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Rights to Animal Genetic Resources for Food and Agriculture
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Notes from an Interdisciplinary Workshop

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Abstract

At the background of the inquiry into the creation of rights to animal genetic resources lie different strands of thinking and various lines of arguments. These are fueled by three major developments in the AnGR sector: the increasing volume in trade in animal products; the scientific progress in animal breeding with the advances in genetic engineering; and the so-called erosion of animal genetic resources.

The *World Trade Institute* of the University of Bern, which has previously deepened the studies on the question of rights to plant genetic resources and traditional knowledge in the international trading system, took up these issues. One year after the adoption of the Animal Genetic Resources Global Plan of Action by the *International Technical Conference on Animal Genetic Resources for Food and Agriculture* (AnGRFA), it gathered a pool of experts to discuss the interface of AnGRFA, international trade and property rights. The result of this exchange is at the centre of this report.

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1 Swiss National Centre for Competence in Research – International Trade Regulation, Individual Project 9: Biotechnology, www.nccr-trade.org.

2 "Rights to Animal Genetic Resources", 27-28 November 2008, World Trade Institute, Berne, Switzerland, http://www.nccr-trade.org/ip-9-past/rights-to-animal-genetic-resources.html.

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Table of Contents

I. INTRODUCTION 7

ABOUT THE CONFERENCE 7
ABOUT THE BACKGROUND 8
ABOUT THIS DOCUMENT 11

II. PRESENTATIONS 14

TRADITIONAL ANIMAL BREEDING AND PROPERTY RIGHTS 14
ANIMAL BREEDING IN A DEVELOPING COUNTRIES CONTEXT 17
ECONOMIC VALUES OF TRAITS OF INDIGENOUS CATTLE IN LOCAL MARKETS: IMPLICATIONS FOR GLOBAL GENETIC MATERIAL TRANSFER 20
DIFFERENCES BETWEEN PLANT AND ANIMAL GENETIC RESOURCES 25
CURRENT AND PROJECTED FUTURE FLOWS OF ANGR BETWEEN COUNTRIES AND REGIONS 29
BIOTECHNOLOGY IN ANIMAL BREEDING – PRESENT STAGE & FORESEEABLE DEVELOPMENTS 33
WHAT DOES THE ANIMAL BREEDING INDUSTRY EXPECT FROM BIOTECHNOLOGY DEVELOPMENTS? 39
LEGAL QUESTIONS RESULTING FROM BIOTECHNOLOGY DEVELOPMENTS IN ANIMAL BREEDING: PATENT LAW 44
"MONSANTO PIG" AND "BRASSICA" OR THE OPEN QUESTION OF WHAT IS AN "ESSENTIALLY BIOLOGICAL PROCESSES" 47
OPPOSITION AGAINST PATENT ON PIG BREEDING – THE REASONS 48
TRADE IN ANIMAL GENETICS, COMPETITION AND CONCENTRATION 53
A NEED FOR CHANGES TO THE ANGR REGULATORY FRAMEWORK? 56
LIVESTOCK KEEPERS‘ RIGHTS 61
SUI GENERIS PROTECTION OF ANIMAL GENETIC RESOURCES : AN INITIATIVE BY THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH ICAR 67
THE PANELLISTS’ CONCLUSIONS 69

III. THOUGHTS AND WAY FORWARD 71

THE PRESENTATIONS IN CONTEXT 71
BACKGROUND 72
STARTING POINT 72
PRESENT SITUATION 73
ONGOING CHANGES 74
FUTURE SCENARIO 75
THE QUESTION OF RIGHTS 75
POTENTIAL SOLUTIONS 77

IV. CONCLUSIONS 79

GENERAL THOUGHTS 79
SCENARIO ONE: PRESENT MARKET FAILURE AND MARKET MECHANISMS 80
SCENARIO TWO: MODERN BIOTECHNOLOGY AND GENETIC ENGINEERING 81

V. BIBLIOGRAPHY 82

REFERENCES 82
FURTHER READING 83

Abbreviations and acronyms

ABS	access to genetic resources andfair andequitable sharing of benefits (access and benefit sharing)
AI	artificial insemination
AnGR	animal genetic resources
AnGRFA	animal genetic resources for food and agriculture
BLUP	best linear unbiased prediction
CBD	Convention on Biological Diversity
CBM	community -based management
CGN	Centre for Genetic Resources (the Netherlands)
CGRFA	Commission on Genetic Resources for Food and Agriculture (FAO)
CIMMYT	International Maize and Wheat Improvement Center
Dir.	Directive
EPC	European Patent Convention
EPO	European Patent Office
ET	embryo transfer
EU	European Union
FAO	Food and Agriculture Organization
GDP	gross Domestic Product
GR	genetic resources
GS	genomic selection
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in Dry Areas
IPR	intellectual property rights
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
LIFE	local livestock for empowerment
MOET	multiple ovulations followed by embryo transfer
MAS	marker assisted selection
MTA	Material Transfer Agreement
NGO	non-governmental organisation
NBPGR	National Bureau of Plant Genetic Resources (India)
NBAGR	National Bureau of Animal Genetic Resources (India)
NBFGR	National Bureau of Fish Genetic Resources

OECD	Organisation for Economic Co-operation
PBR	plant breeders rights
PGRFA	plant genetic resources for food and agriculture
R&D	research and development
RPL	random parameters logit
SMTA	Standard Material Transfer Agreement
SSA	sub-saharan African (countries)
TRIPS	Agreement on Trade Related Aspects of Intellectual Property Rights
UPOV	International Union for the Protection of New Varieties of Plants
WIPO	World Intellectual Property Organization
WTI	World Trade Institute
WTO	World Trade Organization
WTP	prices which consumers are willing to pay

I. Introduction

A. About the conference

The landscape in animal breeding and animal production is changing: new technologies and the option of bioengineering have simplified transfer and reproduction of genetic information and hence (international) trade in *animal genetic resources* (AnGR). This coincides with the decline in animal genetic diversity.

As markets in animal products grow, selection for high productivity is favoured. Trade in reproductive material thus mainly encourages the spread of high yield breeds. These developments lead to *decreasing diversity* of animal genetic resources.

Against this background, the question arises whether incentives can be created in the framework of the trading system to maintain and foster AnGR diversity.

At the interface of the *international trade* order and AnGRFA diversity, a diverse net of other factors must be disentangled and analysed as to their potential (harmful or beneficial) effect. These include property rights in general, (intellectual) property protection, and market concentration – issues at present widely under-investigated in this field. For instance, property rights and intellectual property protection may appear to have paramount importance as factors that are capable of influencing the shape of the market – towards greater diversity.

The option of creating specific *property rights* which apply to AnGR, analogous to the rights created for the protection of innovation in plant genetic resources, is being discussed in international civil society and in part in international fora.

The *World Trade Institute* of the University of Bern (WTI), which has previously deepened the studies on the question of rights to plant genetic resources and traditional knowledge in the international trading system (Biber-Klemm and Cottier 2006), took up these issues. One year after the adoption of the Animal Genetic Resources Global Plan of Action by the *International Technical Conference on Animal Genetic Resources for Food and Agriculture* (AnGRFA),[4] it gathered a pool of experts to discuss

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4 Held in Interlaken, Switzerland, 3–7 September 2007.

the interface of AnGRFA, international trade and property rights. The goal was to take stock of current developments and debates, and to identify core questions and further research needs.

The main question asked was whether we need specific rights to AnGR, analogous to the plant breeders' rights and the farmer's rights in the field of plant breeding. This question connects a series of highly interdisciplinary issues; for instance whether the political processes and legal instruments created in the area of plant genetic resources for food and agriculture (PGRFA) can serve as a blueprint for AnGRFA. This instance leads to the inquiry into the differences between breeding animals and plants regarding access to valuable information and the rights of the breeders to their innovations. This comparison between animal and plant breeding give rist to the question of how ownership rights are being dealt with in the breeding of AnGRFA in the contexts of conventional breeding and indigenous farming.

Another set of inquiries concerns the current trends at the interface of genetic engineering and animal breeding. Do the new technologies and the related increasing density in intellectual property rights (IPRs) directly or indirectly affect the diversity of AnGR? Do we need specific rights to AnGR, analogous to the plant breeders' rights and farmers' rights in the field of plant breeding? What is the competition climate in AnGR and how can (or does) this affect the diversity of breeds? Do we need specific *sui generis* rights at the international level to balance the possibly negative effects of the current developments?

These and other questions defined the format of the workshop. During the two-day seminar held at the WTI in Bern, Switzerland, an inter- and transdisciplinary group encompassing representatives of the scientific community, international organisations, national authorities, the private sector and civil society discussed presentations by experts in the different fields. The abstracts of the presentations and the outcomes of the discussion are compiled in the next section of this working paper.

B. About the background

The debates on AnGR for food and agriculture have recently been given a frame by the FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) and its inquiry into the State of the World's

Animal Genetic Resources for Food and Agriculture (FAO 2007a). Underpinned by its Global Action Plan for Animal Genetic Resources, adopted at the occasion of the International Technical Conference on AnGRFA (FAO 2007b) and taken up at the CGRFAs twelfth regular session.[5]

In the background of the inquiry into the creation of rights to AnGR lie different strands of thinking and various lines of argument. They are based on the evolution in the livestock sector that is characterised by three major developments: first, the increasing volume of trade in animal products; and secondly the scientific progress in animal breeding and the advances in genetic engineering. Thirdly, these trends must be seen against the background of the ongoing erosion of animal genetic diversity.

On the last of these points, there is consensus that the global diversity in farm animals is under threat (Hiemstra et al. 2006), although the lack of population data means that the exact risk cannot be established (FAO 2007a). There is also agreement that diversity of domestic animals and plants is valuable and needs to be maintained (FAO 2007a).

As to the increasing volume of trade in animal products, expansion has been most dynamic in developing countries with rapid economic growth. In these countries, growth of the market in animal products is triggered by the increased purchasing power of the population, which leads to a greater consumption of meat, milk and eggs by a new middle class. The trend, termed the "livestock revolution", is amplified by population growth, increasing urbanisation and changing lifestyles (Steinfeld and Chilonda 2006; FAO 2007a). These lead to structural changes in trade and retailing (FAO 2007a). The globalisation of markets and the weakening of trade barriers allow growth of the livestock sector and changes in production mode. The industrialisation of production is furthered by increasing competition and demands for standardised products by integrated market chains. These developments have an impact on livestock diversity: local breeds are being replaced by a narrow range of high-yielding breeds in specialised industrial systems, or in traditional conditions, as a consequence of inappropriate livestock

5 Information available at http://www.fao.org/nr/cgrfa/cgrfa-meetings/cgrfa-comm/twelfth-reg/en/ (last visited 7 December 2009).

development policies. Livestock diversity is also being diluted by indiscriminate crossbreeding with exotic animals (FAO 2007a).

In parallel to these processes, new technologies in genetic engineering have brought about changes in the process of animal breeding and in the rights to protect the information values linked to it. For a long time however, innovation in animal genetics occurred in an environment that was relatively free from intellectual property protection. Protection in AnGRFA has mainly been sought in *secrecy*, eventually combined with *hybridisation.* The strongest rights classically applied to the protection of innovation in PGRFA (patents and *sui generis* rights) are either not available (*sui generis*) or only made their appearance in the past decade (patents).

A comparable evolution took place in plant breeding in the last century. The application of scientific breeding methods led to the industrialisation of plant breeding. This process was also accelerated by the application of methods of genetic engineering. It triggered greater investments in research and development (R&D) and brought the results of the innovation processes under the protection of IPRs. Yet, in contrast to AnGRFA PGRFA were subject to a global extension of property rights in the second half of the twentieth century: plant breeders' rights (PBRs) were created to address the specific situation of plant breeding, and to balance the interests between access to and exchange of varieties and the return on the investments of the breeders.

At the international level, the TRIPS Agreement leaves the choice over the patentability of animals open to domestic regulation. Unlike for plants, it does not prescribe a *sui-generis* system for the protection of animal 'varieties'. Even in developed countries, classically open to the protection of biotechnology, many exclusions and limitations have been set to the patenting of genetic inventions concerning animals. Nevertheless the question arises whether the parallels in the evolution of animal and plant breeding can be taken further, to the creation of animal breeders and livestock-keepers rights, and ultimately up to the negotiation of an International Agreement on Animal Genetic Resources for Food and Agriculture.

The arguments backing the call for the creation of property rights specific to AnGR can be summarised under the ideas of "creation of incentives for conservation of AnGR diversity", "balancing the system of

IPRs" and the overall call for equity and fairness in the way genetic resources are accessed and used in R&D. In connection with the liberalisation of the market economy, some authors argue that maintenance and sustainable use of the resources could be fostered by the creation of *economic incentives*. They propose the creation of property rights to the genetic resources (and related traditional knowledge), that would allow for the internalisation of their value in the market place (Swanson 1995; OECD 1996; see also the sources in Biber-Klemm and Cottier 2006; the theory has recently been challenged by Tisdell 2008).

This argument goes hand in hand with the call to find a balance in the system of IPRs as applied to AnGR and AnGRFA. Two approaches are discussed: the first is to proceed according to the blueprint developed in plant breeding, where plant breeders' rights and the patenting of innovations were introduced step by step, and then answered by farmers' rights aimed at reinforcing the position of farmers and rewarding creativity in plant breeding. Secondly, the Convention on Biological Diversity's system of Access to Genetic Resources and Fair and Equitable Sharing of Benefits (ABS) triggers another strand of debate. In contrast to PGRFA, the debate on the integration of AnGRFA into the ABS system is still in its initial stages (Ivankovic 2008; CGRFA 2009). In the context of the present discussion, the question of ownership of the resources that are to be covered by the ABS system or the entitlement to dispose of the resources is examined.

