What's on the menu? Options for strengthening the policy and regulatory framework for the exchange, use and conservation of animal genetic resources[1]

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Summary

This paper addresses major issues and challenges for Animal Genetic Resources (AnGR) and the livestock sector, as well as options for further development of policies or regulatory approaches. Three main areas were identified, i) how we can halt the further erosion of genetic diversity and promote sustainable breeding and use, ii) whether there is a need to regulate the exchange of genetic material and iii) how to balance different systems of rights (e.g. sovereign rights of nations, intellectual property rights, communal rights or rights of livestock keepers).

To halt further erosion, complementary *ex-situ* and *in-situ* conservation approaches are needed and breeding and marketing of local breeds should be strengthened. Secondly, recognizing the importance of the exchange of AnGR, broad access and responsible and equitable exchange mechanisms should be further promoted. Thirdly, regarding intellectual property rights, there is a need to adapt the application of the patent system to the special circumstances inherent in animal breeding. Moreover, possible *sui generis* systems should be further explored in order to better balance different rights systems.

Rather than developing a new or adapted internationally legally binding framework, the intergovernmental process under FAO may instead wish to focus, in the first instance, on the development of voluntary instruments to strengthen national policies and the implementation of action at national levels.

Debates and developments related to international agreements in the crop sector have also tended to frame the debate for AnGR. However, before launching into a discussion on whether or not an 'FAO Animal Treaty' would be needed, one should first of all clarify the problems to be dealt with and regulated via an international regime.

Résumé

Cet article rassemble les thèmes principaux et défis des Ressources Génétiques Animales (AnGR) et du secteur élevage, ainsi que les options disponibles pour le développement de politiques ou règlements.

[1]This paper summarizes the main findings of a study entitled 'Exchange, Use and Conservation of Animal Genetic Resources: Policy and Regulatory Options'. Report 2006/06. Centre for Genetic Resources, the Netherlands (CGN), Wageningen University and Research Centre. The study was commissioned by FAO and funded by the Government of the United Kingdom of Great Britain and Northern Ireland, through DFID. The views expressed in the report and in this paper are the sole responsibility of the authors. The full report is downloadable from:
http://www.cgn.wur.nl/UK/CGN+Animal+Genetic+Resources/Policy+advice/
http://www.cgn.wur.nl/UK/CGN+General+Information/Publications/2006/
http://www.fao.org/ag/againfo/subjects/en/genetics/documents/ITWG-AnGR4/AnGR_policy_and_regul.pdf

On a identifié trois domaines principaux:
1. Comment empêcher l'érosion de la diversité génétique et promouvoir l'utilisation et l'élevage durable.
2. Quand est-il nécessaire de réglementer les échanges de matériel génétique.
3. Xomment adapter les différents systèmes législatifs (p.e. les droits souverains au niveau national, les droits sur la propriété intellectuelle, les droits communs ou droits des éleveurs).

Pour empêche une érosion ultérieure des études complémentaires *in-situ* et *ex-situ* seront nécessaires, ainsi qu'un renforcement de la sélection et commercialisation des races locales. En deuxième lieu, et tenant compte de l'importance des échanges de AnGR, on devrait promouvoir un majeur accès et des mécanismes responsables et équitables. Pour finir, en ce qui concerne les droits de la propriété intellectuelle, il faudrait adapter l'application des systèmes de brevet aux circonstances spéciales inhérents au secteur de l'élevage animal. Cependant, on pourrait rechercher d'autres systèmes possibles *sui generis* afin de mieux adapter les différents systèmes législatifs. Au lieu de développer un nouveau système ou adapter un cadre légal au niveau international, le procès intergouvernemental sous la supervision de la FAO voudrait centrer le thème en principe sur le développement d'outils volontaires qui renforceraient les politiques nationales et la mise en oeuvre d'actions au niveau national. Les débats et développements en relation avec les accords internationaux dans le domaine agricole ont contribué aussi à l'encadrer dans les AnGR. Cependant avant d'initier une discussion sur l'opportunité ou moins d'établir un "Traité FAO sur les animaux" il serait nécessaire d'identifier les problèmes auxquels il faudra faire face et comment les réglementer à travers un accord international.

Resumen

Este artículo recoge los temas principales y desafíos de los Recursos Zoogenéticos (AnGR) y del sector ganadero, así como las opciones para el consiguiente desarrollo de políticas o reglamentos. Se identificaron tres áreas principales:
1. Cómo impedir la erosión de la diversidad genética y promover la utilización y cría sostenible.
2. Cuando es necesario reglamentar los intercambios de material genético.
3. Cómo adaptar los distintos sistemas legales (p.e. los derechos soberanos a nivel nacional, los derechos de la propiedad intelectual, los derechos comunales o derechos de los ganaderos).

Para impedir una erosión ulterior serán necesarios estudios complementarios *in-situ* y *ex-situ*, así como un reenforzamiento de la cría y comercialización de las razas locales. En segundo lugar, teniendo en cuenta la importancia de los intercambios de AnGR, se debería promover un mayor acceso y mecanismos responsables y equitativos. Por fin, en lo relativo a los derechos de la propiedad intelectual, sería necesario adaptar la aplicación del sistemas de patentes a las circunstancias especiales inherentes al sector de la cría animal. Sin embargo, se podrían investigar ulteriores posibles sistemas *sui generis* con el fin de adaptar mejor los distintos sistemas legales. En vez de desarrollar un nuevo sistema o adaptar un marco legal a nivel internacional, el proceso intergubernamental bajo supervisión de la FAO desearía enfocar el tema en un principio en el desarrollo de instrumentos voluntarios que reforcen las políticas nacionales y la implementación de las acciones a nivel nacional. Los debates y desarrollos relacionados con los acuerdos internacionales en el sector agrícola también han contribuido a enmarcar el debate en el campo de AnGR. Sin embargo, antes de lanzarse en una discusión sobre la oportunidad o menos de establecer un "Tratado de la FAO sobre animales", se deberían identificar los problemas que se encontraran y cómo reglamentarlos a través de un acuerdo internacional.

***Keywords**: AnGR, Policy and Regulatory Options, Exchange, Conservation, Use, Rights.*

Introduction

The FAO International Technical Conference on Animal Genetic Resources (AnGR) in Interlaken in 2007 will represent a milestone, finalizing the global assessment on the State of the World's Animal Genetic Resources and providing an opportunity to reach agreement on how best to address priorities for the sustainable use, development and conservation of animal genetic resources for food and agriculture (AnGR). One of the expected outcomes of this Conference is a Global Plan of Action on Animal Genetic Resources, therefore Interlaken will probably be for AnGR what Leipzig was for plant genetic resources for food and agriculture. The overall process, coordinated by

FAO and driven by national governments, should result in action contributing to conservation and sustainable breeding and utilization of AnGR. It is expected that three important issues need to be discussed:

1. How we can halt the further erosion of genetic diversity and promote sustainable breeding and use.
2. Whether there is a need to regulate the exchange of genetic material.
3. How to better balance different systems of rights (e.g. sovereign rights of nations, intellectual property rights, individual or communal ownership rights or access rights to AnGR and natural resources).

Debate on these issues may lead to a decision as to whether an international legally binding mechanism is needed, or if 'softer' arrangements can adequately meet the objectives in a more effective manner.

Although not designed primarily for AnGR, international agreements with a general scope (governed by the Convention on Biological Diversity (CBD), the World Trade Organisation/Trade Related Intellectual Property System (WTO/TRIPS) and the World Intellectual Property Organisation (WIPO)) also apply to AnGR. As their implementation advances further, they may have an increasingly significant impact on AnGR exchange, use and conservation. While the special nature of agricultural biodiversity is recognized, FAO could play a key role in facilitating and informing the debate on specific AnGR needs and challenges.

In 2004, the Intergovernmental Technical Working Group on Animal Genetic Resources[2] recommended that FAO commission a study[3] to assess how exchange practices regarding AnGR affect the various stakeholders in the livestock sector, and to identify policies and regulatory options that guide the global exchange, use and conservation of AnGR. This paper presents the main findings of the recommended study: policy and regulatory options related to the exchange and the conservation and sustainable use of AnGR. The identification of options is based on literature surveys[4] and stakeholder consultations. A review of the current situation and the exploration of future scenarios served as input for the latter.[5]

The International Treaty on Plant Genetic Resources (PGR) for Food and Agriculture as an example for AnGR?

Debates and developments related to international agreements in the crop sector have also tended to frame the debate for AnGR. Some argue that it is important to develop a legally binding international agreement for AnGR similar to the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) that has been ratified by a growing number of countries. Core elements of this treaty are a multilateral system for the exchange of accessions of plant genetic resources for food and agriculture and the recognition of farmers' rights which are left to countries to implement. The treaty is in line with CBD and regulates specific aspects for plant genetic resources in agriculture. Before launching into a discussion on whether or not an 'FAO Animal Treaty' would be needed, one should clarify which problems need to be regulated or which trends needed to be positively influenced. Key biological, historical, socio-economic and institutional differences between plant and animal genetic resources need to be understood and to be brought into the policy, regulatory and legal discussions about AnGR. The substantial differences between animal and plant breeding

[2] CGRFA/WG-AnGR-3/04/REPORT, paragraph 24

[3] The study, entitled 'Exchange, use and conservation of animal genetic resources: policy and regulatory options' was commissioned by FAO and funded by the Government of the United Kingdom of Great Britain and Northern Ireland, through DFID. The views expressed in the report and in this paper are the sole responsibility of the authors. The full report is downloadable from:
http://www.cgn.wur.nl/UK/CGN+Animal+Genetic+Resources/Policy+advice/
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http://www.fao.org/ag/againfo/subjects/en/genetics/documents/ITWG-AnGR4/AnGR_policy_and_regul.pdf

[4] Due to the large number of references, they are listed in the Bibliography section at the end

[5] For further details about future scenario's and stakeholder analysis see also Drucker *et al.* (this volume); a detailed analysis of property rights, exclusive rights and use rights is provided by Tvedt *et al.* (this volume).

strongly suggest that to simply copy the solutions from the plant sector to the animal branch will not provide a suitable solution.

