv network that the management of FANGR is not only a genotypic and phenotypic business. It also implies to take into account the socio-economical dimensions. The genetic diversity of domestic animal breeds is the result of a diversity of agricultural systems and practices.

In a changing and challenging world where many options are open, the management of FANGR is an opportunity to contribute to more than one agricultural models, to keep open the options.

On the short term, the complexity of the challenge is to articulate the diversity of genetic resources to a diversity of systems. If the mainstream model of agriculture is based on a limited number of international breeds adapted to large farms, a demand exists for other breeds in alternative systems such as organic agriculture, mountain farming, agriculture for marginal areas or smallholders.

A mid term prospective is to be actor of a learning process on new systems more parsimonious in resources and relevant for a multifunctional development of agriculture as a key element of a balanced relationship to the limited resources of our planet.
Farm Animal Genetic Resources are not the problem; they are part of the solution for a more sustainable agriculture.


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The BREED of the month: Dark future for black horse?

The rustic province of Friesia in the northern part of the Netherlands is the cradle of the famous black-pied dairy cattle and, if weather permits, the scene of the traditional eleven-cities skating tour. It is also origin of one of the most beautiful horse breeds, the elegant Friesian, famous for its black color, proud stature, long tail and long manes. Its abundant 'feather', as they call the long hair at the lower part of the legs, betrays its descent from heavy draught horses, who before the tractor era ploughed through the sticky Friesian clay. It is the first choice to drive the Golden Carriage, which once a year brings the Dutch Queen to the assembled parliament for announcing how the government budget is going to be spent, which expenditures will be cut, and why taxes will be increased again.

However, beauty has its price. The Friesian horses are all derived from three stallions in 1913 and underwent a few other severe bottlenecks. In order to maintain the breed standards, the herdbook has been closed since the beginning of the last century. The inbreeding has increased since 1920 with an unhealthy 1.5% per generation and is now up to 18%. By comparison, offspring of full sibs have an inbreeding of 25%. A recent survey of 35 breeds (Van de Goor et al., Anim. Genet., in press) showed that the Friesians are, by far, the breed with the lowest heterozygosity (0.44 ± .0.05 as measured with microsatellites), also in line with previous studies.

Veterinarians are all too familiar with the consequences that are linked to the inbreeding: eczema, hydrocephalus, dwarfism, low fertility, high incidence of retained placenta and other birth problems, failure to recover from anesthesia, just to mention a few from a long list of breed-specific disorders. It is not always easy to be a Friesian horse!
This in spite of careful genetic management by the breeding society, who has to cope with a situation created 50 to 100 years ago. The society recognizes the problem and seriously tries to minimize a further increase of the inbreeding. They also contribute to molecular research of the gene defect that causes the recessive dwarfism. However, this gene defect is estimated to be carried by an estimated 10% of the Friesian horses, so removal of the mutation from the population by a DNA test would further decrease the genetic diversity. This illustrates the mechanism of the dreadful extinction vortex.

Is there a solution? Of course: crossbreeding using black stallions or mares from other breeds generates offspring without any inbreeding defect. However, let's harbor no illusion: a crossbred Friesian is no real Friesian. Only after several generations of back-crossing, careful selection and decades of patience, horses will be born that combine the unique Friesian traits with an acceptable level of inbreeding. So it is understandable that so far, and since 130 years, crossbreeding is not considered by the Friesian breeders. But isn't it a rhetoric question what is more important, the beauty and 'genetic purity' of the breed or the health and welfare of the animals? What would the horses decide if, in an Orwellian scenario, they would make their own choice?

**Events calendar**

Many events concerning different issues related to GLOBALDIV project will take place in the coming months. Here is a selection of conferences and other events sorted by date:

- **GLOBALDIV EVENT: Final conference EU GLOBALDIV & ESF GENOMIC-RESOURCES** in Lausanne, Switzerland, February 8-9, 2011

- Mediterranean Agronomic Institute of Zaragoza (IAMZ) and FAO will organise a joint advanced course on "Conservation and management of animal genetic resources" which will take place in Zaragoza, Spain, on 17-21 January 2011. Brochure conyaining details about the course is available [here](http://lasigpc8.epfl.ch/globaldiv/), while the Registration form is available [here](http://lasigpc8.epfl.ch/globaldiv/)
GlobalDiv bibliography


Contents

- A global view of livestock biodiversity and conservation - GLOBALDIV - P Ajmone-Marsan
- Genetic diversity in farm animals - a review - LF Groeneveld, J A Lenstra, H Eding, MA Toro, B Scherf, D Pilling, R Negrini, EK Finlay, J Han, E Groeneveld, S Weigend
- Climate change and the characterization, breeding and conservation of animal genetic resources - I Hoffmann
- Integrating geo-referenced multiscale and multidisciplinary data for the management of biodiversity in livestock genetic resources - S Joost, L Colli, PV Baret, JF Garcia, PJ Boettcher, M Tixier-Boichard, P Ajmone-Marsan

Other bibliography

- The European Commission Community Programme on the conservation, characterisation, collection and utilisation of genetic resources in agriculture has given rise to the 17 actions, involving 178 partners located in 25 Member States and 12 non EU countries, and a total EU co-funding of EUR 8.9 million. The projects and overarching framework are available on the following links of the web site of DG AGRI:
  http://ec.europa.eu/agriculture/genetic-resources/actions/index_en.htm
  www3.interscience.wiley.com/journal/123356073/issue?CRETRY=1&SRETRY=0


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