C. About this document

The issues described and the questions raised above defined the format of the workshop. The gist was to gather background information considered relevant for the continuation of the debate across the disciplines involved. Accordingly, the first series of presentations was directed towards providing information on the current practices and challenges. This encompassed the system of property rights to AnGRFA and the way these are being transferred in both industrialised and developing countries (Catherine Marguerat-König and Girma T. Kassie). With regards to the discussion on the ABS system and in comparison with PGRFA, the exchange of animal genetic information and patterns of interdependence and flow in the global context were also addressed

(Anne Valle Zárate). A further important question is that of the differences between animal and plant genetic resources in terms of the characteristics relevant to the questions at hand (Asko Mäki-Tanila).

The technology of genetic engineering opened up new dimensions in the perception of natural resources, and – from a legal viewpoint – initiated a series of entirely new aspects regarding innovation processes based on genetics. In this respect, the most relevant consequence is the introduction of a new layer of values that (can) exist independently of the physical organism. The emergence of technical innovation processes that brought biological resources under the regime of intellectual property is therefore discussed (Jürg Bilang, Michelangelo Temmerman, Christoph Then).

In plant breeding, biogenetic engineering is applied to create tools for more targeted breeding, and – through direct transfer of genetic information between organisms – to the creation of transgenic organisms. The questions asked at the interface between genetic engineering, AnGR, animal breeding and property rights need to be viewed in this context. As a first step, it was important for non-biologists and non-breeders to learn what the new technology means in the context of AnGRFA, for animal breeding in general (Christine Flury) and for the breeding industry in particular (Alain Malafosse). In turn, the implications of the new technologies and the additional layer of values need to be considered from the perspective of law, in particular the law of intellectual property and its possible impacts on animal breeding (Jürg Bilang, Michelangelo Temmerman, Christoph Then) and AnGRFA diversity. Against the background of this information, the initial question as to the necessity to rethink the current order of property rights to AnGRFA was taken up.

Different prospects and models directed at the integration of (small) livestock holders were presented and discussed: the options to apply the CBD's ABS system (Sipke J. Hiemstra); the concretisation of the model of "livestock keepers rights" by analogy to the farmers' rights (Ilse Köhler-Roleffsson); and a registration system for local breeds (Poonam Jayant Singh).

The present document provides an overview of each of these presentations, as summarised by the authors themselves; and presents the conclusions and that can be drawn from the workshop as well as discussing future challenges. The contents of Section II (presentations) fall under the responsibility of the individual authors.

II. Presentations[6]

A. Traditional animal breeding and property rights

By **Catherine Marguerat-König** – Swiss Federal Department of Economic Affairs, Federal Office for Agriculture, Animal Products and Breeding Unit; Switzerland

1. Introduction

Animal breeding has been practiced for thousands of years. The introduction of new breeding methods and strategies slowly changed traditional animal breeding. In Switzerland, farmers are still owners of their animals and property rights are not yet the same problem as in plants.

2. Traditional vs modern animal breeding

Thousands of years of animal husbandry and controlled breeding, combined with effects of natural selection, led to the development of native/local breeds. Around 1750, intensive selection within similar animals resulted in the first specific breeds in England (thoroughbred horses, meat cattle, sheep). In order to control inbreeding and to describe the new breeds, the first herdbooks (registers for animals) were established, followed by the introduction of performance tests and the creation of breeders associations. These breeding activities continued until about 1950 and may be considered as "traditional animal breeding". The era of "modern animal breeding" started with the introduction of new technologies like artificial insemination and embryo transfer, followed by quantitative genetics and analyzing methods like Marker Assisted Selection or Single Nucleotide Polymorphism.

The processes of traditional and modern animal breeding are basically similar. Breeders determine a breeding goal and the strategy to achieve genetic progress. Today's standards and requirements for breeding

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6 All the presentations can be accessed at: http://www.nccr-trade.org/index.php?option=com_content&task=view&id=1485&Itemid=310.

associations are set by EU zootechnical regulations as well as country based legislation.

Breeding is a dynamic process. The interpretation of what is understood by “traditional animal breeding” can vary between developed and developing countries as well as between intensive and extensive production systems and can also change over the years.

3. What is a breed?

To define the term “breed” is even more difficult. Various definitions of what is a breed are given in the literature: A breed is a breed, if enough people say it is (K. Hammond). If an animal looks like it is of a certain breed, it most probably is. „Breed“ is a descriptive term: a group of animals of similar genetic background showing similar phenotypes. A breed is identifiable as a subset of a species, the member of which are identifiable by shared phenotypic (and hence genetically encoded) characteristics. Local populations of a species of livestock are often named after the region and therefore not properly defined or managed as a breed in the European sense of the word. Neighbouring populations, massive mutual gene flow and close relationship make it difficult, from a genetic point of view, to distinguish between breeds. FAO gives the following definition of a breed: a group of animals for which geographical and/or cultural separation from phenotypically similar groups has led to acceptance of its separate identity.

To conclude we could say: In developed countries breeds are characterized by “clear” definitions, physical characteristics and strict definition of purity of pedigree regulated by a breeding society, backed by law. In developing countries, breeds are defined by local traditions, by identifying physical characteristics, by a geographical location or by ethnic groups.

4. Property rights of farm animals, their derivates and products, Access and Benefit Sharing

Farm Animal Genetic Resources (AnGRFA) are privately owned whether they are registered in a herd book or not. The exchange of AnGR is very beneficial and smoothly running. There exists an active international exchange by private-private transactions. The contracts regulating the exchange can be very simple or very sophisticated.

In Switzerland, the farmers own the animals and, in case of females also their direct offspring, regardless of the fact whether it has been produced by artificial insemination or natural mating. Prices of live animals and their derivates like embryos or semen depend on the genetic value and/or market conditions. Nevertheless, models for best practices could further facilitate the exchange. The trade of breeding animals follows common business practices and is guided by recommendation and rules (national/international).

Actually, Switzerland knows different systems to regulate access and benefit sharing depending on the item. We know of contracts regulating collaboration and benefit sharing in cattle, supply agreements regulating ownership of animals, their products and subsequent generations in pigs as well as license agreements in research.

5. Conclusion

It will always be difficult to give an exact definition of "traditional animal breeding" as well as to define what is a breed. Many authors have tried. The best definition of a breed is probably given by K.U. Sprenger: a breed is composed of animals that, through selection and breeding, have come to resemble one another and pass those traits uniformly to their offspring. Property rights of farm animals are quite clear for Switzerland where farmers own the animals. Different models are used to regulate Access and Benefit sharing. The future will show, what has to be regulated in order to guarantee access and benefit sharing in animal breeding.

B. Animal breeding in a developing countries context

By **Markos Tibbo –** International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria

The presentation has reviewed successful examples of participatory breeding and Community Based Management ('CBM') of Animal Genetic Resources (AnGR) from Latin America and Africa. It highlighted breeding practices, indigenous knowledge and some undesirable consequences of some of the practices. It demonstrated that community involvement is crucial for success. It is essential to have all stakeholders involved right from the start.

For planning genetic improvement, an intelligent balance is needed between genetic principles and practical aspects. Solutions to practical problems may be found from experience of other projects, and from farmers themselves. Community-based projects require initial funding and technical assistance.

The science of animal breeding represents a deliberate effort to induce specific traits allowing the weeding out of undesirable characteristics and channelling of the desirable genes into future generations. Since their domestication that occurred 9000 B.C., people have been selecting animals of their desire. Arabs have used artificial insemination as early as in 1320s. There has not been any substantial breakthrough in animal breeding until the late 1700s, when Robert Bakewell developed several new breeds of livestock, and later in late 1800s when Gregor Mendel introduced principles of heredity. The rise of Charles Darwin with his theory in the 20th Century supported by that of Mendel's law has formed the basis for genetics research of modern animal breeding. The discovery of DNA by Watson and Clark, which led to the new field of genetic engineering, has occurred only in the last century.

Domestic animals supply 30% of total human requirements for Food and Agriculture and contribute at least 35% to the agricultural GDP in Sub-Saharan African (SSA) countries. According to FAO (2007), well over a quarter of AnGRFA are at risk of loss. Loss of genetic diversity reduces opportunities to improve food security. Genetic erosion in animals is much more serious than in crops because the gene pool in animals is much smaller. There is an urgent need to manage and conserve unique AnGRFA.

Different animal breeds of today – indeed the vast majority of breeds – are the product of the selective breeding efforts of livestock keepers over many centuries. Most of the world's animal diversity is presently found in the developing world. Nonetheless, uncontrolled breeding remains a major feature of traditional breeding.

Genetic improvement programs in SSA countries largely failed. The programs did not consider the potential of local breeds, institutional and infrastructural arrangements on ground resulting in a rather indiscriminate crossbreeding between "improved" and "local" livestock breeds. These are done in centralized stations with little or no participation of livestock keepers, which was a recipe for failure. In these programs, the different socio-economic and cultural roles of livestock were not analysed, and hence no comprehensive approach for the designing of adapted breeding strategies was possible. Few fragmented successes of those initiatives were reported.

Taking account of the above experiences, Community-Based Management (CBM) of AnGR has recently been introduced in some African countries. This approach 'puts the last first' (end-users first). Planned improvements are driven by needs and wishes of end users. Local communities and institutions are involved in the design, implementation and ownership of breeding strategies and of resulting superior genotypes. This approach allows livestock keepers to participate fully in the identification of problems, the choice of solutions and breeding objectives, and in the designing and implementation of a breeding program. The approach thus reflects the real production environment.

Unsatisfied by the traditional breeding, Jim Shepherd (Australia) and A.G.H. Parker (New Zealand) have first introduced Participatory Animal Breeding in 1967. They used "Group Breeding Schemes" which in the 1970s expanded into South Africa, Great Britain and other countries. Due to the introduction of the best linear unbiased prediction (BLUP) technology in the 1980s, group-breeding schemes evolved into reference sire schemes. In 1990s, the group-breeding concept was reformulated into "Participatory Breeding". This concept embraced the use of local breeds with a breeding structure that is open to upward gene flow.

Selection is done by visual observation based on performance with a focus on both production and adaptation traits.

In modern breeding, breeders decide on the breeding objective and genetic progress; the success depends on their work. In this scheme, a "three-tier" approach is usually used at breeders, multipliers, and base flocks levels.

The Open Nucleus Breeding Scheme is a structure in which the nucleus (where elite animals are bred) is open to the grass-root livestock keepers. They decide on the breeding objective by supplying "adapted" females to produce their breeding males. A modified optimum design of open-nucleus breeding scheme retains 10% elite animals in the nucleus and 90% in the base. This allows gene flow between the layers and takes into consideration principles of breeding such as genetic progress; inbreeding rate; age structure; progeny testing; selection accuracies; genetic variance.

Participatory breeding follows a different approach. In a decentralised or dispersed nucleus schemes the nucleus is distributed within the participating flocks. In this scheme, a sire will have progenies in different flocks allowing ranking of tested male progenies. Such connected populations also allow the ranking of all animals using BLUP analysis. The male nucleus and performance testing scheme works through a male testing station. Candidate males are contributed by participating flocks while the best ranking males are given back for proper use (sire rotation, AI, etc).

C. Economic values of traits of indigenous cattle in local markets: implications for global genetic material transfer

By **Girma T. Kassie**[7] **(**CIMMYT Addis Ababa, Ethiopia)**, Awudu Abdulai (**University of Kiel, Germany**), Clemens Wollny (**Bingen University of Life Sciences, Germany**), Adam Drucker (**Bioversity International, Italy**)** and **Workneh Ayalew (**Papa New Guinea**)**

The livestock wealth of communities in Africa is not merely a source of food, or a means of income, or a marginal enterprise. Rather, it is much more important asset buffering livelihood shocks due to failures in inert resources and enterprises, absorbing production risks that happen in more risky farm enterprises, building assets for vulnerable communities, and saving lives under desperate socioeconomic circumstances. This way, it significantly contributes towards achieving food security at household level.

Although Ethiopia has presumably the largest livestock population in Africa, performance in the production of major food commodities of livestock origin has been quite low. The livestock production system of the country at large is predominantly subsistence whereby the livestock products and services are primarily produced for household/on farm consumption.

Re-orientation of livestock production systems towards consumer preferences and demands through timely and comprehensive transformation is currently the main agenda among the stakeholders of livestock improvement. Market orientation of livestock production system requires proper valuation of both traded and non-traded products and services generated from the system.

Both revealed and stated preference techniques have been employed to analyze the marketing or pricing of livestock and their traits in Africa. The revealed preference analyses virtually employed the hedonic pricing model approach.[8].The stated preference method has also become a

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8 The studies which used this method are Andargachew and Brokken (1993), Fafchamps and Gavian (1997), Jabbar (1998), Barrett et al. (2003) and Jabbar and Diedhiou (2003).

common approach to analyzing the preferences and valuation of livestock attributes. After the pioneering work by Sy et al. (1997) in Canada, many authors have analyzed economic values of cattle traits for some African countries.[9]

This study used both revealed and stated preference approaches for identifying the factors that influence the actual prices in the markets and for valuation of the preferred attributes of indigenous cattle, respectively, in Central Ethiopia.