Halt Further Genetic Erosion and Promote Sustainable Breeding and Use

There is consensus that global AnGR diversity is under pressure. The global livestock sector is increasingly focused on a small number of highly specialized breeds and local breeds are threatened. The existence of threats to farm animal breeds and farm animal genetic diversity is generally accepted, even though debate remains about the severity of genetic erosion. FAO (2007) reported that, globally, 20% of recorded breeds are classified as 'at risk'. On the other hand, the loss of breeds is only one indicator of the loss of farm animal genetic diversity, as a major part of genetic diversity is found within breeds and there is also significant genetic overlap between breeds. Maintenance of *within* breed diversity is as important as *between* breed diversity as a genetic reservoir for future breeding and use. Both commercial breeds and rare breeds sometimes have very limited *within* breed diversity. Therefore, the problem may be bigger than figures of breed loss imply.

Figure 1. Dutch Landrace goat, the Netherlands (photo by H.F. Cnossen).

Even where diverse animal genetic resources currently have a low 'direct use' value, such resources may nonetheless be particularly valuable for future use. Such 'non-market' values provide a key justification for the public sector to play an important role in their conservation and management. However, there is limited awareness about the importance of conservation and the sustainable use of AnGR among policy makers and major stakeholders in the livestock sector.

To halt further genetic erosion, complementary *ex-situ* and *in-situ* conservation approaches are needed, to be organized at national, regional and/or global levels. The major responsibility for the conservation and sustainable use of AnGR lies at the national level (according to the CBD). However, coordination and collaborative arrangements at regional and/or global levels are also likely to be important.

Ex-situ conservation could either support *in-situ* conservation and breeding in the short term or may have a long term (insurance) objective. *Ex-situ* approaches require appropriate infrastructure, organization, technical capacity, agreed priorities, sustained funding and (new) legal arrangements regarding ownership and the use of germplasm.

In many countries there is a lack of human resources and institutional capacity in animal breeding. Lack of effective, sustainable breeding programs for local breeds may be one of the reasons that such breeds lose their competitive advantage, especially where production systems or external conditions are subject to change. Poor marketing and breed promotion is also an important limiting factor for the continued use of valuable breeds. Without interventions and the strengthening of breeding capacity for local breeds, the current threat to the survival of local AnGR is inevitably going to escalate. Within-breed diversity in both local and international breeds may also decline without proper consideration of inbreeding issues and sustainable long term breeding goals.

Figure 2. Yak, Bhutan (photo S.J. Hiemstra).

Responsible and equitable exchange mechanisms

Exchange of genetic material between countries and regions over millennia has been a very valuable mechanism for breed and livestock development. Countries and regions are highly interdependent, and continue to need broad access to AnGR for their livestock development. However, there have also been direct or indirect negative effects on farm animal genetic diversity.

A tremendous amount of AnGR exchange currently takes place between developed countries ('North' to 'North') while globalization drives the exportation of high performing breeding stock from 'North' to 'South'. 'South' to 'South' exchange has also been extensive and important for livestock development but less well documented than 'North' to 'North' exchange. Movements of livestock germplasm from 'South to North' have been rare in the past century. The latter practice is in stark contrast to plants, where South to North flows are prominent, driven by the search for disease resistance and adaptive genes for new plant varieties. This important difference in the gene flow direction is likely to influence discussions on the regulation of exchange.

The exchange of AnGR is currently mainly regulated through the transfer of private ownership (by private law contracts and customary law) and is also influenced by zoo-sanitary regulations. Some countries have specific access regulations or regulations to assess the potential impact of AnGR introductions in the country.

Zoo-sanitary regulations

Zoo-sanitary regulations are considered to be the main constraints to exchange. In order to avoid frustrating the exchange of AnGR, further *harmonization of zoo-sanitary laws* should continue at regional and global levels. Special attention should be given to the use of resources cryo-conserved in the past.

Impact assessment

There are examples of the damaging effects of introducing exotic material from North to South to improve local breeds. The existence of genotype x environment interactions, and the avoidance of undesired effects of exchange, may trigger the need to *assess the (genetic) impact* of import/export on sustainable (livestock sector) development in the country. Such an instrument may be worth considering as a basis for putting in place strategies to support the mitigation of potential negative side-effects of particular exchange practices. Application of a (voluntary) 'code of good practice' would be useful in this context, creating stronger responsibilities for both exporters and importers. Genetic impact assessments (both positive and negative) could also be extended to include economic and livelihood impacts as well as other developmental and/or environmental impacts. A potential disadvantage that would have to be overcome is the likelihood of increased bureaucracy, thereby blocking imports and reducing livestock sector development opportunities.

Access and benefit sharing

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. There are cases where the value in further breeding turned out to significantly outweigh the purchase value of the exported breeding animal or germplasm. The CBD presupposes the right of a country to exercise sovereign control over its AnGR (accompanied by a number of responsibilities). An exporting country may wish to maintain property rights over the AnGR after the resources have left the country. Even if the animals and breeding material are under private ownership, states have, according to the CBD, the right to regulate export. It can be argued that private parties agree on benefit sharing when AnGR is being transferred by a private law agreement. An *export regulation* could however set rules or a minimum standard for the content of a private law agreement to be considered legal or valid.

An *export regulation* could provide a useful supplementary tool for private law agreements, in particular in situations where negotiating capacities or market positions are significantly unequal. Two countries who commonly trade AnGR could also decide to develop a *bilateral framework agreement* aimed at facilitated exchange, following a pre-negotiated set of rules.

Development of a *model Material Transfer Agreement* (model MTA) at the international level, largely based on current exchange practices as well as covering all important negotiation issues relevant to AnGR exchange, would also be useful, in order to support the responsible exchange of AnGR. Development of such a *model MTA* may become particularly important if patterns of gene flow were to change substantially in the future. Private law guided exchange could be supplemented by a *model MTA* which would supplement the fragmented use of contracts today.

Following the negotiations in the CBD regarding an International Binding Regime for Access and Benefit Sharing, there is a need to survey how these changes in the international legal order for the exchange of genetic resources in general will affect

Figure 3. Cover of the Report "Exchange, use and conservation of animal genetic resources: policy and regulatory options". Report 2006/06.

Figure 4. Groningen White Headed cattle, the Netherlands (photo by H.F. Cnossen).

the exchange of AnGR in particular. Development of an international agreement on a *standard MTA* for AnGR could be a response to CBD developments and to unequal negotiating capacities and the market dominance of larger commercial entities in the livestock sector. A MTA for AnGR should reflect the significant differences between plant and animal genetic resources.

Intellectual Property Rights and Use Rights

Genetic flows have changed over time, genetic diversity is under pressure, and the power between stakeholders is increasingly unbalanced. Further concentration and vertical integration in the livestock industry, combined with the protection of investments through the use of intellectual property rights are generating an increased concern about *equity* and may seriously affect the positions of livestock keepers, small farmers and (small scale) breeders.

Today, almost all farm animal genetic resources are under private control and ownership and not considered to be in the public domain. However, breeds are 'public' in the sense that governments often recognize them as distinct breeds. Commercial breeders generally 'protect' their investments by 'staying ahead' of competing breeders, through physical control of the use of their breeding animals and the use of private law contracts. The use of Intellectual Property Rights (IPR) in animal breeding has to date mainly been focused on *trademarks*. Developments in patenting in some countries have triggered discussions about the potential impact of patenting on animal breeding methods and animal genes and cells. This has also started a discussion about the need to define the *rights* of livestock keepers/farmers/breeders over the AnGR they have developed over time and about access rights to AnGR and natural resources. An increasing tension is apparent between existing *physical ownership* or *communal ownership* to AnGR and increased use of the patent system in the commercial breeding sector. Regarding developments in the patent system, concerns have been raised that a high number of patent claims and the broad scope of the claims may lead to a significant body of *exclusive rights* on knowledge and breeding technology with substantial impacts on the use of AnGR.

Figure 5. Drenthe fowl, the Netherlands (photo by F. van Welie).

Exclusive rights

There is considerable concern that patents be granted to existing methods – although they may not sufficiently disclosed to qualify as *prior art* in the patent system. To counterbalance the effect of excessive patenting, *preventive publishing* is often put forward as a strategy to ensure that common knowledge will be considered *prior art.* However, the ability to exploit even small adaptations to what was originally published (i.e. 'patenting around the prior art') means that such an approach may be an ineffective counterbalance in practice. Other alternatives could be to oblige patent offices to take into account specific AnGR *prior art/novelty/ inventiveness guidelines* and/or having countries introduce specific *exemptions* in national patent law, such as *farmers' privilege* or *breeder's exemption.* A systematic legal analysis would be advisable to assess how general patent law rules apply to AnGR and breeding. There is also a need for analyzing the effects patents might have on research and investments in the animal sector; and eventually it may be worth considering the degree to which patent protection is needed at all in the animal

sector, to promote breeding, research and development in the livestock sector.

Sui generis protection

The present system of *plant breeders' rights* (UPOV) provides protocols for assessing and describing the unique characteristics of a new plant variety, ensuring that it is distinct, uniform and stable. Such a system is unlikely to be applicable to farm animal breeds in the same way as it is for plants. *Sui generis* protection systems could nonetheless be useful. Establishment of *breed associations or herd book registration* (governed by breeding laws) combined with *trademark* protection would be a good alternative for breed conservation and property right protection. A *sui generis* protection could also be linked to special geographical related properties and characteristics of the animals or their products (*geographical indications*).