Hedonic price models showed that market place, seasonal differences, sex and function based classification of cattle, body size, and age were very important factors influencing the market prices cattle sellers receive. The significance of the characteristics of animals in influencing prices paid for the animals reveals the importance of the preferences for traits in the decision-making process related to buying and selling of cattle. Thus, the cattle breeding strategies and activities should duly consider the preferences expressed through the prices paid for animals in such markets, where the cattle keepers are the main sellers and buyers.

The results of the stated preference analysis that employed Random Parameters Logit (RPL) showed that cows have other functions more important than milk production. Fertility, disease resistance and strength of the calves they bear are as much or more important than milk. The breed concept, which is very much associated in Ethiopia with the area where the animal is brought from, was found to be less important as such and it appears that farmers are interested in obtaining animals from the district or locations in which they live in. For bulls, the RPL results indicated that cattle buyers assign high values for good traction potential, disease resistance, calf vigor, and for places of origin. The preferences cattle buyers have for these attributes do vary essentially due to differences in occupation, education and age.

These results are consistent with the basic reasons why animals are kept in the area, but appear to be incoherent with the government funded interventions of livestock development. The Government of Ethiopia needs to revise the structure of the livestock improvement programs still running and needs to make note of the important details that influence the production, marketing and utilization of livestock products. The

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9 Tano et al. (2003), Scarpa et al. (2003a,b), Ouma et al. (2007), Zander (2006) Roessler et al. (2007), and Ruto et al. (2008).

smallholder community in this part of Ethiopia depends on semi subsistence agriculture and so livestock development interventions should focus on reproductive and adaptive traits that stabilize the herd structure, rather than focusing on traits that are only important for commercial purposes.

With regard to the implications on genetic resources' transfer, economic values imply implicit prices which consumers are Willing to Pay (WTP) for a type and level of a trait of a given animal. Like any other normal good, the market for genetic materials follows the basic principles of demand and supply. Therefore, valuation efforts will send price signal for marketers facilitating local, regional and even global transactions/ transfers of genetic resources. This can simply be associated with the fact that the WTP's imply the perceived utility from each of the attributes of the genetic resources. This perceived utility is the one that governs the demand for the resources. The change in perceived utility or demand will through market forces, dictate the supply to respond accordingly.

All this implies the fact that the status quo of genetic material transfer across boundaries might not continue. One important force looming in significance in this market is climate change and its consequences. Climate change is characterized above all by increases in temperature, variability in climatic forces, and erratic pattern of these forces. This apparently indicates that focus only on productive traits will be less sustainable as the significance of adaptive traits will be pronounced due to the precariousness of the change in climate. The focus would therefore be maintaining and transfer of adaptive traits of genetic resources both at local and/or global level. Specifically, in the short run, the current trend of transfer of genetic materials that carry productive traits from North to South seems to continue. In the long run, however, genes that carry adaptive traits will start to flow from South to North. Estimation of the values of preferred attributes will lubricate this transfer or the forum for the exchange of genetic materials.

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D. Differences between plant and animal genetic resources

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There are a series of differences in plant and animal breeding that must be taken into account in the discussions on the creation of property rights to animal genetic resources for food and agriculture and the possible negotiation of recommendations, guidelines or even an international treaty for AnGRFA.

There are the very basic differences consisting in the fact that farm animals, with the relative exception of pigs and chicken, produce little progeny per female. This leads to a higher market value of the individual animal; different access regimes and the prevalence of bilateral exchange based on private property rights. Therefore, – in contrast to PGR – there is not much discussion about the ownership of animal genetic resources. The farmer owns the animal and its genetic composition after purchasing semen, embryo or animal. The price is determined by the genetic value. Because resorting to other breeding programmes is very beneficial, there is active international exchange of breeding animals by private-private transactions. In EU, the information standards in the exchange are set by the zootechnical legislation. WTO ruling contains sanitary measures for animal trade.

An important source for the divergences in animal and plant breeding is the genetic setup of farm animals and plants respectively: Farm animal populations are evolving through selection. The main resource for genetic change is genetic variation within the animal populations. In contrast to PGRFA, there is much variation within animal populations and 20-30% of the visible variation is genetic. Populations are dynamically changing and in each generation, the genetic variation is increased by some 0.1% due to mutations. Accordingly – in contrast to plants that depend on continuous introgression of new genetic material – animal populations harbour in each individual enough variation for change and for compensating any side effects of selection.

It would be ideal to have very uniform animals for production (and genetic variation only in animals used for selection). This could only be achieved by standardising the production environment and feeding, as it is impossible to achieve genetically identical individuals. Cloning is almost impossible in animals and homozygosity can be enhanced only by inbreeding. Therefore animals used for production exhibit the same amount of genetic variation as those used for selection. This is the same for lines used for making crossbred production stock. Hence, farmers have access to all the genetic variation and can therefore carry out efficient selection themselves. The current farm animal species have been domesticated 5000-15000 years ago. There were several domestication sites and events. In turn, cultivated plants stem from a few centres in the world that are very rich in genetic variation. The empirical selection by people raising animals produced local strains and types adapted to the natural environment, available feed and human needs. Such populations were later called local breeds. The concept of "breed" became popular in the late 19th century. Scientific selection started in the 1940's and focussed the efforts on the most productive animals and their crosses. Consequently, many local breeds became neglected.

A breeding programme is made of several steps: 1) collection information on pedigree, performance, product quality, health, including molecular genetic typing, 2) ranking individuals genetically, 3) using the best ones to produce the next generation. The faster the turnaround of each generation, the more efficient a selection scheme.

In farm animals, the breeding programmes are run by farmers' co-operatives or breeding companies. A modern breeding programme is paying much attention also to maintaining genetic variation for future. The long-term success of selection is achieved by ensuring a balanced representation and use of family lineages in the selected stock. The long-term survival of genetic variation in farm animals depends therefore on the soundness and competitiveness of breeding schemes. In conclusion, the amount of genetic variation, (i.e. the genetic information and the genetic resources) in farm animals is the same in production animals and in animals selected for breeding programmes.

Plant breeding can resort to a wide range of tools (methods?), such as crosses over species, changes in the chromosome sets, and so on. Even today, plant breeding can easily make use of the genetic variation in related wild species. In turn, the varieties used in production are usually very homogenous. Homogeneity is achieved by continuous inbreeding or cloning. Yet, there is a need of continous genetic improvement of the varieties to maintain productivity. Therefore, plant breeding depends on access to and exchange of genetic material and information.

Plant breeding takes place in breeding operations run by public breeding organisations or private enterprises. There are a series of gene bank collections maintained by public funding. The International Treaty on Plant Genetic Resources (2004) is stipulating the free use of such gene banks for the species most relevant for food security. Access is facilitated by a standard procedure for material transfer.

Protection of plant varieties resembles patent like principles. Less homogenous animal breeds are in this sense very different from plant varieties. In animal breeding, the clearest patentable objects are the molecular genetic findings which can be exploited in selection.

Animal breeds are roughly speaking of two different types: local traditional breeds and modern commercial breeds. The local breeds are now exploited in promoting local culture and in preparing and marketing specialised products. In contrast to the gene transfer in PGR, the introgression of desirable traits from exotic local breeds to commercial breeds has failed so far. There have been several attempts to revolutionise genetic make up of animals by gene transfer but the results have been disappointing in large animals. The most promising cases are in fish. Moreover, the public opinion is strongly against producing food from transgenic animals.

The genetic resources of plants and animals are both very important for the development of food production and they both should have lots of attention. There are also pronounced differences between them which could be summarised as in the table here below.

	Plants	**Animals**
inbreeding	used extensively	not desirable
value of individual	low	high to very high
testing costs	inexpensive	expensive
genetic modification	possible/efficient	difficult/not accepted
exchange	South → North	N→N and N→S
ownership	public genebanks	private

patentability	varieties (TRIPS)	breeds not patentable
centres of origin	well defined	multiple domestication
trading	farmers'/breeders' rights	bilateral agreements

Many of the properties of animal genetic resources and breeding are further discussed by Ivankovic (2008), Hiemstra et al. (2006), Mäki-Tanila et al. (2007) and Oldenbroek et al. (2007).

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E. Current and projected future flows of AnGR between countries and regions

By **Anne Valle Zárate** – Institute of Animal Production in the Tropics and Subtropics, University of Hohenheim; Germany

Livestock breeds have been developed over time out of samples of the global genetic genepool through natural selection in adaptation to specific local environments, accompanied by artificial selection, resulting from wishes and skills of specific local people. Human and livestock migration led to a continuous influx and outflux of genes in livestock. Breeds arose through natural mutations, having better survival or production characteristics, and genetic drift resulting from accidental sampling processes in small populations. These processes led to fixation or loss of genes, gradually modifying livestock populations. They can hardly be quantified in specific cases, and not at all on global level. Thus, there are limitations in tracing back the past flows and even stronger limitations in documenting current flows. The projection of future flows escapes scientific procedures.

A study has been implemented, trying to document the exchange of livestock genetic resources, and describing the status, influence and trends of global genetic gene flow in livestock genetic resources. It includes separate global studies and case studies for the four major livestock species: sheep, goats, cattle and pigs.

1. Case study: The worldwide gene flow of the Improved Awassi and Assaf Sheep breeds from Israel

Sheep gene flows were relatively small in number and extent. Transfers were mainly conducted by private initiatives of single breeders. In Israel, within-breed selection in the unimproved sheep started at the beginning of the 20th century, resulting in the formation of the Improved Awassi strain, also incorporating local breeds from neighbouring countries. To improve its prolificacy, the Improved Awassi was crossed in the 1960s with the East Friesian Milk sheep from Germany, resulting in the formation of the Assaf that has nearly replaced the Improved Awassi in intensive production systems in Israel. Recently, the Booroola gene, a major gene coding high prolificacy, was introgressed by crossbreeding to the Improved Awassi and the Assaf resulting in two new strains, the Afec Awassi and the Afec Assaf, respectively. Since 1965, the Improved Awassi has been transferred to 15 different countries in Southern and Eastern Europe, Central Asia and Oceania. The gene flow of the Assaf started in 1977. In total, 10 transfers to 7 different countries were realised, mainly to the Iberian Peninsular. No Assaf breeding material has been transferred to Eastern Europe, Central Asia, Australia or New Zealand.

1. Case study: Boran and Tuli cattle breeds – Origin, worldwide transfer, utilization and the issue of access and benefit sharing

Movements of breeding animals were best documented in cattle due to early establishment of breeding organizations. Main directions of cattle transfers were initially E-W and N-S, but more recently, W-E as well as S-S movements have gained importance. African indigenous cattle breeds, particularly the Boran and the Tuli, have received increasing interest in the past as a source of genetic diversity with potential to improve cattle production in sub-/tropical environments worldwide. Because of their adaptability and productivity in tropical conditions, Boran and Tuli cattle attracted the interest of livestock scientists and the international beef industry. In 1988, first Boran and Tuli embryos have been imported to Australia from Zambia and Zimbabwe. In 1991, Boran and Tuli embryos were exported from Australia to the USA. Both breeds also found their way into the Australian, American, and South American beef industries through various other channels, however in limited extent.

2. Case study: Impact of the use of exotic compared to local pig breeds on socio-economic development and biodiversity in Vietnam

Vietnam owns a considerable variety of local pig breeds, adapted to prevailing low internal input production systems. The introduction of pigs and breeds from neighbouring countries started centuries ago, as part of human migration, occupation and trade. The influx of breeds was an important component in the development of Vietnamese local breeds.

Higher-yielding breeds from Europe and America were introduced due to their higher performances to improve or replace the low yielding local breeds. Data on recent transfer of breeding pigs were difficult to obtain because of the structure of modern pig breeding with main emphasis on hybrids and the leading role of few breeding companies in worldwide distribution of pigs. Gene flow in the recent past and present has caused a net inflow of pigs into Vietnam. The influx of exotic breeds has positively influenced output and efficiency of pork production in Vietnam, but also threatens local pig populations, putting them at risk of extinction.

3. Conclusions

Flows of animal genetic resources in the past were characterized by sporadic gene flows from outside a region and long periods of consolidation under the impact of adaptation and local knowledge. Increased global mobility, technical innovations facilitating the transport of animal genetic resources and globalization of commerce with breeding animals enhanced frequent gene flows N-N, N-S and S-S since the 20th century, resulting in a globalization of the genetic progress. Concentration on a few successful breeds led to their worldwide expansion, often at the expense of local breeds. Particularly breeding programmes in the North concentrated on few productive breeds, aiming at further improving their productive performances, while neglecting adaptation traits. This has often resulted in a loss of adaptation traits. By contrast, due to a lack of impact of gene flows from the North, adaptation traits could be conserved in local breeds in the South. In the 21st century, hygienic concerns and veterinary regulations are increasingly restricting the transfer of animals, resulting in a reduced mobility of live animals, but not in genetic material. Projections for gene flows in the 21st century suggest that there will be an increased impact of genetic material of few globally acting enterprises on N-S and S-S transfers and an increased N-N exchange of genetic material through networking in breeding programmes. Yet it is estimated that the interest of the North in genetic material from the South will increase, serving as a resource for “lost genes” for adaptation, quality and disease resistance traits. Promising new technologies to detect commercially interesting genes in local populations in the South, providing evidence of desired traits in such populations, may ease the mobility of valuable genetic material from South to North in the future, the transfer following individual commercial transaction or international negotiations.

F. Biotechnology in animal breeding – present stage & foreseeable developments

By **Christine Flury** – Swiss College of Agriculture, Switzerland

Over the last decades several scientific developments and inventions revolutionized biotechnology. These changes substantially influenced animal breeding and genetics and are expected to further do so. Here, biotechnologies relevant for animal breeding and genetics are split up in breeding technologies and reproduction technologies and discussed in the relevant subsections below. Expected influences on Animal Genetic Resources (AnGR) are listed and discussed in the last section.

1. Breeding technologies

Developments in the field of molecular genetics, such as the development of the first microsatellite markers for livestock species and the increasing availability of genetic maps (i.e. Bishop et al. 1994) facilitated the marked progress from traditional to modern breeding. Marker Assisted Selection (MAS) allows theoretically for increased knowledge about the black-box DNA. The expectations regarding MAS were high, but could only be fulfilled for a couple of traits/defect genes. One of the success-stories was the detection of DGAT1 – a gene with major impact on milk yield and fatpercentage (Grisart et al., 2002). Beside this, qualitative/defect traits were mapped such as genes influencing coat color (f.e. Joerg et al., 1996) and genes influencing diseases such as BLAD[10] (Kehrli et al. 1990) and Dumps[11] (Schwenger et al. 1993). Beside some success stories the implementation of MAS in conventional breeding programs did not reach the expectations.

The density of available marker data increased markedly in the last years. In December 2008 Illumina Inc. announced the availability of the 50k-cattle-chip and with this the possibility to genotype cattle for more than 50'000 single nucleotide polymorphisms. With this development,

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10 BLAD: Bovine Leukocytes Adhesion Deficiency.

11 Dumps: Deficiency of Uridine Monophosphate Synthase.

the application of Genomic Selection (GS) proposed by Meuwissen et al. (2001) became realistic. It is expected, that this new method will revolutionize existing cattle breeding programs. Simulated results suggest a two-fold increase in selection response with a remarkable decrease of costs applying GS on bulls and bull-dams (Schaeffer et al. 2006). In 2008, the first breeding organizations[12] offered DNA proven bulls. Many more breeding organizations around the world are expected to introduce this new methodology in the near future. However, some questions are still open and need further investigation.

Proteomics is understood as the next level of complexity in studying biological systems after genomics – followed up by metabolomics and interactomics. Proteomics consider the regulatory networks and pathways underlying the expression of important phenotypes, and thus, allow the analysis of gene expression data. For the analysis of gene expression data, micro array technology is necessary, and with this new approaches for data analysis. These techniques are expected to decode the regulatory networks that are underlying several complex traits. At the actual stage, no concrete results which had a direct impact on breeding programs are known, but it is expected that this might change in the future and that proteomics offer new perspectives in understanding complex traits such as bovine reproductive biology (i.e. Wolf et al. 2006).

For the use of transgenic animal models from livestock some knowledge on genes that control characters of interest and their regulation is necessary (Montaldo, 2006). There are few examples from agricultural research, such as the expression of antibacterial substances in the milk to increase mastitis resistance. However, the techniques to obtain transgenic animal species of agricultural interest are still inefficient (Montaldo, 2006). Beside this technological aspect, there are still open questions of scientific evidence as well as public concerns regarding risks of transgenic animal models.

1. Reproduction technologies

Since the late 60's Artificial Insemination (AI) is available for cattle. Today, for the three main dairy cattle breeding programs of Switzerland

12 For example LIC, New Zealand, http://www.lic.co.nz/.

(Holstein, Brown and Red Spotted) the fraction of AI is around 90%. It is expected that this fraction of AI is representative for dairy cattle breeding programs of conventional dairy programs around the world. Frozen semen is transportable and with this tradable, further the health and quarantine restrictions are less stringent than for living animals. About 8% of the total number of deep frozen cattle doses produced worldwide were traded internationally in 1998 (Thibier and Wagner, 2002 in FAO, 2007). According to FAO (FAO, 2007) the Holstein breed was reported by 128 countries and is with this the far most widespread breed. This is not astonishing, as a high fraction of global semen exports is known to belong to this breed.

Semen sexing allows the separation of x and y-sperms and with its use the possibility to increase the number of female calves born. For flow cytometry – the method of choice, a patent was granted. Since 2003 the license belongs to Sexing Technologies, USA.[13] In Switzerland sexed semen is commercially available since 2007.[14] The success rates of sexed semen are known to be lower than for normal semen. Nevertheless the sales of sexed semen are globally increasing and are expected to further do so.

Embryo Transfer ('ET') allows the increase of the reproduction capacity on the female side. Since the 1980s ET is widely used in cattle. So called MOET-programs (multiple ovulation followed by embryo transfer) were established in cattle-improvement programs of the developed world. In such programs the selection gain is increased due to decreased generation interval. The focus of AI and ET is still on cattle, for other species the above-mentioned reproductive technologies are generally not widely used in practice.

The well known sheep Dolly (born in 1996) was the first mammal cloned from an adult somatic cell. Cloning allows the production of genetically identical copies of an adult individual. However, the full identity of clones is not guaranteed due to differences in environmental factors. Today cloning is commercially offered by companies such as ViaGen[15]. The costs for cloning are remarkable ranging from 30'000 $ for a cat to

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13 http://www.sexingtechnologies.com/.

14 http://www.swissgenetics.ch/.

15 http://www.viagen.com/.

100'000 $ for a horse. The application of this technology for animal breeding is expected to be restricted as animal breeding relies on variation and the costs are still far from being economically portable.

1. Expected influences on Animal Genetic Resources

The availability of denser marker maps allows the better understanding of differences between individuals/populations. Differences between local/commercial breeds can be assessed based on this information. Genome-wide marker data might offer new perspectives to describe the genetic diversity of local populations without population information (Flury et al. 2008).

Reproductive biotechnologies mainly focus on cattle. The wide use of AI allowed for a worldwide distribution of genetic material during the last decades. The inappropriate use of AI and unplanned insertion of exotic germplasm is expected to threaten indigenous genetic resources (FAO, 2007). For the future this trend is expected to hold on.

In developed countries the technological progress is expected to go on. The successful application of the presented biotechnologies require high-level inputs (financial-, human-, and technical resources). The State of the World Report (FAO, 2007) highlighted a large gap in terms of capacity of biotechnologies between developed and developing countries. This gap is expected to increase.

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G. What does the animal breeding industry expect from biotechnology developments?

By **Alain Malafosse –** Union Nationale des Coopératives d'Elevage et d'Insémination Artificielle, France; On behalf of the European Forum for Farm Animal Breeders

The concept of breeding includes reproduction and evaluation-selection processes implemented within animal populations to organise replacement of breeding animals of herds with improved progeny, using the best sires and dams genetically evaluated and selected thanks to selection programmes. This paper emphasises on dairy breeding.

Efficiency of the whole process is mainly due to implementation of 'biotechnologies' both in the reproduction and in the selection area and management of data and family information in computers. The goal of biotechnologies is to improve disease free exchange of genetic material and herd efficiency in offering new tools for breeding management – to save time and money and to simplify the farmer's work – and to adapt the genetic make-up of herds to the constant changes of economical conditions. So 'biotechnologies' offer new services to farmers as do new products. It is important to mention that we do not change the genes of the animals, but in the choice of the fathers and mothers and the selection process increase the likelihood that animals are the ideal ones to do their job.

In *reproduction and dissemination of genetic progress*, one may mention two types of techniques: either to get more offspring from superior animals (artificial insemination, embryo production and transfer, even somatic cell nuclear transfer, cloning-not mature and not implemented in Europe); or to choose the sex of the progeny (embryo sexing, sperm sexing).

In *genetic evaluation*, biotechnology of molecular genetics ('genomics') is used according to knowledge accumulated in populations of reference: to improve quality of records thanks to markers (identification, traceability, parentage recording); to eradicate gene defects from animal populations; to genotype breeding animals for simple genes of interest (milk and meat quality, colour). It allows getting genetic evaluation with a reasonable accuracy on economical traits for candidates at a very early age. It is implemented either to improve economical efficiency of selection programmes (same genetic progress with less sires on progeny test) with Markers Assisted Selection or via Genomic Selection allowing a good genetic evaluation of sires with out evaluation on progeny test and reducing costs.

Besides reproduction and genomics, genetic evaluation has taken advantage of the development of computer sciences with implementation of the Best Linear Unbiased Prediction (BLUP) and the possibility to work on huge datasets and render possible genetic evaluation on many traits, including functional traits. Due to the new developments, breeding programmes can become more sustainable, including in poultry over 40 traits to be selected for, including for instance environmental output, health, welfare and efficiency

Biotechnologies are implemented in different species to a different extent: any mentioned techniques are implemented in cattle. In pig, AI with fresh semen is used to a large extent, mostly for genetic dissemination; the same may be mentioned in turkey or rabbits for example. Genomics is implemented in any species as various extend and for various purposes.

'Biotechnologies' also aim at improving the efficiency of selection programmes: genetic progress is created thanks to optimal combination of the available techniques within the breeding programmes. The annual genetic progress is proportional to *selection intensity* and *accuracy of genetic evaluatio*n, and disproportional to *generation interval*. Various biotechnologies are linked to each of these factors. For example in cattle:

- *Artificial insemination* reduces the number of sires necessary for breeding with a factor of 2 000 compared to natural service. It increases selection intensity in using the best bulls in reproduction.
- Progeny testing of bulls is implemented in cattle breeding thanks to *semen freezing*. So only selected bulls with a good accuracy of genetic evaluation are used in AI. Semen freezing has improved tremendously the efficiency of semen distribution.

- Embryos recovered from very young heifers thanks to *Embryo transfer* (ET) technologies, may give quickly birth to young males reducing generation interval.

When looking at the history of biotechnologies one may observe that a lot of innovations in the reproduction area (from AI to somatic cell nuclear transfer cloning) were developed from the late thirties to the late nineties. Molecular genetics (genomics) became implemented from the nineties onward

One may speak about a revolution when implementation of a new technique associated with the former ones changes deeply the conditions of organisation of the industry, of the breeding programmes, and modifies the leadership on the genetic material or on the attached IPs, even if the innovation seems not to be a technological breakthrough as such. Semen freezing (mainly in cattle breeding) and genomic selection belong to the category of revolutionary techniques. Again, the optimal combination of techniques and know-how is crucial in this respect.

Breeding companies are mostly farmer owned organisations in ruminants, partly private companies and farmer's organisations in pigs, and private companies in poultry. Breeding companies use biotechnologies to run breeding programmes, and to offer services to farmers, mostly in the reproduction sector (cattle), or giving feed and management advice (pigs, poultry).. The concrete services offered are a matter of differentiation/ competition between the companies.

The issue of access to gene resources varies from species to species: In ruminants it is necessary to collaborate between breeders and to exchange genes. So there is a sense of collective property of genetics and free access to genes (semen, embryos,breeding aninals).

In the other species the access is done via membership in a cooperative or via companies. In these cases, access to genetic resources is more a matter of discussion, as here crossbred animals are being used by the farmers, the pure lines being developed by the breeding companies.

IP issues related to patenting hardly play a role in animal breeding – they might become more important in the future. Animal breeders work with entire populations in ruminants and with breeding nucleus or lines in the other major species. In poultry and pig, genetic diversity is important in the breeding programme planning. In Code-EFABAR the pig and poultry breeders indicate the ways they forster genetic diversity to ensure broad genetics being available for the future. This – in comparison to plants – implies different ownership patterns. However, there is strong awareness on this issue within both small and large breeding organisations. The goal is to prevent too broad claims, and patents on established techniques (already running business). The European Forum of Farm Animal Breeders – EFFAB is running a patent watch to this end, and the International Committee for Animal Recording (ICAR) is running a "Patenting Sentinel and Action Service"[16]. For instance, the development of the 'leptin gene in pigs' claim and final granted patent in Europe, has been carefully and effectively followed by the professionals in pig breeding.

A discussion was introduced in France in the nineties to deal with the question of IPRs in AnGRFA. Proposals on items for discussion were:

- To set up "un Droit d'Obtention Animale – DOA" an Animal Property Right (in analogy to plant breeders' rights – droit d'obtention végétale);
- To work on the concept of "protection des Polulations Animales Sélectionnées –PAS" "Protection of Selected Populations" (animal populations selected by the owner of the property right, complementary to patents)
- To get the right to the owner of the right to control the use of breeding animals and of the genetic material (semen of a bull may be used to product mlking heifers but not breedind dtocks).

The discussion turned out to be very sensitive. The breeding industry has increased its sophistication in data collection, breeding programming and application of biotechnologies. Constant progress and disease free exchange of genes is due to the optimal implementation of these techniques. Biotechnologies are profitable in economical terms. Yet, the first benefits will be for the farmers that assure affordable food..

[16] http://www.psas-web.net.

Information and exchange on genetic resources can also concentrate on improving the fruitful links between animal breeding, small and large, and research, globally.

In the Sustainable Farm Animal Breeding and Reproduction Technology Platform, it became clear that new technology and knowledge developments tend to take place first at the larger and some specialised knowledge nodes. Implementation of new developments is often taking place first in larger breeding organisations where expertise and financial resources make it accessible. Then, because the knowledge development in animal breeding is so open, further development and diversification takes place in smaller institutions – research and breeding. Also, scientific developments on small populations or genetic diversity can and make use of the technology developments in 'large' breeding – and vice versa. The close cooperations that thus take place are the real 'intellectual property' in breeding – fostering this cooperation and exchange is important.

Research is essential to improve or to develop new biotechnologies. Public transparency and discussion are also important.

Investments, mastering of research projects, intellectual property matters, maintaining know-how, transparency, dialogue and capacity of assessing offers on the market are at stake for the breeding industry.

H. Legal questions resulting from biotechnology developments in animal breeding: patent law

By **Michelangelo Temmerman –** World Trade Institute; Switzerland

Among legal questions that have arisen with the advent of biotechnology and its increasing use in AnGRFA, the questions of intellectual property protection and their impact in the field are of great importance. Most notably, the entry of biotechnology in this field coincides with the entry of patents.