Conclusions

Based on analysis of the existing policy frameworks, and as potential solutions to the problems raised during the stakeholder consultations, a number of possible policy and regulatory options for AnGR were identified during the study. These should be considered within the context of an informed debate regarding the need for strengthening the existing policy and regulatory framework for AnGR, as well as in terms of the *form* that any such strengthening should take. With regard to the latter, rather than developing a new or adapted internationally legally binding framework, the intergovernmental process under FAO may instead wish to focus, in the first instance, on the development of voluntary instruments to strengthen national policies and the implementation of action at national levels. This could be carried out in parallel with further analysis of how other international regimes may influence AnGR. The Interlaken Conference is expected to raise the level of awareness on the many roles and values of AnGR, and to highlight the special nature of AnGR, their distinctive features, and problems needing distinctive solutions.

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Back to the future. How scenarios of future globalisation, biotechnology, disease and climate change can inform present animal genetic resources policy development

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Summary

With the aim of assessing how exchange practices regarding Animal Genetic Resources for Food and Agriculture (AnGR) affect the various stakeholders in the livestock sector and to identify policies and regulatory options that could guide the global exchange, use and conservation of AnGR, an exploration of future scenarios was used as a complementary approach to reviewing the current situation, as well as to identify stakeholders' views on AnGR policy development.

Four 2050 future scenarios were developed and included:

1. Globalization and regionalization.
2. Biotechnology development.
3. Climate change and environmental degradation.
4. Diseases and disasters.

Having developed the scenarios, these were then used as an input point for a wide range of stakeholder consultations.

The findings show that such an approach has been a useful analytical tool. The '*far*' future perspective appeared to make people less defensive, especially in a situation where current exchange problems were not yet particularly visible or well documented. Many interviewees broadly considered that it was not a question of 'if' the scenarios would happen, but rather a question of 'when'. This implies that we might do well to consider the need to respond to future challenges through the proactive development of new policies or regulations. Such a finding is partly in contrast with the general perception of the current regulatory situation being broadly acceptable.

Résumé

On a réalisé une enquête sur les possibles futur scénarios comme approche complémentaire pour revoir la situation actuelle et identifier l'avis des intéressés au secteur de l'élevage sur le développement politique des Ressources Génétiques Animales (AnGR) afin d'évaluer comment les modalités d'échange de AnGR dans le domaine de l'alimentation et de l'agriculture ont un effet sur les éleveurs et pouvoir ainsi identifier les politiques et réglements qui peuvent servir de guide dans ces échanges, l'utilisation et la conservation de AnGR au niveau mondial.

On a identifier quatre possibles scénarios futurs qui comprennent:

1. La globalisation et régionalisation.
2. Le développement biotechnologique.
3. Les changements climatiques et dégradation de l'environnement.
4. Les maladies et calamités.

Une fois établis ces scénarios, ils ont été utilisés comme point de départ pour la consultations auprès des éleveurs. Les résultats montrent que cette approche a été un outil utile.

Les perspectives de futur "lointain" montrent la population avec moins de protection, spécialement dans les situations où les problèmes dus aux échanges n'étaient pas visibles ou connus. La

plupart des consultés ont considéré que le problème n'était pas tellement "si" mais plutôt "quand" ces scénarios pourraient se présenter. Ceci implique qu'il faudra très bien considérer la capacité de réaction aux défis dans le futur à travers des initiatives de développement de nouvelles politiques ou règlements. Ce résultat contraste en partie avec la perception générale sur la grande acceptation de la situation réglementaire actuelle.

Resumen

Se ha realizado una exploración de futuros escenarios como enfoque complementario para revisar la situación actual, así como identificar la visión de las partes interesadas del sector ganadero, sobre el desarrollo político de los Recursos Zoogenéticos (AnGR) con el fin de evaluar cómo las modalidades de intercambio de AnGR en la alimentación y agricultura afectan a los propietarios del sector ganadero e identificar políticas y reglamentos que puedan servir de guía en los intercambios, utilización y conservación de AnGR a nivel mundial.

Se establecieron cuatro escenarios futuros que incluyen:

1. Globalización y regionalización.
2. Desarrollo biotecnológico.
3. Cambios climáticos y degrado ambiental.
4. Enfermedades y calamidades.

Una vez establecidos estos escenarios, se utilizaron como punto de partida para una mayor consulta con los propietarios. Los resultados muestran que este enfoque ha sido una herramienta útil.

Las perspectivas del futuro "lejano" hicieron la gente menos protegidas, especialmente en situaciones en que los problemas debido a los intercambios no eran particularmente visibles o bien documentados. Muchos de los entrevistados consideraron que el problema no era tanto "si" sino "cuando" estos escenarios podían darse. Esto implica que tendremos que considerar muy bien la capacidad de respuesta a los futuros desafíos a través iniciativas de desarrollo de nuevas políticas o reglamentos. Este resultado se contrapone en parte a la percepción general de la situación reglamentaria actual ampliamente aceptada.

***Keywords**: AnGR, Policy development, Regulatory options, Future scenarios.*

Introduction

Following a recommendation from the Intergovernmental Technical Working Group on Animal Genetic Resources[1], the FAO commissioned a study[2] (Hiemstra *et al*., 2006) to assess how exchange practices regarding Animal Genetic Resources for Food and Agriculture (AnGR) affect the various stakeholders in the livestock sector and to identify policies and regulatory options that guide the global exchange, use and conservation of AnGR.

In order to identify present and/or future issues and problems related to the exchange, conservation and sustainable use of AnGR, literature surveys, scenarios and stakeholder consultations were used. A review of the current situation and the exploration of future scenarios served as an input point for stakeholder consultations.

Future scenarios for exchange, use and conservation were used to illustrate plausible future developments ('*histories of the future*'), with the aim of supporting improved decision making in the present about issues that have long-term consequences in the future (Hiemstra *et al*., 2006). Four 2050 future scenarios were developed. These included: globalization and regionalization; biotechnology development; climate change and environmental degradation; and diseases and disasters. The future scenarios were based on major driving forces, which are not only visible today, but which could have an increasing impact on the exchange, use and conservation of AnGR in the future. Such impacts imply that we might indeed need to respond to future challenges with new

[1]CGRFA/WG-AnGR-3/04/REPORT, paragraph 24

[2]The study, entitled "Exchange, use and conservation of animal genetic resources: policy and regulatory options" was commissioned by FAO and funded by the Government of the United Kingdom of Great Britain and Northern Ireland, through DFID. The views expressed in the report and in this paper are the sole responsibility of the authors. The full report is downloadable from:
http://www.cgn.wur.nl/UK/CGN+Animal+Genetic+Resources/Policy+advice/
http://www.cgn.wur.nl/UK/CGN+General+Information/Publications/2006/
http://www.fao.org/ag/againfo/subjects/en/genetics/documents/ITWG-AnGR4/AnGR_policy_and_regul.pdf

policies or regulations, and this is partly in contrast with the general perception of the current situation.

The structure of this paper is as follows. Section II provides an overview of the four 2050 scenarios, while Section III highlights the main findings of the stakeholder consultations based on the discussion of these scenarios. Section IV discusses these findings in the context of their policy and regulatory implications, while Section V provides conclusions about both the findings and the usefulness of the scenarios approach.

Overview of the Scenarios[3]

The conditions for animal breeding and the conservation of AnGR diversity are changing for a number of reasons. The development of a policy or regulatory framework for AnGR may therefore wish to anticipate future developments. For this reason, four emerging challenges or (potential) future scenarios[4] were developed in order to illustrate plausible future developments ('*histories of the future*'), with the aim of supporting improved decision making in the present about issues that have long-term consequences in the future.
Each scenario sub-section starts by highlighting the main driving forces or pillars on which the scenario is built[5]. The future scenario *per se*, as presented to and discussed with the stakeholders is then described.

2050 Globalization and regionalization scenario

Driving forces

Population growth, urbanisation and increased incomes are expected to more than double meat and milk consumption in developing countries between 1993 and 2020. This 'livestock revolution' will result in a major increase in the share of developing countries in total livestock production and consumption, putting greater stress on grazing resources and triggering more land-intensive production closer to cities. It would also be associated with rapid technological changes and livestock production shifting from a multipurpose activity with mostly non-tradable outputs, to one focused on food production in the context of globally integrated markets.

Globalization[6] trends may be expected to result in a wider use of a limited number of breeds, standardization of consumer products and a move towards large scale production. Retailers and supermarkets will be leading players in the globalization process. Vertical integration is expected to become the primary business model on a global scale. Furthermore, globalization may adversely affect smallholder competitiveness and threaten the sustainable use of local breeds.

The 2050 Scenario

The globalization of production and trade was effectively promoted by the establishment of the World Trade Organization in 1993 which has a much wider mandate and stronger implementation mechanisms than the GATT. The global economy triggered global product sourcing by processors and retailers in the most powerful markets. This global sourcing led to the standardization of products. Initially, this process started with individual chains such as McDonalds that put in place strict standards for their potatoes, beef, and wheat flour, and which finally led to the exclusive use of prescribed potato and wheat varieties and finally prescribed one animal breed or type of animal for

[3] The scenarios summarised here are based on a more detailed analysis presented in Hiemstra *et al.*, (2006) and related materials. Full details are available from the lead author upon request.
[4] A scenario is defined as a coherent, internally consistent, and plausible description of a possible future state of the world. Scenarios provide alternative views of future conditions considered likely to influence a given system or activity (IPCC, 2001). The scenarios are meant to be plausible, pertinent, alternative stories about the future, with the objective of permitting an exploration of possibilities rather than predicting the future *per se*. In this context, scenarios do not have to turn out to be absolutely correct to be useful.
[5] References from which these driving forces were identified are given under the relevant sections of the Bibliography at the end of this paper.
[6] "Globalisation" is understood to include the international integration of food markets which has generally been observable at the end of the 20th century and can be attributed to the liberalization of international commercial policy and the bundle of inter-related technological changes underlying the process (Hobbs and Kerr, 1998).

their global operations. Their example was followed by powerful consortia of retailers.

Parallel to the globalization-led uniformity of products, consumers in the higher segments of the market started to demand regional products with distinct consumption values, supplied through very short chains. Apart from consumption qualities, consumers wanted to support the production function of the local landscape despite scale advantages in production in other parts of the world. The Slow Food movement, which started in a small way at the beginning of the millennium, gained a market share of 5% to 15% in the industrialized world, with the USA at the low end, central Europe and Japan at the higher end and China in between. The Fair Trade movement of the 1990s has connected its initially economic and human welfare objectives with the Slow Food movement, providing northern markets with regionally identified products produced in traditional farming systems.

Globalization has had some adverse consequences, such as the globalization of communicable animal diseases and human health consequences as a result of the over consumption of livestock products by some population sectors, and exposure to livestock waste, as a result of increased livestock product consumption and intensive livestock production, respectively.

The dual development of globalization and regionalization has led to large multinational companies that adapt the production condition to suit the needs of the high productive breeds, lines and hybrids in tightly controlled production chains. Globalization has resulted in an increased demand for breeds with productive traits appropriate for intensive farming systems and consequently a reduced demand for breeds with adaptive traits appropriate for extensive farming systems, thereby increasing the relative importance of conservation measures for the latter.

As an example of these developments, the Bovaria cattle were developed out of a cross between a European breed with excellent growth rate and carcass characteristics and a beef breed from Latin America with excellent meat quality and resistance to heat stress. Bovaria appear to have a wide adaptability to all major beef producing environments ranging from the Argentinean pampas to the saline water irrigated production plains on the Arabic peninsula. Introgression of the heat stress resistance genes left the important meat characteristics unchanged. The breeding company BPAIC (Bovine, Pig and Avian Improvement Company) grew into a multinational body with strategic alliances with major biotechnology conglomerates and its own gene bank providing the materials for ongoing improvements. BPAIC can be considered a monopolist in the business, but it can avoid anti-trust allegations by pointing to the multitude of local breeding companies and associations maintaining the herd books of a wide variety of breeds that supply the Fair Trade and Slow Food regional markets. Some of these local breeding companies and associations require support, including at the regional level, from donor institutions and/or national governments in order to survive. Such subsidies are part of the International Initiative on Farm Animal Genetic Resources (IIAnGR), established in 2014.

IIAnGR was established to enhance a wide range of national initiatives to support the conservation and sustainable use of farm animal genetic diversity. However, the gradual development of the market into two segments (globalised and national/regional) has not resulted in an increase in the international exchange of genetic resources. BPAIC is entirely self-contained in terms of genetic resources and provides the commercial sector with excellent breeding stock; national breeding programs exchange genetic material within the region but the national breed activities tend to avoid the use of exotic materials. Access to genetic resources and benefit sharing issues on a global level have thus become less relevant than expected.

2050 Biotechnology scenario

Driving forces

A series of developments in biotechnology are expected to speed up on-going developments in the livestock sector with potentially major impacts on the exchange, use and conservation of AnGR through:

- Continued progress in reproductive and cryopreservation technologies for all livestock species.
- Development of a new generation of quantitative genetic tools, linking genomics and quantitative genetics.
- Improved efficiency and safety of transgenic and cloning technologies.
- Better control of animal diseases and increased availability of (marker) vaccines.

Based on the impact of a combination of these major breakthroughs by 2050, it may be expected that superior genotypes will be distributed and

used across the globe even more easily than today, which may negatively affect the conservation of global farm animal genetic diversity. Furthermore, rapid developments in biotechnology are providing new opportunities to explore and possibly exploit genetic resources in ways that were not possible before. Exchange patterns may change and AnGR from developing countries may increasingly contribute to commercial breeding. Molecular biology is already having an increasing impact on the animal breeding sector, as well as playing a role in the introduction of the patenting of processes and products used in animal breeding.

The 2050 Scenario

All continents have recovered from a serious global recession, which surprisingly did not stop scientists continuing to develop (bio)technology. After a relatively quiet period, investors are seriously interested again in the implementation of biotechnologies in their businesses. Last week, Clonestock, a world leading biotech company, which has undertaken two major acquisitions in the livestock breeding sector, organised a press conference, which attracted a lot of attention in the international agricultural press. Stock prices of Clonestock have increased by 20% today.

The press release showed the final, positive results of safety studies of genetically modified clones of Robusta cattle. The company managed to produce a highly productive breed with specific heat and disease tolerance characteristics. The original breed was genetically modified, introducing a selected number of genes, after many years of studying the genetic background of heat and disease resistance. The company patented many genes with major and/or minor effects. This selection was greatly assisted by the development of effective cloning techniques developed in the early 21st century.

The introduction of Robusta cattle had already started in 2025 and at that time Clonestock had set up a nucleus herd with the aim of selecting the best Robusta sires and dams to produce commercial offspring. Clonestock started selling clones of the best combinations of sires and dams to commercial dairy farms all over the world, especially to less favoured areas or those in tropical climates. Clonestock predicts that by the end of this year (2050), 25% of dairy production in Asia, Africa and the Americas will be produced by their clones.

In the late 20th century breeding and biotech companies did not invest in transgenic and cloning technologies, because of negative consumer perceptions and ethical considerations. Scientists had also serious doubts about the safety of these technologies in farm animals and about animal health and welfare implications. However, public perception changed slowly when GMO crops proved to be safe and when on-going research in this area showed that it was possible to produce transgenics and clones on a large scale.

Clonestock strategically decided to combine cloning with the production of transgenic animals. Within this context the company was better able to protect breeding stock and property rights in relatively small nucleus herds. Cloning of transgenic animals appeared to be a safe and efficient way of disseminating breeding animals or embryos for production purposes. In order to protect their investments in research and breeding, Clonestock introduced a '*termination*' gene into the cloned genetic material, which made it impossible for the clones to reproduce.

The introduction of cloned transgenic animals does not affect smallholders directly. Poor countries and small holders can continue to breed and keep their local breeds but the production gap between the clones and the local animals is further increasing. To some extent this will affect local markets and local communities, because prices of animal products, including animal products produced by clones, are expected to drop even further.

Although policy makers and scientists argued that plant genetic resources and plant breeding raise totally different issues from those associated with animal genetic resources and animal breeding, *ex-situ* conservation differences between plants and animals disappeared to a large extent as a result of rapid developments in biotechnology. After the International Technical Conference on AnGR in 2007, the international community and larger biotech and breeding companies decided to develop global and private gene bank initiatives. Private companies invested in cryo-preservation of germplasm and somatic cells for strategic reasons. The international community decided to start an emergency cryo-preservation programme and develop a trust fund after another outbreak of foot and mouth disease in Asia in 2007. Access to the global gene bank is possible under a strict Material Transfer Agreement which includes a provision that benefits arising from the use of gene bank material have to flow back to the trust fund. Because of this strict rule, breeding and biotech companies decided to set up an insurance cryo-preservation collection themselves and to put more emphasis on

maintenance of within breed/line/company diversity.

2050 Climate change & environmental degradation scenario

Driving forces

Known causes or drivers of past climate change include changes in the atmospheric abundance of greenhouse gases and aerosols, in solar radiation and in land surface properties. Such changes can have both manmade (e.g., greenhouse gas emissions, land use changes) and natural (e.g., volcanic emissions, changes in the Earth's orbit, changes in the sun's intensity) origins. Five main impacts on global climates can be identified in terms of temperature, precipitation, sea level rise, the incidence of extreme weather events, and the level of atmospheric carbon dioxide and other greenhouse gas content. Climate change can be expected to affect livestock productivity directly by influencing the balance between heat dissipation and heat production and indirectly through its effect on the availability of feed, fodder and water, as well as changes in disease challenge. Among other possible effects, climate change may significantly move livestock production away from current marginal rangelands, and may thus contribute to the shift in favour of intensive production systems.

The 2050 Scenario

By 2050 Earth's now more affluent human population has increased from the 6.5 billion in 2005 to 9 billion, over 65% of whom live in cities. Global mean surface temperatures have risen by 2°C compared to 1990 and mean sea levels have risen by 25 cm. Global mean precipitation is 2% higher than in 1990. However, these global numbers hide complex spatial patterns of changes. In some regions, temperature increases are three times the global mean, while in others temperatures have declined.

The specific direction of change can only be predicted by considering specific localities. Broadly speaking at the higher latitudes (beyond 50°N and 50°S), higher temperatures have lengthened and increased the intensity of the growing season. Crop and feed yields have increased in those regions where there have been no major changes in rainfall. By contrast, in tropical and equatorial regions higher temperatures since 2005 have further exacerbated what had already been quite frequent water and heat stress on plants due to higher rates of evaporation. In addition, changes in extreme weather and climatic events have occurred increasing livestock losses, decreasing yield stability, damaging production infrastructure and disrupting access to markets. Environmental degradation has accompanied these processes, which has caused a drop in crop and livestock levels. The unequal distribution of losses and gains has had a major effect on production, trade and relative prices.

The fact that the speed of climate change has been and will continue to be faster than the speed of livestock and forage evolutionary adaptation means that many of the breeds used in extensive systems have moved or been replaced. Large-scale movement of livestock breeds occurred in search of more appropriate climatic zones (e.g., lowland sheep can now be found in the highlands) and less degraded pastures. By contrast hardy wildlife species, such as the Oryx, have increasingly been domesticated for use in areas of high climatic challenge.

Although the direct impact of climate change on livestock systems has only been moderate in global terms, it is expected to increase in severity and consequently all nations are strongly behind the 2027 '*Son of Kyoto*' protocol and its greenhouse gasses (GHGs) trading mechanisms, which include methane emitted from livestock.