Unlike *trademarks* and *geographical indications* – IP rights that have been in use for decades in AnGRFA – *patents* cover the genetic material and its use as such. Unlike the former rights that cover the use of protected commercial signs and names, patents thus allow the right holder to exclude others from accessing the material, namely the animal.

It is important to anticipate the effects patents can have when entering a new field of agriculture like AnGRFA. Whereas they have some record of being applied to genetically engineered animals intended for medicinal research, agricultural applications are more recent. The main impact of biotechnology on agriculture and thus AnGRFA today is found in the application of selection processes comprising certain biotechnological steps such as marker selection. Transgenic animals for agricultural purposes are still scarce. Analogies may be drawn from the application of patent law to plants, a field with over 20 years of patent influence, but this must be done taken into account the biological and organisational differences of animal agriculture.

The potential impact of the entry of patent law can be felt on several layers. It mainly affects the possibility of gaining access to genetic material and thus also to the animals. It influences the ownership structure and can provoke a shift in control from farmers to the right holders or inventors. The traditional rule that ownership of animals includes the right to the subsequent generations is reversed in relation to patent-protected animals. Here the owner of the individual will need authorisation (licence) of the patent holder to reproduce it. Whereas genetic resources where accessible by owning the tangible animal before, this is no longer the cases for those resources that are being patent protected. This is a logical consequence of the 'technologisation' of agriculture, and only applies to those animals that pass the patentability tests and are thus considered new, inventive and useful *inventions*. More problematic in this field, as is being discussed below by Then and Bilang, are patents granted to breeding or production methods that do fulfil these criteria, yet also extend to the animals that are the outcome of these methods but cannot themselves cope with the patentability requirements.

The patent system is considered necessary or at least useful to encourage and finance the realisation of the prospects of biotechnology in this field, yet it must be balanced to the (short-term) needs of farmers and it must be avoided that the system is used for mere commercial purposes in a way that distorts the patent system from benefiting society at large. This raises the question of farmers' privileges (possibly specific to small-scale farmers) and the strength of research exemptions in patent law for instance. It also entails considering a system that rewards the contribution of farmers to the creation and conservation of AnGRFA.

The AnGRFA example of the markets for poultry and pig shows a setting that evolved into a very strong concentration without the interference of patents. This is an opposite situation from PGRFA, where patents are an essential tool to the monopoly positions of commercial giants such as Monstanto. From the 'IP side', only secrecy and hybridisation have played a role in AnGRFA. In the light of the erosion of AnGR and the increasing genetic uniformity of products on the markets, it appears essential to correct what we may call a market failure of marketed biodiversity: the situation where a small number of companies monopolise a market with genetically uniform animals. Among the tools classically capable of correcting market failures and changing the shape of a market (next to subsidies or tax incentives, for instance) IPRs may thus have a (positive) role to play in bringing niche products or new breeds on to those concentrated markets in a competitive way. This, as much as eventual downsides, much also be taken into account and analysed when the introduction of patents is discussed. It may however mainly bring food for thought in relation to an eventual sui generis IP protection system.

It takes two different yet eventually converging analyses to assess the effects of patents entering the AnGR field. First one must look how strong – technically speaking – patent rights will be, given the nature of the inventions and the nature of the patent system. This includes, for instance, an analysis of the potential extension of patents granted for (production or selection) methods for the animals that are the result of those processes. It also requires an assessment of how many subsequent generations of a protected animal will remain under the patent right and thus under the control of the right holder. At the same time, secondly, one must consider the appropriate level of protection, a non-legal issue, so as to be able reach a point where both legal and non-legal analyses ultimately converg. The technicality of the (patent) law and the needs of the practice must both be analysed and applied to each other before taking measures.

I. "Monsanto pig" and "Brassica" or the open question of what is an "essentially biological processes"

By **Jürg Bilang –** European Patent Office, Germany

The European Patent Convention lists a few exceptions from the general principle that patents can be granted in all fields of technology. Two of these exceptions are relevant for biotechnological inventions: The exception of inventions, which are contrary to the ordre public (Article 53(a)), and the exception of plant and animal varieties as well as essentially biological processes (Article 53(b)).

The interpretation of the latter exception is the subject of two referrals to the Enlarged Board of Appeal at the EPO. Based on the well-known "Brassica patent" (EP 1 069 819) the Board is requested to clarify to what extent human intervention is necessary to take a claim out of the exception of Article 53(b).

Another patent which attracted public attention is the "Monsanto pig" patent (EP 1 651 777). However, much of the criticism is based on the application as filed, on the contents of which no patent office has any influence. As a consequence of the examination proceedings before the EPO the granted patent comprises no claims directed to animals (pigs).

J. Opposition against patent on pig breeding – the reasons

By **Christoph THEN –** Testbiotech e.V., Germany

1. Introduction

The so-called patent on pig breeding (EP1651777) should be seen in the light of the general debate about 'patents on life'. This discussion is going on in Europe since about 20 years. There are several arguments raised against those patents:
(1) General ethical arguments such as living nature should not be seen as a technical invention;
(2) Scientific arguments such as a gene sequence is not just a chemical compound but a kind of context dependent information with a lot of potential functions. Thus a company that is the first to isolate a gene sequence should not get a monopoly on all of its functions;
(3) Social and economical reasons: Patents can block access to genetic resources and thereby hamper innovation. This aspects are all discussed as well in the context of agriculture, plant and animal breeding as in the area of medical research.

2. Legal frame in Europe

Despite criticism from many stakeholders, patents on genes and living organisms are granted at the European Patent Office (EPO) and many applications are pending. According to figures of the EPO (DVD-ROM Espace EP-B Vol. 2009/001), more than 2000 patents are already granted on gene sequences from humans and / or animals. Nearly 800 patents are granted on animals, about 1200 on plants.
The legal basis for these types of patents is the EU Directive on "Legal Protection of Biotechnological Inventions" (98/44/EC) that was finally adopted in 1998 and integrated into the regulations of the EPO. It became Rule 26-29 of the European Patent Convention (EPC), which is the legal basis of the EPO (which does not belong to the institutions of the EU).
The directive prohibits patents on plant and animal varieties, which are also excluded by European Patent Convention (Art 53b) but allows

patents for "inventions which concern plants or animals (...) if the technical feasibility of the invention is not confined to a particular plant or animal variety."(Art. 4 (2) of Dir. 98/44)

Furthermore, the directive exempts "essentially biological processes for the production of plants or animals" which are also excluded under European Patent Convention, EPC (Art 53b) from patentability. However, the directive defines biological processes in a way that it is difficult to apply this exemption in practice: "A process for the production of plants or animals is essentially biological if it consists entirely of natural phenomena such as crossing or selection." (Art 2 (2) Dir. 98/44)

The EPO admits some difficulties to understand this definition of the EU Directive 98/44, which became part of Rule 26 (5) of the EPC. In its decision T83/05 the Board of Appeal of the EPO states:

The wording of Article 2 (2) Biotech Directive (...) is, in the view of the board, somewhat difficult to understand. On the one hand, only processes which consist entirely of natural phenomena are considered as essentially biological processes for the production of plants. On the other hand, crossing and selection are given as examples of natural phenomena. This appears to be self-contradictory to some extent since the systematic crossing and selection as carried out in traditional plant breeding would not occur in nature without the intervention of man." (page 336/37, paragraph 53).

Even the scope of the patents is regulated by EU Directive 98/44. In Article 8 the scope of the patents is extended to all further generations showing the relevant genetic features:

"(1) The protection conferred by a patent on a biological material (...) shall extend to any biological material derived from that …

(2) The protection conferred by a patent on a process (...) shall extend to biological material directly obtained through that process and to any other biological material ...".

3. The pig patent and reasons for opposition

EP 1651777 (applied by Monsanto, now owned by Newsham Choice Genetics) was granted in 2008. The patent is based on marker assisted selection. It describes a certain genetic variation of the (well known) porcine Leptin receptor. Claimed are genetic variations, which can be found in all pig populations, without defining which of the described variations are the most relevant. Because the claims are not restricted to a distinct variation?, it is difficult to define the scope of the claims. . The pigs produced by this method cannot be distinguished from others. This is a problem under Art. 83 and Art. 84 of the European Patent Convention (EPC) which require a disclosure "sufficiently clear and complete" (Art. 83. EPC) and "the claims shall define the matter for which protection is sought."(Art 84, EPC).

Further Article 56, EPC comes into play: Regarding the true technical 'inventive' substance of the patent, the technical input is relatively minor or even trivial and can hardly be seen as inventive. Most of the technical elements described in this patent were already known by prior art. This becomes evident even by careful reading of the technical description of the patent. Since the patented features lack sufficient "inventive step", the patent might be withdrawn for technical reasons.

Coming to the issue of essentially biological processes for the production of animals which are excluded from patentability in Europe (Art 53 b, EPC), the most relevant parts of the patent are claims number 3 and 4. These claims read as follows:

Claim 3: "A method of enhancing a trait selected from the group consisting of: average feed intake and/or average daily weight gain, backfat, muscle mass, water holding capacity, meat colour, meat pH, intramuscular fat, meat tenderness, and/or cooking loss of animals in a pig herd, the method comprising:

a) screening a plurality of pigs to identify the nature of an allelic variant in the porcine leptin receptor (pLEPR) gene(...)

b) selecting those pigs having a desired allele; and

c) using the selected pigs as sires/dams in a breeding plan to produce offspring; wherein the offspring have an increased frequency of the desired allele."

Claim 4: "A method of enhancing meat production from a swine herd comprising:

a) screening a plurality of pigs to identify the nature of an allelic variant in the porcine leptin receptor (pLEPR) gene (...)

b) selecting those pigs having a desired allele;

c) using the selected pigs as sires/dams in a breeding plan to produce offspring, wherein the offspring have an increased frequency of the desired allele; and

d) repeating steps a) through c) until an increased allelic frequency for the desired allele is achieved."

The way these claims are phrased, they can be interpreted as a method of production of pigs and meat: The claims are not restricted to a method of screening or selection, but combine the steps of selecting with further steps of breeding. As a result, even the pigs (and meat) can be seen as being within the scope of these claims (product by process) and Article 8 of Directive 98/44 (as cited above) could become relevant.

Regarding the technical nature of the claims and the overall process of breeding, there are some technical elements in the claims (the identification of variants within in the leptin receptor gene), which might be patentable (if inventive) as a method for screening. However, this technical detail does not turn the whole process of breeding into a technical process in my view: The pigs are not changed in their genetic conditions; they even cannot be distinguished from other pigs that existed before. The wording of these claims provokes a conflict with Art 53 b, EPC, a matter that is also discussed in precedent cases at the enlarged board at the EPO (G2/07 and G1/08).

4. The precedent cases

The case of the pig patent has to be seen against the background of a two precedent cases pending at the European Patent Office (EPO), which are concerning plant breeding (G2/07 and G1/08). In EP 1069819, 'the patent on broccoli', a method of breeding is claimed as well as plants, seeds and the relevant food products. EP 1211926, `the patent on wrinkled tomato', concerns tomatoes with reduced water content and the related breeding methods. Both cases deal with conventional breeding and essentially biological processes in a similar way as it is the case with the pig patent. It is expected that the EPO's Enlarged Board of Appeal will take a decision on these cases (earliest) in the end of 2009. The decision is likely to influence the general interpretation of Article 53b, EPC, and it's connected Rules. Thereby it can have a major impact on the patentability of conventional breeding of plants and animals in Europe.

5. Need for clear regulations

According to the groups and institutions opposing such patents as the pig patent (see www.no-patents-on-seeds.org), access to genetic resources should be kept open, being a precondition for any kind of food production. The take over of global food production via patents by international corporations are seen as potential reason to enhance international food crisis.[17]

Similar concerns are shared for example by the International Assessment of Agricultural Science and Technology for Development (IAASTD), 2008: "In developing countries especially, instruments such as patents may drive up costs, restrict experimentation by the individual farmer or public researcher while also potentially undermining local practices that enhance food security and economic sustainability"[18].

In the light of this discussion, the international community should seek ways and means to counteract patents such as EP 1651777 not only case by case but by general legislation, establishing clear regulations that cannot be circumvented by tricky wording of patent claims . IPRs related to breeding of plants and animals have to be regulated in way that safeguards open source mechanisms for further breeding. What needed is a general prohibition of patents on processes for breeding in plants and animals and products derived therefrom.

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17 See the report "The Future of Seeds and Food": http://www.no-patents-on-seeds.org/index.php?option=com_content&task=view&id=91&Itemid=42.

18 http://www.greenfacts.org/en/agriculture-iaastd/l-2/3-biotechnology-for-development.htm#0.

K. Trade in animal genetics, competition and concentration

By **Susanne Gura** – League for Pastoral Peoples and Endogenous Livestock Development; Germany[19]

Consumers are usually not told which breed of chicken, cattle or swine have produced the eggs, milk and meat offered in the supermarkets or the butchery shops. They should get interested, since they are contributing to the development of a global genetic monoculture. Meat processing factories and factory farms want uniform animals. Hardly noticed by the public, a concentration process is taking place not only in livestock production and processing, but also in the livestock breeding industry.

Only four companies supply the majority of genetics for commercial layer hens, broilers, turkeys and other poultry. The production of hybrid end products and an associated structure, where multiplication and production are separated steps, allow for a de facto proprietary control over the breeding lines. This has strongly contributed to the extremely high concentration. Around two thirds of the world's broiler and half of the world's egg production are industrialized.