The growing volume of livestock trade has resulted in AnGR research becoming more important. Increased germplasm flows within and between countries create new opportunities for crossbreeding and the introduction of exotics, together with a need to ensure that such flows are beneficial and do not threaten remaining livestock diversity. Genetic impact assessments and controlled breeding programmes play a key role in this context. Research related to the economic benefits of livestock germplasm flows have also been important, ensuring that such germplasm flows continue to facilitate monetary and non-monetary benefit sharing. Internationally funded AnGR research is now comparable to that of crops and plants, compared to being less than 10% in 2005.

2050 Disease & disaster scenario

Driving forces

International trade and human travel has already led to the rapid spread and ultimately the globalization of diseases, resulting in a deterioration in the global animal health situation during 1980-2000. This situation is expected to worsen. Diseases, natural disasters, civil war and other threats can have a serious impact on local AnGR and thus on conservation of global farm animal genetic diversity.

The 2050 Scenario

The ripah-virus disease which affects pigs has now arrived in southern Africa. Starting in eastern Asia in April 2042, it was able to conquer almost half the globe in less than 5 years. This paramyxovirus used to be a harmless virus that lived in the hindgut and was originally excreted and decomposed in manure. However, the feeding of manure to animals had become a necessity in the 2030s in order to keep up with the increasing meat demand of the world population which has become more affluent than ever projected. Despite the many safety regulations for heat treatment of the manure the ecology of the hindgut changed, with the virus developing heat resistance and increasing virulence.

Following the outbreak of a fast-spreading poultry disease named avian influenza in the early 2000s, researchers and international organizations had already warned that the high density of various domestic animals species and humans in the emerging intensive production systems, particularly in Asia, may lead to increased disease risks in farm animals and humans.

Today, in hot summer weather, the ripah-virus experiences optimal conditions and spreads fast. Veterinary and medical services all over the world are collaborating in their efforts to fight the disease which has already seen 10 million pigs killed by severe diarrhoea and respiratory problems. Stamping the virus out through mass pig culling is the preferred control strategy, but breeders of local breeds are scared about the potential loss of their breeding stock. Culling is likely to particularly affect those breeds that are not registered in herd books, as registration in a herd book is required to receive the exemption permit given by the Global Animal Breed Conservation Trust. Breed registration also offers an entry point for semen or somatic cell storage in the trust's (*ex-situ/in-vitro*) gene bank. However, there are many breeds for which breeds associations or herd books do not exist. These were bred either by local communities or commercial companies who had various reasons for not registering their breeds. For example, some communities had instead chosen to include their breeds in local/indigenous breed registers, whereas companies had chosen to register the products of their breeds as trademarks.

An international gene bank had become necessary after the value of breeds was internationally recognized as our global heritage and a back-up system for future restocking was considered necessary. As many countries recognized that they did not have the capacity to have their own secure gene bank, they decided to establish an international gene bank, with the necessary regulatory framework to enable the exchange of material to and from this gene bank. The international gene bank developed standard forms for Prior Informed Consent, Material Acquisition Agreements and Material Transfer Agreements for receiving and passing-on material, in agreement with the owners.

Material from the gene bank had already been used for restocking after the disastrous earthquake in Indonesia which caused the loss of most animals. Since its establishment in 2010, the gene bank has built up a collection that covers 40% of all breeds of domestic animal species across the globe. All material is cryo-preserved in liquid nitrogen. Breeds from the developed countries are much better represented in the gene bank, because it was easier for these countries to provide some back-up material from their normal breeding activities. As artificial insemination was less practised in developing countries in the early days, their breeds have been stored less frequently. However, recent years have seen more somatic cells from developing country breeds being deposited, as they can be easily collected through a biopsy in the ear.

At the present time, the ripah-virus threat has triggered rare breed and animal welfare NGOs to establish breed rescue teams which collect genetic material in the affected countries, in collaboration with the veterinary services. The geo-referenced database held by the trust helps to locate breeds in remote areas, and the Material Acquisition Agreements are simple and can be used even within the short time available in such emergency situations. These teams had managed to save the genetic material of a further 42 breeds in 20 countries before the disease hit, and thus saved our global biodiversity heritage for future use.

Stakeholder Consultation

Having developed the scenarios, they were then used as an input into the stakeholder consultations. A wide range of stakeholder group representatives (e.g., government officials, scientists in the public and private sectors, representatives of breeding organisations and livestock keepers or representatives of their organizations) were consulted through:

- interviews in four case study countries (Brazil, Ethiopia, India, the Netherlands)[7].
- additional interviews in other OECD, African, Asian and Latin American countries.
- an e-conference involving approximately 200 participants from 43 countries[8].

Stakeholder perspectives and findings

Globalization

A large majority of stakeholders believes that the current globalization trend will continue. Globalization will bring considerable uniformity in animal products. Current niche products could become global, and uniformity will lead to the dominance of fewer breeds. Although one interviewee indicated that the dominance of a small number of breeds would not necessarily result in a decrease of global genetic diversity, the majority of interviewees believe that uniform, intensive production systems (in family owned or corporate farms) with the same breeds all over the world will have a strong negative effect on indigenous breeds. Therefore it would be necessary to strengthen conservation strategies for local/indigenous breeds and to create gene repositories.

There was also a strong belief in the potential for the development of regionalized and niche markets based on livestock products. Much will depend on the viability of local or regional markets and products. The trend towards special products is currently mainly localized in Europe but stakeholders from other regions also have a positive view on the development of niche products or local markets.

Although there was generally agreement that universalized demands and concepts could be beneficial for the development of niche or local markets, in general globalization was seen as a potential constraint to the development of local food systems and the use of local breeds for food production. Retailers and supermarkets will be playing a lead role in the globalization process. Vertical integration is expected to become the primary business model on a global scale. Small farmers and local breeds will have problems to meet the requirements for food safety and product uniformity, and compete in global markets with corporate or large scale operations with vertically integrated enterprises. Developments in agriculture taking place in developed countries are expected to be repeated in other parts of the world but local consumer demands in developing countries may not be strong enough to sustain specialty products.

Current trends towards uniform production systems, the standardization of consumer products and a move towards large scale production are expected to continue. In this respect, developing countries become increasingly dependent on developed countries providing the resources or products and they may not benefit much from globalization. Some stakeholders noted that unequal conditions in relation to the ability to cope with globalization would result in developing countries continually lagging behind richer countries, as the latter have technologies and capital resources that are absent in poorer countries.

It is also expected that globalization will result in the degradation of ecosystems and ecosystem services which poor people depend upon for their survival.

Different views were expressed by NGO and farmers' representatives with regard to the

[7] Countries were selected on the basis of their representing different development categories, the importance of the livestock sector within those countries, the existence of different types of production systems and producer sizes, varied genetic resource policy and/or legal approaches, different degrees of biotechnology capacity and different vulnerability to climate change or disasters.

[8] It is acknowledged that the number of case study countries was limited and e-conference participation and additional stakeholder interviews in non-case study countries do not cover the entire world. Consequently, some important viewpoints and specific situations may have not been covered. However, within the time and funding constraints of the FAO commissioned report, a range of country types were selected and a wide range of stakeholders consulted, with the goal of permitting a balanced analysis that can support informed decision-making with regard to policy and regulatory options for AnGR.

strategies to cope with globalization, i.e. whether the focus should be on improving competitiveness (farmers), or on the protection of local producers from the impact of globalization (e.g., imports of competing goods) and from the expanding vertical integration within the livestock production and marketing sectors (NGOs). Some farmers viewed globalization as advantageous in terms of increasing market opportunities, but expect the government to address issues related to animal health.

It was also suggested that national governments should mainly focus on development of rural areas and of associated animal genetic diversity and livelihoods, because rural development is (compared to peri-urban developments) less attractive for the private sector and therefore lacks investment. The challenge is to support livestock development and to protect pastoralists, smallholders and their breeds at the same time.

Biotechnology

Reproductive technologies have revolutionized the animal breeding sector and facilitated the exchange of genetic material between countries and regions of the world. However, scientists are as yet unclear about whether the technologies currently available or in the pipeline will find a practical application in the foreseeable future. Some claim that some of these technologies which are already in use or will become available for animal breeding, could have serious impacts on the characteristics and structure of animal breeding. Indian stakeholders argued that if investments become available for identifying the genes for disease resistance, adaptability, fertility and growth, the leadership of animal industries will shift to developing countries that have dense and diverse populations of AnGR.

Breeders and the breeding industry realize that biotechnology has led to reduced genetic variability, mainly through widespread multiplication of individuals. Such a trend may be extrapolated when new techniques become available and when the concentration in the breeding industry for cattle, pigs and poultry further increases. Breeders in the Netherlands generally think that consumer pressure may reduce the impact of new biotechnological developments, such as genetic modification or cloning, on developments in the breeding industry. Cloning is expected to be viewed slightly more favourably than genetic transformation (GM animals).

Government representatives were less concerned about biotechnology issues than other stakeholders. Some consider that despite the current restrictive nature of the regulations on these technologies, the application of biotechnology in breeding and production cannot be stopped in the long run. However, they also realize that animals are much more complex organisms than plants in terms of reproduction control, and such complexity will reduce the speed of application of biotechnology.

A number of stakeholders cautioned about serious ethical problems and potential conflicts between the breeding industry and farmers. Important issues are '*food safety*' or '*squeezing poor countries out of animal production*'. Some claim that the major beneficiaries of biotechnology applications will be the resource rich stakeholders. Poorer countries and poor livestock farmers within these countries are likely to lose out. Biotechnology developments will also trigger further discussions about benefit sharing arrangements and intellectual property rights. Several respondents felt they were insufficiently informed about a range of biotechnology developments and issues.

Biotechnology is also considered to be potentially increasingly important for the conservation, evaluation and utilization of AnGR. However, advanced (reproductive) technologies are not frequently used for local breeds (in developing countries). Several biotech developments have been much more slowly implemented than originally predicted. Others stated that those technologies are particularly well suited to further develop local breeds and that insight into resistance to diseases and abiotic stresses may even help to increase leadership in animal breeding in developing countries. Hence, the impact of biotechnology may be either positive or negative depending on how it is used or regulated.

Climate change

A majority of stakeholders involved in this study could envision that climate change may have a serious impact on the exchange, use and conservation of AnGR. Stakeholders in India and Ethiopia were particularly outspoken on this topic and mentioned climate and environmental change as one of the major future driving factors.

According to government representatives, when climate is changing drastically, the adaptability of breeds will become more critical. Climate change could result in rapid and significant changes in livestock systems and their dynamics. Such a

scenario underlines the mutual dependency of countries in genetic resources. The main effect of climate change is expected to be seen in extensive livestock systems.

Breeders on the other hand stated that modern/science based breeding will go faster than climate change and can be handled by breeding companies. They realize that it will require faster adaptation of breeds than today to be able to serve a variety of production systems. A prevalence of (new) diseases might however complicate the breeding of adapted breeds.

Scientists argued that climate change will affect livestock systems mainly by the effects of a prevalence of diseases, but also that, for example, animals from lowland areas may replace those in the cooler highlands. Some think that climate change will lead to more frequent drought but this may affect population sizes rather than AnGR diversity *per se*. In this respect we can learn from current restocking programmes after drought[9]. Conservation of AnGR may become a major issue when we realize that both crossbreds and traditional breeds could be lost due to a lack of suitable environmental conditions.

Livestock keepers consider that the effect of climate change will be more positive than negative or are not aware of any significant change in climate. One interesting dilemma here is whether climate change will go faster than adaptation capacity of breeds or breeding programmes. A pastoralist said that effects may be less than mentioned in the scenario.

Diseases and disasters

Some case study countries have recently faced problems as a result of outbreaks of animal diseases. In the Netherlands and Brazil, such diseases were a threat to unique farm animal populations and seriously affected the export of animal products. On the other hand, in the Netherlands and the UK, recent disease outbreaks resulted in an increased interest in (conservation of) farm animal genetic diversity.

Dutch government representatives said that very strict veterinary regulations are needed and (harmonisation of) veterinary issues should play a more prominent role in WTO. Others expect that stricter zoo-sanitary regulations will operate as non-tariff trade barriers. Some scientists claim that this might strengthen the utilization of locally adapted breeds, due to their tolerance/resistance to diseases and parasites.

Some southern stakeholders seek a solution in disease free-zones that could form part of a '*fair trade*' framework, while others thought that this would be difficult to implement and may create an additional trade barrier. It was also argued that such disease free zones might work against the need for the free movement of livestock keepers, particularly in pastoral areas.

Many contributors underlined the threat of diseases and disasters and the impact of disease eradication programmes on local/indigenous breeds. However, evidence on such impact is limited. It is important to anticipate these serious threats and conserve animal genetic diversity through various strategies. Several contributions indicated that we need national, regional and global systems for monitoring and conservation of important AnGR.

Discussion and Potential Policy Instruments

A majority of stakeholders considered that all four scenarios might become a reality in one way or another and may affect the exchange, use and conservation of AnGR. A general conclusion from the overall consideration of the scenarios by stakeholders was that although (perceived) short term problems are limited, substantial longer term effects on exchange, use and conservation may arise in the future. Exchange may increase or exchange patterns may change, together with changes in (intellectual) property rights protection and an increasing imbalance in the power relationships between rich and poor (both between and within countries). Interviewees were most outspoken about the need for the strengthening of an AnGR regulatory framework in the context of the biotechnology scenario, which particularly raised equity issues.

[9]Author's comment: note that a number of restocking programmes to date have had a negative effect on AnGR diversity due to restocking with other than local breeds.

The on-going globalization process is certainly seen as having the potential to affect exchange patterns and negatively affect the conservation of farm animal genetic diversity. The effects of biotechnology and climate change were generally considered as of concern only over a longer term horizon. While both were considered to have rather unpredictable impacts, they have the potential to have a significant effect on the exchange, use and conservation of farm animal genetic diversity, including a positive effect on conservation or development of adapted breeds. Diseases and disasters are also unpredictable but it is clear that they could seriously threaten AnGR if such a scenario becomes a reality.

A range of potential policy instruments could be applied to address the stakeholder concerns identified in the consultation process. Any policy instruments targeted to improve AnGR management should ensure that the measures:

- Generate benefits to the economy, environment, or society under current conditions.
- Address high-priority issues such as irreversible impacts of the loss of animal biodiversity, long-term planning for adaptation (e.g., breeding), and unfavourable trends (e.g., breed replacement) which may inhibit future adaptive management.
- Target current areas of opportunity (e.g., revision of national livestock sector development plans or breeding laws; research and development).
- Are feasible (adoption is not significantly constrained by institutional, social/cultural, financial, or technological barriers).
- Are consistent with, or even complementary to, adaptation or mitigation efforts in other sectors [see IPCC (2001, Section 18.4.2)].

Many of the possible policies have been discussed at a number of international meetings[10] and it is also interesting to note how some of them cut across the different scenarios. In summary, the potential (non-comprehensive) range of instruments includes[11]:

- Support for both the conservation and improvement of local AnGR. Provide financial incentives for breeding and raising local breeds and promote/support marketing of local breed products.
- Capacity building (education, awareness raising, information, use of participatory approaches, recognition of importance of AnGR, etc.)
- Regulation of export and import of livestock germplasm, establishing protocols for the guidance of donors and NGOs when importing exotic breeds, including through the development and implementation of '*genetic impact assessments*'. Protocols could also play a role in the promotion and adoption of '*AnGR-friendly*' restocking programmes following disasters such as droughts or diseases Furthermore, national Biosafety Acts could be established within which any future introduction of AnGR containing genetically modified organisms can be regulated.
- Ensure greater levels of effectiveness in the surveillance and monitoring of infectious diseases in humans, wildlife, and livestock. Clear policy mandates must be put in place to encourage and ensure the rapid worldwide sharing and dissemination of information on infectious disease outbreaks. Adoption of increasingly demanding international sanitary standards drawing on international codes and standards from the Organisation Internationale des Épizooties (OIE) and Codex Alimentarius. Make special provisions for indigenous AnGR in animal disease acts.
- Address potential smallholder exclusion by building participatory institutions of collective action for small-scale farmers that allow them to be vertically integrated with livestock processors and input suppliers. Provide additional support to smallholders through:
  a. market reform policies that encourage smallholder investment and avoid differential subsidies to large-scale operations
  b. institutional development to help small-scale operators meet global standards regarding quality, food safety, and timeliness (including in the context of supermarkets' procurement systems); and
  c. the provision of public goods such as research, extension, and infrastructure.

[10]In particular, "Community-based Management of Farm AnGR", Mbabane, 2001; "Incentive Measures for Sustainble Use and Conservation of Agro-biodiversity", Lusaka, 2001; "Development of Regional and National Policy"; Luanda, 2002; and "Legal and Regulatory Framework for Farm AnGR", Maputo 2003. For full details, see Koehler-Rollefson (2004).

[11]Further details regarding the development of this list of policy options can be found in Hiemstra *et al*. (2006), as well as in Hiemstra *et al*. (this issue).

- Acknowledge the critical role that local communities play in AnGR conservation, and secure access rights to natural resources for indigenous livestock breeding communities (could include '*Karen Declaration*'-type of livestock-keepers rights approach which includes support for indigenous knowledge remaining in the public domain and that AnGR be excluded from intellectual property rights claims; regime for research and development).
- Develop procedures for access and benefit sharing, including Prior Informed Consent (based on the recommendations of the Bonn Guidelines), and possibly within a framework similar to that of the African Model Law.
- Inclusion of livestock under any future emissions trading schemes (e.g., under '*Son of Kyoto*')

Conclusions

Returning back to the present from our exploration of the future in 2050, it appears that embarking on such time travel has been very useful in helping to think in terms of current problems, on the one hand, and a situation 40+ years from now, on the other hand. The '*far*' future perspective appeared to make people less defensive, especially in a situation where current exchange problems were not particularly visible or well documented (as of yet). Many interviewees broadly considered that it was not a question of '*if*' the scenarios would happen, but rather a question of '*when*'. This implies that we might do well to consider the need to respond to future challenges through the proactive development of new policies or regulations. Such a finding is partly in contrast with many participants' general perception of the current regulatory situation being broadly acceptable.

With regard to the above list of potential policy options that follows logically from the scenario development process and the findings of the stakeholder consultation, it should be noted that the authors simply present these as a list of options which, together with others, could form the basis for informing future debate about the need for such policy and regulatory options. The task of deciding which, if any, of these options to adopt and the form in which they may be adopted, falls to the decision-makers who are one of the main target audiences of this paper and the original Hiemstra *et al*. (2006) study.

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Regulatory options for exchange, use and conservation of animal genetic resources: a closer look at property right issues[1]

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Summary

Three main areas for further development of policies or regulatory options for animal genetic resources (AnGR) were identified in a study on the exchange, use and conservation of AnGR (Hiemstra *et al.*, 2006):

1. how to halt the further erosion of genetic diversity and promote sustainable breeding and use,
2. whether there is a need to further regulate the exchange of genetic material and
3 how to balance different systems of property and use rights.

This paper provides an in-depth analysis regarding the third challenge, that of addressing the problems and options available for balancing the different property right systems for AnGR.

Résumé

On a identifié trois domaines principaux pour le développement futur de politiques ou règlements pour les ressources génétiques animales (AnGR) dans une étude sur l'échange, l'utilisation et la conservation des AnGR (Hiemstra *et al.*, 2006):

1. Comment empécher l'érosion de la diversité génétique et promouvoir une amélioration et utilisation durable.
2. Quand est-il nécessaire de réglementer les échanges de matériel génétique.
3. Comment harmoniser les différents systèmes de propriété et droits.