Pork, which is the most consumed type of meat in the world, is already industrialized to one third of global production. Hybrid pig lines are increasingly used, again with the separation of multipliers and fatteners, so that breeding companies can make sure that their breeding lines are not used by others for further breeding purposes. Concentration is fast increasing, and the genetic monoculture is increasing as well.

In cattle, although there is no hybrid breeding yet and the animals are usually owned by farms less large than the poultry and pig factories, genetic monoculture has reached a similar level. A bull, with the help of artificial insemination, can have a million offspring. The dairy and meat producing communities cultivate their stars and pay high prices for a

19 Excerpt from Susanne Gura, Livestock genetics companies. Concentration and proprietary strategies of an emerging power in the global food economy, League for Pastoral Peoples and Endogenous Livestock Development, 2007, http://www.pastoralpeoples.org/gura_livestock_genetics.htm.

straw of frozen semen. Not surprisingly, the artificial insemination companies want to clone their best bulls. Cloning so far is not primarily meant for the dinner plates but to complement gene technologies.

Over past decades, breeding objectives focused almost exclusively on performance: yearly egg production, milk yields, milk fat content, and growth rates. Efforts were concentrated on only a handful of breeds of cattle, pig and chicken. Substantial production increases were thus achieved – but only if the feed quality and quantity to make use of the better feed conversion rate is also provided.

As a result, high-yielding livestock populations have become genetically very uniform. For most industrial breeds of cattle and pig, the "effective population size", a parameter used by experts to calculate genetic diversity, corresponds to less than the 100 animals required to maintain a breed.

Poultry breeding industry insiders maintain that there is sufficient genetic variability within and between the lines. However, there is no such proven information for poultry – the companies are keeping the breeding lines as trade secrets. With the onset of gene technology, companies who thus far focused on just one species, started to get interested in others. In 2005, the world's largest pig and cattle breeding companies PIC and ABS were merged into one company, Genus plc, which also incorporates shrimps genetics. The size of livestock breeding companies as such are 7 medium scale, with so far at most 2000 employees, and annual turnovers probably not exceeding 0,5 billion €, where information is available. However, they are usually integrated vertically with feed producing and/or meat processing companies, such as the US meat giant Tyson.

The US company Monsanto, better known for its leadership in genetically modified seed rather than in livestock genes, may soon dominate gene markets not only with regard to plants but also livestock, thanks to an aggressive policy of acquisition, cooperation and patent policy in cattle and pig genetics.

The rate of loss of the world's livestock breeds has recently accelerated to one breed per month, while it was around one breed per year on average during the last century. Trade liberalization contributes to an unprecedented growth in international trade of livestock products, and it is not the products of smallholders that are moved around the globe. In contrary, smallholder products are often wiped off markets, once a trade agreement allows foreign products in, or sanitary standards tighten. Smallholders get a tiny fraction, if at all, of the subsidy support industrial production and trade is receiving. Regulations usually work against smallholders and in favour of industrial production, although smallholders, in some countries, contribute up to one third to the nation's economy.

Alternatives are rather diminishing than increasing. The slowly but steadily growing global organic sector has problems to find livestock adapted to is production systems, especially in poultry. Local breeding in developing countries is usually not supported by national policies or development organizations.

The United Nations are currently raising the issue of the erosion of genetic resources, and the resulting threats for livelihoods and agricultural biodiversity. In Europe, where awareness about the roles and values of breeds has already reached the political level, conservation programmes are implemented. Thus, no more breeds have been lost in some of the European countries.

However, what is being lost is food and cultural diversity, and food sovereignty. We also experience increased public health problems due to excess livestock based food intake, as well as animal welfare and disease problems, and environmental pollution. A few globally operating genetics companies determine what choice consumers have. Acting as if consumers all over the world want ever larger quantities of ever cheaper meat, milk and eggs without caring for environmental, social and cultural impact, they are expanding their market.

L. A need for changes to the AnGR regulatory framework?

By **Sipke J. Hiemstra & Milan Ivankovic –** Centre for Genetic Resources; the Netherlands

The FAO Commission on Genetic Resources for Food and Agriculture (The Commission) has recognized the importance of conservation and sustainable use of animal genetic resources for food and agriculture (AnGR). The Commission approved the finalisation of the first Report on the State of the World's Animal Genetic Resources (FAO, 2007) and the Global Plan of Action and the Interlaken Declaration were adopted at the First International Technical Conference on Animal Genetic Resources (September, 2007).

Within the framework of these developments, the Centre for Genetic Resources (CGN) carried out two studies[20], in collaboration with partner organisations, i) Exchange, use and conservation of AnGR: policy and regulatory options (Hiemstra et al., 2007), and ii) Analysis of applicability of Access and Benefit Sharing (ABS) principles on Animal Genetic Resources (AnGR) (Ivankovic & Hiemstra, 2008). The aim of these two studies is to support informed and evidence-based decision-making by exploring a range of policy and regulatory options for AnGR. The current state of affairs was analyzed in detail and we consulted a variety of stakeholders in the livestock sector. Also four emerging challenges (globalization, biotechnology, climate change, emerging diseases and disasters) were identified and future scenarios were used to discuss the need for a change in the regulatory framework for AnGR.

Domestic animals supply 30% of total human requirements for food and agriculture and 70% of the world's rural poor depend on livestock as a component of their livelihoods. The global livestock sector consists of a variety of production systems and farm animals used for a wide variety of functions. Centuries of selective breeding and exchange of farm animals or germplasm within and across countries have resulted in the development of the current diversity of breeds and within-breed genetic

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20 Publications available on www.cgn.wur.nl.

diversity. The exchange of AnGR has played and will continue to play an important role in breed and livestock sector development.

There is consensus that global AnGR diversity is under pressure. The existence of threats to AnGR is generally accepted, even though debate remains about the severity of genetic erosion.

Exchange of genetic material between developed countries (North to North) is dominant and – driven by globalization – high performing breeding stock is exported from North to South. South to South exchange has also been extensive and important for livestock development. However, such exchange has been much less well documented. Movements of livestock germplasm from South to North have been rare in the past century, and in most cases, the economic benefits to both North and South have been relatively small. This is in contrast to plant genetic resources, where South to North flows are prominent, mainly driven by the search for new disease resistances and adaptive traits to be incorporated in new plant varieties.

International, regional and national law, as well as customary law at community levels, are all relevant for AnGR. Although not designed primarily for AnGR, international agreements with a general scope (CBD, WTO/TRIPS and WIPO Treaties) also apply to AnGR. Currently, the exchange of AnGR is mainly regulated by the transfer of private ownership (by private law contracts and customary law) and is also influenced by zoo-sanitary regulations. As the implementation of the above international treaties with a general scope advances further, they may have an increasingly significant impact on AnGR exchange, use and conservation.

Core elements of the International Treaty on plant genetic resources for food and agriculture (ITPGRFA) are the inclusion of farmers' rights and the multilateral system of access and benefit sharing to cover the genetic resources of major food and fodder crops that are under the control of the Contracting Party Governments and the international gene banks. Debates and developments related to international agreements in the crop sector have tended to frame the debate for AnGR as well. In order to assess the need for any specific AnGR policies and regulations, key differences between plant genetic resources for food and agriculture (PGR) and AnGR were identified. These include important biological, historical, socio-economic and institutional differences. These differences need to be understood and to be brought into the policy, regulatory and legal discussions about AnGR.

A number of policy and regulatory options were identified. Genetic erosion may be minimised through a variety of (complementary) ex situ (in vitro) and in situ conservation approaches, organised at national, regional and/or global levels. Many stakeholders in the livestock sector feel that there are currently few major limitations related to the exchange of AnGR (other than zoo-sanitary regulations) and that exchange should not be unduly frustrated by needless administrative barriers. At the same time, potential negative impacts of exchange should be avoided. While there are many positive examples of the introduction of 'exotic' genotypes, they are not always well adapted to the environment or the production system. We suggest to consider development of an international voluntary instrument or set of instruments for the responsible exchange of animal genetic resources. The development of (genetic) impact assessment methods or instruments may be worth considering. It may also be useful to develop a model Material Transfer Agreement (model MTA) for AnGR at the international level. This could support the responsible exchange of AnGR and could be largely based on current exchange practices, as well as covering all important negotiation issues relevant to AnGR exchange. Development of such a model MTA may become particularly important if patterns of gene flow were to change substantially in the future.

AnGR are mainly under private control and ownership, and cannot generally be considered to be in the public domain. It is a general belief that the current exchange of AnGR has generated benefits for both seller and buyer under the present circumstances where private law agreements have been in use. However, there are some cases where stakeholders consider that benefit sharing has not been sufficiently catered for. It is argued that relationships between stakeholders are becoming increasingly unbalanced. In particular globalization and changes in business organisation (e.g. global sourcing, standardisation, vertical integration and lengthening supply chains) are generating an increased concern about equity and the position and rights of livestock keepers and smallholders.

A sui generis protection system for AnGR could be useful, particularly where based on the establishment of breed associations (possibly associated with trademarks), geographical indications, the protection of traditional knowledge and livestock keepers' or breeders' rights. The fact that the concepts of plant varieties and animal breeds are quite different implies that the present system for plant breeder's rights (for example the UPOV sui generis system) is unlikely to be applicable to the livestock sector in the same way. For a sui generis system to be adequate for the animal sector, the particular needs for legal protection must be further analysed carefully. Legal and political aspects of 'livestock keepers' rights' would also need to be further explored and might contain similar provisions as those on 'farmers' rights'.

Access and Benefit Sharing negotiations under the CBD have not finished yet, but it is expected that a certain regime will be created. There are many speculations about the form that ABS will take with respect to AnGR. Many stakeholders agree that ensuring wide access to genetic resources and equitable frameworks for benefit sharing both on the national and international levels are a prerequisite for sustainable use of livestock biodiversity, its further development and continued availability for the generations to come.

The majority of stakeholders in the ABS debate with respect to AnGR believe that having a single all-inclusive regime is far from ideal, given the differences between PGR, AnGR (and microbial GR) and non-domesticated biodiversity. Some stakeholders are even questioning the need for an international ABS regime encompassing AnGR, because existing national ABS legislation together with other relevant legal frameworks would already regulate ABS to a satisfying degree. Additional international ABS provisions would only impose additional transaction costs without adding anything new to current ABS practices. However, the questions is not whether we need an ABS regime, but on how to design ABS principles and mechanisms which are also addressing the specific nature of AnGR. A specific sub-regime for AnGR under the auspices of an overall ABS regime could address the specific nature of AnGR in a more detailed and precise manner.

An interesting suggestion is to continue using the existing frameworks (such as the European legal framework for the breeding organizations) and to try to supplement them with additional ABS-derived elements. Some recommend that this approach would be more functional than establishing an entirely new ABS agreement specifically designed for

AnGR, as it might simply impose higher administrative and legal administrative costs when it comes to exchanging of genetic material.
Adequate supporting measures for farmers who use local and indigenous breeds should form a necessary component of an ABS instrument for AnGR. Creative thinking is needed, for example about alternative ways to subsidize and valorize traditional breeds through products with geographical distinction such as branding and trademarks. This would allow further maintenance of AnGR on-farm.

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M. Livestock keepers' rights

By **Ilse Köhler-Rollefson** – Local Livestock For Empowerment (LIFE) Network, Germany

1. Introduction

Livestock Keepers'Rights are a concept developed by Civil Society during the "Interlaken Process", the run up to the First International Technical Conference on Animal Genetic Resources held in Interlaken in September 2007. They are advocated for by the LIFE ("Local Livestock For Empowerment") Network, a group of non-government organizations (NGOs) and livestock keepers/ pastoralists. The group attributes the loss of many breeds in developing countries to the loss of the traditional rights of livestock keepers to breed, keep and sustain their livestock on common property resources, and supports community-based conservation of local breeds. "Livestock Keepers' Rights" are a set of principles that would enable and encourage livestock keepers to continue making a living from their breeds and thereby achieve the combined effect of conserving diversity and improving rural livelihoods.

The movement had its seed during an international workshop "Local Livestock Breeds for Sustainable Rural Livelihoods – Towards Community-based Approaches for Animal Genetic Resource Conservation" that was held in November 2000 in Sadri, Rajasthan. This was the first event ever to focus on the role of farmers and pastoralists in animal genetic resources conservation and to investigate how sustainable livelihoods and breed conservation could be mutually supportive. Until then farmers and pastoralists were not even recognized as stakeholders in breed conservation that was projected as the domain of governments and scientists. One of the outcomes of the meeting was the "Sadri-Declaration" (Lokhit Pashu-Palak et al. 2002), a statement about the importance of local livestock breeds for rural livelihoods. The declaration was widely circulated, marking the beginning of the movement for Livestock Keepers' Rights leading to the foundation of the LIFE Network.

To reach the goal to support local communities' in their endeavour to make a living from their livestock, the LIFE network developed a participatory method for documenting breeds that made evident the role of livestock keepers and their indigenous knowledge in (stewarding) safeguarding / for the stewardship of farm animal diversity. Scientific methods of breed characterisation focus only on phenotypical characteristics of breeds. The method developed by the LIFE Network demonstrates that livestock breeds are products of communities and their indigenous knowledge, thereby putting to rest the belief that breeds in developing countries are the product of natural selection alone (Lokhit Pashu-Palak Sansthan and Köhler-Rollefson 2005).

In order to emphasize that breeds are socially embedded and the products of active efforts by communities and breeders associations, the term "Livestock Keepers' Rights" was born during the World Food Summit in June 2002. The term was originally coined in allusion to the "Farmers' Rights", enshrined in Article 9 of the International Treaty on Plant Genetic Resources for Food and Agriculture that signpost the recognition of the role of farmers in developing and sustaining crop biodiversity (FAO 2001). This much-discussed right assures farmers of their right to save, use, exchange and sell farm-saved seeds. Bearing in mind the intensifying animal genome research, the advances in genetic engineering and the increasing importance of Intellectual Property Rights (IPR) in the livestock sector, it was considered essential to flag the role of livestock keepers as owners of their respective animal genetic resources.

At this stage the term Livestock Keepers' Rights was still vague but it was subsequently concretized in a series of meetings with livestock keepers, pastoralists and support organisations that took place in Karen (Kenya) in 2003, Bellagio (Italy) in (2006), Yabello (Ethiopia) in 2006, Sadri (India) in 2007 and Addis Ababa (Ethiopia) also in 2007. During these meetings that were attended by hundreds of livestock keepers representing more than 20 countries, the threats to the ability of pastoralists and small-scale livestock keepers to continue acting as stewards of domestic animal diversity were identified. In the course of these consultations, seven key elements or cornerstones of Livestock Keepers' Rights were identified that would enable livestock producers to continue maintaining their breeds.

2. Cornerstones of Livestock Keepers' Rights and their rationale

a) Recognition of livestock keepers as creators of breeds and custodians of animal genetic resources for food and agriculture

This cornerstone was articulated to express the active contribution of livestock keepers in the evolution of breeds and to highlight the fact that diversity is linked to the conservation of a variety of production systems and cannot be maintained in any significant manner by relying on ex situ conservation. Many scientists assumed over a long period that breeds that had no herd books were the product of natural selection only. Accordingly farmers and pastoralists were not considered as stakeholders in the conservation of domestic animal diversity.

b) Recognition of the dependency of the sustainable use of traditional breeds on the conservation of their ecosystems.

This cornerstone accentuates that breeds are embedded into and have been moulded by specific natural environments. Therefore they need to be conserved in the same contexts, in order not to lose their unique adaptive characteristics. This demand links the issue of conservation and sustainable use of animal genetic resources to the access to land and other common property resources.

c) Recognition of traditional breeds as collective property, products of indigenous knowledge and cultural expression.

This cornerstone claims collective ownership of the communities over their breeds and highlights the fact that they are not a free-for-all that can be mined at will for interesting genetic traits. Instead, certain access procedures should be followed in line with the provisions of the CBD that in article 8(j) commits its signatories to respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity. In principle this cornerstone is also supported by the Convention on the Protection and Promotion of the Diversity of Cultural Expressions that was approved by UNESCO on 20 October 2005. This convention defines cultural expressions as those that result from the creativity of individuals, groups and societies and that have cultural content. Breeds fulfil this criterion.

d) Right of livestock keepers to breed and make breeding decisions.

This is perhaps the most pertinent and crucial cornerstone but is not addressed in any existing international agreements. It requires urgent attention since the increasing exertion of intellectual property rights by scientists and industrial breeding companies threatens to interfere with the continued freedom of livestock keepers to use and develop their own breeding stock and breeding practices.

The basic processes that have generated and sustained livestock genetic diversity in the past are thus undermined. With respect to poultry and pigs especially, but also cattle, breeding has already become highly centralized and breeding companies seek to protect their investment through licensing agreements, trade secrets and by means of patents.

Designs to patent breeding practices and genome sequences may well lead to a situation in which livestock keepers who have kept a breed for centuries would need to seek permission from the patent holder to use their own animals for breeding (Tvedt et al. 2007). Such trends will have negative impacts for both breed and intra-breed diversity as well as on the livelihoods of poor livestock keepers.

There is also an inherent injustice in the fact that the traditional knowledge that has gone into the development of many local and indigenous breeds and often forms the foundation and prerequisite for the scientific improvement of breeds remains unrecognized and unprotected. There is thus a need for formal protection of the right of livestock keepers to continue to use their breeds and their breeding practices without having to pay royalties. This issue could be tackled either at national levels or in a multi-lateral agreement. The breeding of livestock should be recognised as an inalienable right and as an important component of the Right to Food.

e) Right of livestock keepers to participate in policy making processes on animal genetic resources issues.

Since livestock breeding communities are crucial actors and key stakeholders in the sustainable management of animal genetic resources, their representatives should be systematically involved in all fora dealing with the issue at international, regional, national and field levels.

f) Support for training and capacity building of livestock keepers and provision of services along the food chain.

Herders and small-scale livestock keepers especially in marginal areas often lack access to veterinary and other services appropriate to their management systems. Veterinary curricula are geared towards intensive production and "high-tech" environments and incentive systems for service providers do not honour the promotion of low-tech and locally adapted solutions.

g) Right of livestock keepers to participate in the identification of research needs and research design with respect to their genetic resources to ensure compliance with the principle of Prior Informed Consent.

Much research fulfils the needs of scientists only and is of little practical relevance to livestock keepers. and there is a lack of research to solve the problems that livestock keepers perceive as important.

Although "Livestock Keepers' Rights" were originally modelled on Farmers' Rights as articulated in the ITPGRFA, they have evolved into a much more comprehensive concept than Farmers' Rights. They are not restricted in scope to the right to breed, save and exchange genetic material but encompass other approaches to strengthen the position of small-scale livestock keepers.

Most of the cornerstones are reflected in existing international agreements, including the Interlaken Declaration, the Global Plan of Action on Animal Genetic Resources, in the UN Convention on Biological Diversity, and in the UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Experiences.[21]

The "rights of livestock keepers" are referred to in the Interlaken documents but without further specification. The logical next step for

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21 The one exception is cornerstone No. 4 -- the right to breed and make breeding decisions. It is urgent to tackle this issue.

nudging them towards international acceptance would be to investigate the nature and extent of the *customary rights of livestock keepers in individual countries and then analyse their potential for official codification, possibly starting with national legislation.*

Even more important than turning Livestock Keepers' Rights into law would be to recognize them as guiding principles for livestock development by both national governments and major international agencies. If the same donors that promoted crossbreeding and replacement of indigenous with exotic breeds – often by investing enormous sums of money – were to support livestock keepers in developing local breeds, in organizing themselves and in niche and added value product marketing, they would make a major contribution to saving biodiversity and to creating rural income opportunities. In the absence of a momentum for an International Treaty on Animal Genetic Resources, there are now considerations to develop a "Code of Conduct" on livestock research and development that is based on the cornerstones of Livestock Keepers Rights and can be adopted by scientists and organisations involved in livestock research and development.

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N. Sui generis protection of animal genetic resources : An initiative by the Indian Council of Agricultural Research ICAR

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India is bestowed with a vast diversity of genetic resources, of both plant and animal origin, which are the part and parcel of the Indian agrarian economy. The vast range of agro ecological zones of India has helped to develop a large number of breeds of livestock and poultry due to years of evolution within specific agro climatic conditions, through selection and animal husbandry practices that ultimately culminated in the emergence of a breed. The country has a rich domestic animal biodiversity of cattle, buffalo, goat sheep, horse, camel, pig, donkey, yak, mithun, poultry and fishes that form the backbone of Indian agrarian economy.

In order to protect plant genetic resources, the Indian Council of Agricultural Research (ICAR), under the Ministry of Agriculture, put in place a system to protect new varieties of plants at the National Bureau of Plant Genetic Resources (NBPGR), much before the sui generis legislation under the Protection of Plant Varieties and Farmers Rights Act (PPV&FR, 2001) was adopted in India. In relation to animal breed protection, the situation is different as in most countries.

To pre-empt any unforeseen grant of patents on animals/fish, including the improved breeds/strains from India, ICAR however established a novel system of registration and documentation at the National Bureau of Animal Genetic Resources (NBAGR) and National Bureau of Fish Genetic Resources (NBFGR). This system follows the the same lines as the one in place for plant genetic resources at NBPGR. The system allows registering and documenting new and improved breeds and strains of poultry and fish developed by selective breeding by farmers, researchers or communities.

Standard descriptors have been identified for each species including cattle, buffalo, goat, sheep, camel, horse, pig, chicken and fish to be filled by the breeder /owner/ researcher. The eligibility criteria requires scientific evidence for uniqueness, reproducibility and value as evidenced by publication in a standard peer reviewed journal or evaluation data of at least three years or recommendation of state animal husbandry department regarding novelty and uniqueness of the breed claimed. The registration would be valid for 25 years[22].

The breeds are categorized as populations within each species, wild feral, landraces, primary population, standardized breeds, selected lines, varieties, strains.

The registration system for animal breeds initiated by ICAR provides a recognized process for registration of animal genetic resources at the national level. The protection by registration covers ownership of all rights associated with the animal by the researcher/ farmer, and provides a mechanism for sharing the benefits arising out of use of the animal with its owner.

In the long run, this mechanism is meant to provide incentives to researchers and farmers for conserving genetic resources. Since animals as such, whether genetically modified or developed by selection, according to the Patent Act of 1970 cannot be patented, the animal breed registration serves as an additional sui-generis arrangement, which is not mandatory as per TRIPS.

22 See http://www.nbagr.ernet.in/GUIDELINES.pdf , last visited 16th March 2009.

O. The Panellists' Conclusions[23]

It appears that two different scenarios were at the background of the panellists interventions: firstly the idea to assess the effects of patents to AnGRFA; and secondly rather the aspect of conservation of AnGRFA and the creation of equity in access and exchange.

The panel drew conclusions from varying viewpoints; yet they were unanimous in two aspects. The first is that the goal and objectives of the creation of rights to AnGRFA must be defined following a thorough assessment of the factual background. The second is that the answers arrived at in this exercise need to be carefully squared with available tools and complementary mechanisms – within or outside the realm of IPRs. The notion of a "toolbox approach" was coined, the task being to find an ideal combination of tools to serve the defined end.

An important message was that there are not only exclusive rights, but a range of other instruments and mechanisms to be assessed, such as GIs, TMs, AOCs, rights to TK, or approaches under the aspect of compensatory liability or under contracts. At the interface with patents, the applicability of the flexibilities in the patent system needs to examined (breeder's exemption, farmer's privilege, compulsory licensing). In this context it should be borne in mind that conventional AnGRFA breeding is similar to other low-tech innovation. In finding responses to the anticipated developments in high-tech innovation, it is important to be aware of the possibility of counterproductive effects if exclusive rights are assigned to products and processes and, in particular, to research tools. The option would be to provide for easy exchange of the resources, to work with registration systems, and entitlement to royalties, but to avoid exclusion to use products and processes.

The global public good "diversity of AnGRFA" cannot be maintained by market mechanisms alone. It is necessary to carefully assess the options

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23 Reichman Jerome (Duke University School of Law); Bartels Hans-Georg (WIPO); Mäki-Tanila Asko (MTT Agrifood Research, Finland); Mundt Claudia (Swiss Federal Institute of Intellectual Property); Becker Barbara (ETHZ, Network of International Development and Cooperation); Bhatti Shakeel (FAO, ITPGRFA); Pythoud François (Swiss Federal Office of Agriculture).

regarding the cost–benefit relationship in general, and in particular (open) exchange of the resources, the transaction costs and the enforceability of the rights.

III. Thoughts and Way Forward

A. The presentations in context

The discussion on the rights to Genetic Resources for Food and Agriculture has emerged in parallel to the developments in bioscience and biotechnology, in particular in genetic engineering, that brought genetic resources under the patent system and led to increasing enclosure of the genetic information by patents or – for plants – by the plant breeders' rights. The response has been the creation of farmers' rights and the CBD's system on Access and Benefit Sharing. The call for animal breeders´ rights and livestock keepers' rights – and the question of the applicability of the ABS system toAnGRFA has to be seen in this context.

The question of the necessity for and the feasibility of creating specific rights to AnGRFA needs to be assessed against the background of the goals (as reiterated throughout the workshop): to maintain diversity of AnGRFA, to improve the livelihoods of livestock keepers in the South as guardians of important livestock diversity, to promote equity in the marketing of AnGRFA; and – ultimately – to maintain the gene-pool to assure food security under changing conditions. Accordingly, the goal was to square the question of rights to AnGRFA with the need for the conservation and sustainable use of AnGRFA diversity. The basic question is thus whether an adapted system of property rights is able to foster conservation and sustainable use of AnGRFA diversity in general, and the maintenance of specific adaptation traits in particular.

In tackling the question of rights to AnGRFA, three different approaches need to be taken into consideration: 1) Analysing the *present situation* regarding the triangle of AnGRFA diversity, rights to AnGRFA, and the present state of external elements that have an impact on AnGRFA diversity; 2) understanding the *ongoing changes* in R&D and in the marketing and flow of AnGRFA, and their significance for AnGRfA diversity; and 3) – given the potential of the development of genetic engineering and its impact on the property rights and the flow of AnGRFA – creating and discussing a *scenario on future developments* and changes.

These aspects were tested against the background premises that: 1) for AnGRFA – as for genetic resources in general – there is a North–South divide regarding diversity of AnGRFA and access to technology; 2) there is a probability of a future South–North inequity in the utilisation of genetic information; 3) genetic engineering – bringing AnGRFA under the regime of patents – may prompt enclosures that counteract the public interests in diversity and equity; and 4) ways and means must therefore be found to balance negative developments and to prevent harmful effects.