Cer article présente une analyse détaillée du troisième point, c'est à dire, comment approcher les problèmes et quelles sont les options disponibles pour harmoniser les différents systèmes de droits de propriété dans le domaine de AnGR.

Resumen

Se han identificado tres áreas principales para futuros desarrollo de políticas o reglamentos para los recursos zoogenéticos (AnGR) en un estudio sobre el intercambio, la utilización y conservación de AnGR (Hiemstra *et al.*, 2006):

1. Cómo impedir la erosión de la diversidad genética y promover una mejora y utilización sostenible.
2. Cúando es necesario reglamentar el intercambio de material genético.
3. Cómo harmonizar los distintos sistemas de propiedad y derechos.

Este artículo presenta un análisis detallado del tercer punto, es decir, cómo enfocar los problemas y cuales son las opciones disponibles para harmonizar los distintos sistemas de derechos de propiedad en el campo de AnGR.

Keywords*: AnGR, Regulatory options, Patent,* Sui generis*, Breeders' rights and livestock keepers' rights*

[1] This paper summarizes the main findings on property right issues of a study by Himestra et al. (2006) entitled "Exchange, use and conservation of animal genetic resources: policy and regulatory options". The study was commissioned by FAO and funded by the Government of the United Kingdom of Great Britain and Northern Ireland, through DFID. The views expressed in the study and in this paper are the sole responsibility of the authors. The full report is downloadable from:
www.cgn.wur.nl/UK/CGN+Animal+Genetic+Resources/Policy+advice/
www.cgn.wur.nl/UK/CGN+General+Information/Publications/2006/
www.fao.org/ag/againfo/subjects/en/genetics/documents/ITWG-AnGR4/AnGR_policy_and_regul.pdf

Introduction

The analysis of different property right and legal systems (in this paper) forms part of a larger study by Hiemstra *et al*. (2006) into how exchange practices regarding AnGR affect the various stakeholders in the livestock sector.

The study's main objective was to identify policies and regulatory options for the global exchange, use and conservation of AnGR (Hiemstra *et al*., 2006 and Hiemstra *et al*., this issue). The background for FAO to commission this study was a recommendation from the Intergovernmental Technical Working Group on Animal Genetic Resources (see: CGRFA/WG-AnGR-3/04/REPORT, paragraph 24). The analysis of policy and regulatory options available is based on literature surveys, scenarios analysis and stakeholder consultations (Hiemstra *et al*., 2006; Drucker *et al*., this AGRI issue).

Different legal systems and types of property rights are relevant to AnGR. The current legal framework shapes the freedom to use, breed and sell AnGR on national, regional and global levels. For farm animals and thus also for AnGR, private ownership is the rule and public domain the exception. The principal point of departure is that the owner of the individual animal has the right to use the genetic resources in further breeding or even to sell genetic material (for a more profound discussion of ownership of AnGR, see Hiemstra *et al*. 2006, pp. 15–16; Tvedt *et al*. 2007, pp. 8–10).

The right to use the animal in breeding is often specified in a (formal or informal) contract between the seller and the buyer of the animal. The contract or informal agreement determines the scope of what is transferred and which rights still belong to the seller (if any). Contracts imply a dynamic element in establishing (or transferring) rights from one owner to the other. The most important limitation of the use of a contact is that it only applies between two parties, and has limited legally binding effects for third parties (For a more detailed discussion of contracts, see Tvedt *et al*., 2007, p. 11–12).

Intellectual property rights are also used in the animal sector. Currently, the most familiar is a trademark. A trademark is a "*sign, or any combination of signs, capable of distinguishing the goods or services*" that may add value to a product by distinguishing the product from other similar products in the market (TRIPS Article 15).

Thus a trademark does not target the AnGR *per se*, but products developed from animals. Geographical indications can protect "*indications which identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin*" (TRIPS Article 22, paragraph 1). Similar to trademarks, geographical indications do not protect the breed or genetic material *per se*, but may add commercial value to the animals or breeds produced in a particular region. A third type of intellectual property right which is relevant for AnGR are patents (see Section A below).

This paper addresses the problems of, and options available for, balancing different property right systems for AnGR. Three groups of regulatory options can be identified:

1. Patent law and animal breeding.
2. *Sui generis* protection in animal breeding.
3. Livestock keepers' rights.

Section A explains the current situation regarding patent law as applied to the animal breeding sector. Section B identifies possible *sui generis* systems, which could be (further) developed for AnGR. Section C elaborates further on the specific issue of livestock keepers' rights (or farmer's rights). Finally in Section D we summarize our main conclusions and highlight key issues to be discussed in international forums.

Section A. Patent Law and Animal Breeding

Patent law is general in scope, applying to all fields of technology and innovation [for a more in-depth analysis of how patent law applies to animal breeding and AnGR, see Tvedt (2007, forthcoming) and Nuffield Council on Bioethics (2001) regarding an analysis how patent law applies to genes in general]. Consequently, it does not necessarily take into account the specific needs and challenges of AnGR or the animal breeding sector (Tvedt 2007, Rothschild and Newman 2004 and Rothschild and Newman 2002). The main legitimacy of this existing legal framework rests in its contribution to innovation, research and development. If patent law is not contributing to increased research and development in this field, the time-limited monopolies can hardly be justified. One concern for AnGR is that a high number of claims, as is common for patent applications in the plant sector, may lead to the establishment of a significant body of exclusive rights with substantial impact upon the use of AnGR by researchers, breeders and farmers. The potential consequences are yet to be seen.

In the plant breeding sector, the main rule is that Plant Genetic Resources (PGR) are in the public domain and open to use by everyone. This is quite different from the case of AnGR, which are often in individual or communal private ownership. It may well be that the need to maintain a viable public domain for AnGR is not as important as it is for plants (For an analysis of public domain for genetic resources in general, see Tvedt 2005). However, if patent protection is granted with a low requirement of inventiveness and novelty (potential examples are in fact in the process of being granted (see Fitzgerald 2005), and if granted broadly in terms of scope, research and breeding activities which were previously widely possible might become more restricted. In some cases this could even impact traditional uses in the country of origin. Due to the short history of applying patents to AnGR, there is an absence of case law and scholars commenting on how these general principles of law will be applied in this particular area. In this context, this study has identified the following questions that may raise particular problems in the future.

Patentability in the animal sector

The question of what types of inventions are eligible for patent protection was previously left to the discretion of each country. This was radically altered by the Agreement on Trade-Related Intellectual Property Rights (TRIPS Agreement) under the WTO, which establishes a comprehensive scope of patentability by requiring all member countries to provide for patent protection in all fields of invention, save for some narrow exemptions: Countries are allowed to exempt patent protection of animals other than micro-organisms, and for essentially biological processes (TRIPS Agreement 27, paragraph 3).

The TRIPS Agreement essentially creates opportunities for exempting animals other than micro-organisms from product patent protection in national patent law. The practical implications of this exemption depend upon the interpretation of the legal concept 'other than micro-organisms'. There is no definition or any agreed understanding of the term 'micro-organisms' among the parties to the TRIPS Agreement. Thus, countries have significant discretion as to whether to include or exclude animals, animal-proteins, genes and cells under patent protection in their national patent system, which may have a significant impact on biotechnology. One linguistically possible interpretation of this term is that countries have the freedom to exempt product patent protection for every category of animal-related biological invention except those being clearly recognised as micro-organisms in a biological sense [Correa (2007, p. 293); Westerlund (2001) takes the opposite position and argues that the exemptions should be interpreted narrowly, see also de Carvalho (2005)].

Consideration of the patent applications received under the WIPO Patent Cooperation Treaty system shows that process patents are highly relevant for the animal sector (Tvedt, 2007) and that countries are highly likely to grant process patents in the field of animal breeding. The TRIPS article 27 paragraph 3 opens for countries to exempt "*…essentially biological processes for the production of […] animals", but obliges countries to delimit such an exemption and provide for patents to "other than non-biological and microbiological processes*". The essential question is what is an "*essentially biological process*"? A WIPO official, de Carvalho, argues that this wording should "*… be read in a restrictive manner…*", since it is an exemption and maintains that: "*…there are processes which are biological, to the extent they comprise some phase in which biological reproduction is employed, yet their most important steps consist of acts of human direct interference. These processes, in essence, are not biologica*l" and must therefore, according to him, be patentable according to his understanding of the TRIPS Agreement (de Carvalho 2005, pp. 217-218). Correa notes that "*…its main aim in the TRIPS Agreement context is probably to limit the exclusion of patentability to traditional breeding methods […]*" (Correa 2007, p. 293). Note that neither of them are discussing this issue particularly within the context of the animal breeding sector. As the TRIPS agreement does not specify the legal concept further, countries have some discretion to implement a broad or narrow definition and practice of the concept of essentially biological processes for the production of animals. The experience from the EU Directive on the legal protection of biotechnological inventions (EC/98/44) shows that this discretion has in fact been used to implement a narrow exemption from patentability in Europe (Tvedt, 2007). We may therefore expect differences among countries with regards to the scope of patentability both for product and process patents, but as a general rule patent protection can be expected to become widely available in the field of animal breeding.

Prior art

The concept of 'prior art' relates to what is considered to be a body of information which cannot be patented. In principle, everything already known should be considered part of prior art and thus ineligible to meet the patent criteria. However, this is only a formal point of departure as the national patent office must put this principle into practice. For an activity where the current practices or prior art are not necessarily published in a sufficiently formal manner, there is a concern that common knowledge could conceivably become patent protected. To avoid such occurrences, measures could be taken to ensure that all relevant sources be covered during the prior art search process. Such a measure could be implemented by expanding the check-list for patent offices when they search for prior art.