B. Background

In discussing a potential analogy between rights to PGRFA and AnGRFA it is important to be aware of the basic differences between the two. The background of these divergences is that farm animals, with the exception of pigs and chickens, produce few progeny. This leads to a higher market value of the individual animal. The flow of the genetic resources in the market differs accordingly and is based on bilateral exchanges of private property rights. Even if animals used for production exhibit the same genetic diversity as those used for selection, the "dual character" of PGRFA as both seeds containing hereditary information and as tradable goods or foodstuff seems less evident in AnGRFA.

The main resource for genetic change in AnGRFA is genetic variation *within* the animal populations. Populations are dynamically changing; and in each generation, the genetic variation is increased by some 0.1%. Whereas plants depend on continuous introgression of new genetic information, this is not necessary in AnGRFA as there is spontaneous mutation and sufficient genetic diversity (Mäki-Tanila).

C. Starting Point

For the reasons mentioned above, property rights in AnGRFA relate to individual animals that frequently belong to a specific breed. Regarding the genetic resources, the language in animal breeding is about the value and the characteristics of *'breeds'*. The question here is what exactly is meant by this term**.** It is indeed likely, especially with the eventual creation of a *sui generis* system, that the subject of such rights will be 'breeds'. The terminology and the agreement on a given definition is therefore of primary importance. In both the North and the South, phenotypical characteristics and the perception and declaration as a breed play a role. Breeding processes are similar: selection is made according to desirable traits. The qualities of the parental lines are documented in a register (Europe), or memorized by the breeder (Marguerat, Köhler-Rollefson).

From this it can be concluded that AnGRFA and their derivates as a rule are *privately owned,* whether they are registered in a herdbook or not. In traditional and conventional[24] breeding systems, the value of the genetic information created by the breeder is included in the market price of the animal. The right to progeny is – as a rule – transferred with the transfer of the female animal. So the farmers own the animals and, in the case of females, also their direct offspring, regardless of whether it has been produced by artificial insemination or natural mating. The introduction of patent rights may therefore not bring about a shift in ownership from public to private, but rather from private (farmers) to private (inventors or patent holders). Prices of live animals and their derivates like embryos or semen depend on the genetic value and/or market conditions. In traditional/indigenous systems, the property rights system might be more diverse, but follows the same basic principles.

D. Present Situation

The breeding and reproduction environment has been significantly changed by the developments in the field of molecular genetics. The technology of marker assisted selection is continuously improving and is expected to revolutionize existing cattle breeding programmes. Breed improvement through genetic control may provide key entry points to increased productivity and/or to selecting for specific disease resistance (Flury). Such technologies however bring in patent rights and the shift in ownership these provoke: namely, from the farmer to the patent holder.

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24 For this publication a distinction is proposed between: traditional/indigenous breeding in community breeding contexts without written documentation (Kassie, Köhler-Roleffsson, Tibbo); conventional breeding: phenotypical selection criteria; including artificial insemination and embryo transfer technologies; modern breeding: quantitative genetics, analysis methods (marker assisted selection, single nucleotide polymorphism (Marguerat).

At the same time, new technologies foster an easier transfer of the resources and thus enable more intense international trade. As a result, the genetically uniform high-yield breeds increasingly outcompete local breeds. This increases the so-called erosion of AnGR.

Genetic diversity on AnGRFA markets varies from poor to almost nonexistent (in swine and poultry). Poultry, cattle and pig markets show a progressive pattern of dislocation of public and cooperative breeding. This leads to markets that are increasingly controlled by large corporations with the potential to limit or hamper competition, leading to genetically uniform livestock populations, selected uniquely according to performance. It is however interesting to note that the above-described effects on diversity of industrially bred animals at present is not due to monopolies through patents, but to trade secrets combined with the techniques of hybridisation (Temmerman; Gura). AnGRFA, in spite of the increasing industrialisation of breeding and production processes, has remained largely outside the scope of patenting (Temmerman). The question that thus arises is if, and to what extent IP rights could be used to unblock this situation, by creating incentives to market genetically diverse products.

E. Ongoing Changes

The breeding technologies such as artificial insemination, semen sexing technologies and embryo transfer enable a faster and increased multiplication of interesting traits (Flury, Malafosse). In addition, they allow for the intensification of the marketing of animal genetic resources on the global level – as frozen semen is transportable and health and quarantine restrictions are less stringent than for living animals (Flury); although transfer of AnGR took place under the traditional breeding system too (Valle Zarate).

At present, the introgression of desirable traits by gene transfer from exotic local breeds to commercial breeds is not really successful. According to Flury there are few examples of transgenic animals from agricultural research and the techniques are still inefficient (besides the problems of public acceptance). Such transfer is of course possible by conventional breeding methods as Valle Zarate describes in her case studies on Boran and Tuli cattle breeds.

According to Valle Zarate and others, increased global mobility, technical innovations facilitating the transport of animal genetic resources, and globalisation of commerce with breeding animals enhances the gene flows. In contrast to the PGRFA, in AnGRFA the main flows take place in a North–North, North–South and South–South direction.

F. Future Scenario

According to Valle Zarate, projections for the 21st century suggest that there will be an increased impact of genetic material from a few globally acting enterprises on North–South and South–South transfers, and an increased North–North exchange of genetic material through networking in breeding programmes. Yet it can be inferred that new technologies to detect commercially interesting genes in local populations in the South may ease the mobility of valuable genetic material from South to North.
Taking into account such future developments, the question remains to what extent genetic engineering and, in particular the production of transgenic animals, would change *the property rights landscape in AnGRFA* too. Moreover, as mentioned in the introduction, the increasingly international market for animals, animal products and derivatives becoming has a profound impact on AnGRFA diversity. It seems predictable that in both transgenic animals and those that are the outcome of conventional breeding, the focus will rather be put on increased productivity traits – genetic structures that are more developed in Northern countries. In parallel an impact on the question of rights, including IP rights, is highly probable.

G. The Question of Rights

Today patents are increasingly playing a role in accentuating the diffusion of the traditional v. biotechnology distinction. Whereas 'traditional' methods are not covered by IP rights of the patent type, biotechnology methods or methods with a number of 'non-traditional' steps often do fall under patent protection. Selection and herd improvement methods may for instance be based upon biotechnological steps, with 'conventional' yet improved breeds as an outcome. The one (or more) biotech step(s) may bring in patents and thus the control of the patent holder over the breed.

This of course highlights the rights question – i.e. the question whether the system of private property rights to AnGRFA, as described above, is appropriate to provide a basis for *fair market relations* for such transfers in expanded, globalized markets. For instance Kassie et al. suggest that valuation efforts will send price signals for marketers facilitating local, regional and even global transfers of genetic resources. In turn, Hiemstra conveys the argument that globalization and changes in business organisation may put livestock keepers and smallholders at a disadvantage and lead to inequitable outcomes.

Together with these questions come the questions of impact on genetic diversity. The impact on diversity and the question of fair market relations and share, are strongly interlinked. The strengthening of the market position of smallholders will also strengthen the diversity on the market and thus support conservation. Smallholders usually offer niche products outside the genetically uniform industrialised production. Strengthening their market position is as much an issue of private standard setting, possibly of subsidies, of using existing IP rights to bring the system closer to the law rather than the opposite (e.g. by means of collective trademarks and geographical indications), and of a simple market mechanism of supply and demand. These may be of equal importance to the question of (creating new) property rights.

The question of rights is also one of assessing the current and future impact of existing right systems and in particular of the patent system. Accordingly, the patenting of AnGRFA is at the centre of the debates. Unlike TMs and GIs, patents entered the field of AnGR only recently, with the advent of genetic engineering. Transgenic animals exist for medicinal purposes, but are scarce in AnGRFA (see also Mäki-Tanila). The main application of biotechnology in AnGRFA at present is in the application of selection processes. Yet, as Temmerman submits, it is important to anticipate the effects patents can have once they enter the field of AnGRFA (Cf. also Then and Bilang). He points out that patents are an instrument to encourage and finance the realisation of the prospects of biotechnology. In turn, patents affect the possibilities of gaining access to genetic material and thus to the animals as such. They may further influence the ownership structures and provoke a shift in control from farmers to the right holders in shifting the right to progeny from the owner of the animal to the patent holder.

At the centre of the debate is thus also the scope of the patents and particularly their extension on an X-number of subsequent generations, possibly obtained by natural reproduction. Whereas is it arguable that the right to produce always remains with patent holder, the impact of this rule may be stronger here than in other sectors. The AnGR system is traditionally based on an opposite ownership scheme. It willl be necessary comes to tailor an appropriate balance between the need for a return on investment and the needs of this sector, and its smallholders in particular, and the questions of risk minimising instruments.

H. Potential solutions

In order to balance the increasing enclosure of innovation in AnGRFA, in particular the potential impact of patents on AnGRFA diversity and market mechanisms that appear to go against the promotion of conservation and competition, an appropriate set of measures is needed to conserve, maintain and sustainably use diversity in AnGRFA and to promote equitable and fair market access for smallholders from the South.

In that sense a *sui-generis* protection system for AnGRs – based on the establishment of breeders' associations, associated with geographical indications or trademarks, and the protection of traditional knowledge and livestock keepers' or breeders' rights could be useful. In turn, given the *prevalent flow of AnGR from North to South* and the structure of the property rights, the applicability of the *ABS system* to AnGRFA seems to be limited (Hiemstra).

Such initiatives may be backed by registration systems, either in the form of the European herdbooks that are supplemented by some adapted ABS principles, by a participatory documentation system that integrates indigenous knowledge for the stewardship of farm animal diversity (Köhler-Rollefson); or by an official registration system, that allows the registration and documentation of new and improved breeds according to standard descriptors, and includes primary populations (Singh).

A basic request is to mainstream awareness to enable effective participation of local and indigenous communities on the potential use of

AnGR to strengthen the position of smallscale livestock keepers in combination with innovative approaches for community-based participatory breeding schemes (Tibbo).

IV. Conclusions

A. General Thoughts

The management of AnGRFA must be rethought with regard to the three major developments that are occurring: the introduction of biotechnology and the advent of bioengineering; the erosion of animal genetic resources; and the globalisation of the marketplace and the increase in trade in livestock products and derivates. A sustainable and coherent regulatory approach must be designed.

It should be borne in mind that behind the question of the creation of rights to AnGRFA are two lines of argument that need to be distinguished. They can be roughly characterized as follows: The first argument is to be seen from the perspective of increasing enclosure by patents on AnGRFA that have been subjected to biotechnological or semi-biotechnological processes. Here the objective would be to find ways to balance possible negative impacts on conventional breeding methods and on diversity of AnGRFA. This approach sets out from the rights question. The second line of reasoning responds to the situation where the developments of the markets in animals and animal products lead to concentration and homogenisation of the gene-pool. The goal here would be to find a balance for the failure of the market to maintain biodiversity. This approach represents a departure from the question of market mechanisms and trade in AnGRFA products.

There are of course interrelationships between the two approaches. Yet, in our view it is important to understand that the two scenarios play in different time-frames: whereas the impacts of the market-developments are ongoing, the increase in the utilisation of techniques of modern biotechnology in breeding (such as transfer of genes or cloning) are not yet market relevant in agriculture. Here the task is to identify the future trends – and to assess whether the law is ready to cope with the developments.

B. Scenario one: Present market failure and market mechanisms

If we look at this scenario with respect to creating incentives for the conservation of genetic resources, the questions arising are *at present* linked to the functioning of market mechanisms rather than to the questions of rights, as – *a priori* – the question of rights to the genetic information seems to be clear. As mentioned earlier, the genetic information is linked to the property in the animal. Besides the possibility of common property in indigenous communities, the assignation of rights follows the same mechanisms in traditional and in conventional systems.

Yet, as a hypothesis to be further investigated, it is submitted that the system of property rights in AnGRFA is adapted to traditional systems in "herdbook (written registration) countries", as well as in "indigenous" memorized registration systems. The radius of the market was originally limited by the transportability of the genetic information (formerly the animal); this led to balanced markets. From this it can be concluded that the value presently assigned, in particular in the traditional markets, follows local rather than global market mechanisms; in other words, the information might be undervalued in relation to the options of adding value in the global context.

Another problem of this market failure is that there might also be a disjunction in time. One possible scenario is that with changing environmental conditions, such as the effects of climate change, the value of diverse AnGRFA would increase enough to operate as an incentive for conservation. Yet, diversity is being lost at present.

Thirdly, as has been shown, the market as it is played today, with its emphasis on productivity and competitive advantage leads to industrialised production modes and homogenisation in many cases. Yet, an emphasis on productivity is hard to avoid. This means that tackling the issue of conservation of AnGRFA diversity cannot be done by working only on the market level.

It is therefore proposed to put the emphasis also on a creative use of IP rights to strengthen the market position of new players and to contribute to the creation of niche markets and their (often genetically diverse) products. GIs and collective trademarks as well as patent type rights can be used to enable new players in the field to gain a better market position on concentration markets.

However, as mentioned above, solutions must also be found in publicly funded conservation programmes since correcting the market (i.e. the demand for high-productivity products) may never succeed to a sufficient degree. The starting point for both conservation programmes and value-adding exercises for trade in AnGRFA derivatives may be the identification, registration and monitoring of selected breeds kept by smallholders, also in the countries of the South.

C. Scenario two: Modern biotechnology and genetic engineering

So far there is little patenting of transgenic animals, but patents have started to come through in the form of process patents. Such a development is bound to increase. It will have to be investigated on the basis of a carefully elaborated scenario and the option to create *sui-generis* IPRs, as well as flexibilities given in the design of (exclusive) IPRs like patents (scope, duration, rights to progeny).

The question of rights and *sui generis* mechanisms needs to be further investigated, taking account of the conclusions of the workshop.

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