Although preventive publishing is often put forward as a strategy to ensure that common knowledge will be considered prior art, it should be taken into consideration that such publishing only prevents patents from being granted in relation to that specific and particular form of published information. This means that preventive publishing may prove to be less effective in protecting against small adaptations to what was originally published. The large number of patent applications for different breeding methods which are currently being considered by patent offices is already increasing the challenge of identifying relevant prior art.

Novelty and inventiveness

The novelty of an invention is considered by comparing the prior art with the invention described in the patent claims. If these two textual sources are identical the novelty criterion is not met and the patent should not be granted. In technical areas where extensive publication is not the norm, the chance of meeting the novelty criterion is higher than for areas where there is an extensive body of publications. The livestock sector might thus be exposed to many patent applications meeting the patent criterion even if they are not particularly novel in a practical sense. The same items of prior art are used to assess inventiveness. If a low level of inventiveness is required, a granted patent may include what was de facto already known or in practice. Practical measures to deal with these problems include the development of specific guidelines for patent offices relating to how such assessments should be conducted. Such specific guidelines would of course have to comply with the requirement in the TRIPS Agreement, which states that patent protection is granted without discrimination among the various technological fields. Specific regulation of aspects of biotechnology patents is already accepted by the EU Directive on Biotechnological Patents (EC/98/44), so the TRIPS Agreement does not close the door to adapting special guidelines for single areas of invention. The general conclusion with regard to AnGR issues is therefore that an important gap needs to be addressed in order to ensure that methods already in existence do not become patented due to a lack of formal publications.

Scope of the granted right

After a patent is granted, the next task is to determine the scope of the exclusive right that the claims would confer to the patentee. According to the TRIPS Agreement, Article 28, the scope of a process patent protection is:
"*... (b) where the subject matter of a patent is a process, [it confers a right] to prevent third parties not having the owner's consent from the act of using the process, and from the acts of: using, offering for sale, selling, or importing for these purposes at least the product obtained directly by that process*."

The process patent covers an exclusive right to the use or application of the described method. But the scope of protection extends also to cover at least the product obtained directly by that process. This means that the scope of process patent protection in the TRIPS Agreement requires countries to provide for indirect product patent protection that covers the outcome from the use of a patented method. Using a patented process might therefore give the patentee a legal position in relation to the offspring from the application of the process. This is highly relevant for the breeding sector as the next generations of animals bred by applying a patented method might become subject to the exclusive right.

In addition to concerns regarding the above principles and the granting of patents, the application of the principle of equivalence may create further difficulties when applied to livestock sector issues. The scope of what is covered by a patent is described in the patent claims. While interpreting the written patent claims, in some countries the scope of patent protection is made

even broader than it appears from a reading of the patent claims. The invention as described in the patent claims might be interpreted to become wider to also cover inventions that are so-called 'equivalent' to the invention described in the patent claims. If such an expansive 'doctrine of equivalence' is applied, there is a possibility of restricting someone else's potential to carry out breeding and/or research activities. Little attention has been given to this principle in patent law and none for the area of animal breeding. It is nevertheless an important issue, as it might become a significant factor in establishing broad exclusive rights. This will have unforeseeable consequences for AnGR. Since there hardly is any case-law dealing with these questions in the livestock sector, there is a need for a thorough, systematic legal analysis related to assessing how general patent law rules will apply to AnGR and breeding (for further details, see Tvedt 2007).

Exemptions to patent protection

An additional measure for supporting the adaptation of patent law could involve the identification of useful exemptions that would lead to a more balanced application of patent law vis-à-vis the livestock sector (for an analysis of the balancing of property rights in the aquatic sector, see Rosendal 2006). In this context, it is important to note that although a patent grants the exclusive right to use an invention as it is described in the patent claim, Article 30 of the TRIPS Agreement specifies that "countries have discretion to implement exemptions in the right conferred by the patent on a general level in the patent act". One example of such an exemption applies to plants in Europe, where the EU Patent Directive Article 11 implements a version of the 'farmers' privilege' – i.e. the right of the farmer to reuse his harvest as seeds under certain specific conditions even if those seeds contain a patented gene. There is a similar opening for EU countries to implement an exemption in the animal sector according to the directive and a wide discretion for all countries according to the TRIPS Agreement. Nevertheless, surprisingly few developing countries have implemented such legitimate exemptions in their patent legislation.

Finally, it is also worth considering the degree to which patent protection is needed in practise to promote breeding, research and development in this sector. While the issue of increased bureaucracy is often raised as a counter argument to the implementation of CBD-based access legislation, it should also be taken into consideration that the patent application process and subsequent enforcement are also time-consuming, expensive and heavily dependent upon the involvement of lawyers. It would therefore be useful to assess what the potential benefits of patent protection might be for breeding, research and development in this sector, taking into account the fact that the investments of breeders and others need to be protected. This would need to be weighed against any potential costs, e.g. increased costs of breeding material and reduced exchange and use of AnGR.

Section B. *Sui Generis* Protection in Animal Breeding

The term '*sui generis*' is not a clearly defined legal term or concept in international intellectual property law. The TRIPS Agreement talks about "an effective *sui generis* system" for the protection of plant varieties as an alternative to providing patent protection to the same subject matter. But the TRIPS Agreement does not itself define such a system 'of its own kind' – a *sui generis* model for plant variety protection. One example of such a *sui generis* system for the protection of plant varieties are the plant breeders' rights under the different versions of the UPOV Convention. *Sui generis* systems for traditional knowledge have also been on the agenda at the World Intellectual Property Organisation (WIPO) for some years, but agreement on such an international system is still far off. If a *sui generis* system for AnGR were to be developed, it is crucial that the differences between plants and animals are carefully taken into account.

For AnGR it is not immediately apparent which subject matter requires further intellectual property protection. Where such a subject matter is identified and could be protected within the context of a *sui generis* system, then there is still a need to clarify *inter alia* i) who needs protection, ii) which entity should be the holder beneficiary to the right, iii) what should be the criteria for achieving protection, and iv) what should be included under the exclusive right. In the following section four options for *sui generis* protection are discussed:

Animal variety or breed protection

In considering the application of an intellectual property right such as a *sui generis* system for

AnGR or the breeding sector, defining the precise subject matter that should be protected by the right is clearly important. Compared to plant variety protection, providing intellectual property protection for 'animal varieties/breeds' would not make much sense due to biological reasons. The variety/breed is probably not the most relevant entity in animal breeding, but rather the individual breeding animal or its germplasm. Furthermore, the concept of an animal variety/breed is not easily defined. Such considerations mean that in terms of development of a *sui generis* system for the livestock sector, it would be difficult to identify characteristics that could serve as a standard description of the 'subject matter'. Further work is required to clarify the relevant subject matter for protection.

Establishment of breed associations

A *sui generis* system could be linked to eligibility for being included in a particular register or herd book (managed by a breed association). Under such a *sui generis* protection system, registration would lead to the establishment of a right and the criteria for being granted that right are those required for being registered. The difficult question here is what the rights (and legal consequences) conferred by such a registration should entail. For example, should such registration give any exclusive rights to the genetic material? One alternative could be that registration gives rights to the individual animal. However, such registration would not add much in addition to the already held physical property right over the animal plus the complete genome of the particular animal in question. A second alternative could be that registration of individual animals also confers an exclusive right to single genes or alleles in the registered animals. This alternative is however problematic, as single genes or alleles often occur in a similar form in different individual animals and there is a need to avoid creating competing exclusive rights to the same gene. A third alternative could be that only those farmers and breeders with animals registered by the breed association have the right to use the name or brand of the breed. Such a '*sui generis* protection' would be more similar to a regular trademark approach. Establishment of breed associations or herd book registration (governed by breeding laws) combined with trademark protection could therefore be a good option for breed conservation and property right protection.

Rights to genetic material of individual animals

One might also think about establishment of a *sui generis* right to the genetic material of the individual animal. With reference to the second alternative in the preceding paragraph, the first problem associated with such a right is the parallel occurrence of similar or identical genes and alleles in other animals. This would either undermine the exclusivity of such a right or result in competing property right claims. In addition to the problems related to identifying such genes, establishing a general *sui generis* right to the genes of the individual animal would probably not add anything new compared to ownership of the animals.

Geographical related properties

A *sui generis* protection could also be linked to special geographical related properties and characteristics of the animals or their products (geographical indications). A final alternative for a *sui generis* system would be to leave it to the breeder to characterise in a sufficiently precise manner as to what s/he claims as an exclusive right. This could then be used to establish a system for securing rights to technological developments and provide, for example, protection for a single gene when isolated and described. Such protection is however already provided by the existing patent system.

Summing up options for *sui generis* systems

To sum up, there are a number of relevant subject matters for intellectual property protection:

- At the level of the individual animal – protection is conferred by physical ownership of that animal and/or its offspring. Rights transferred during the purchase/sale of individual animals can be protected through the use of contracts.
- At the breed level – protection through the establishment of breed associations (or herd books) and the use of trademarks may be appropriate
- At the allelic, gene or protein level – protection is provided by patent law.

- Technical inventions relevant for breeding - protection would be covered by current patent law.

The conclusion on *sui generis* intellectual property rights in the animal sector is that it is not easy to identify the subject matter which needs to be protected. If a *sui generis* system were to be developed there would be a need for a more profound theoretical analysis in close cooperation with breeders to identify the subject matter that needs further intellectual property protection. Such an analysis would also need to identify the necessity of stimulating breeding and innovativeness by using such a legal system.

Section C. Livestock Keepers' Rights

Livestock keepers' rights or farmers' rights to animals are unexplored legal or political concepts in the livestock sector. The term 'farmers' rights' is mentioned in Article 9 of the ITPGRFA (FAO International Treaty on Plant Genetic Resources for Food and Agriculture). Farmers' rights 'recognize the enormous contribution' farmers have made regarding plant genetic resources (PGR). Responsibility for realizing such rights rests with national governments and there is a clause specifying that Article 9 shall not limit any already existing 'rights that farmers have to save, use, exchange and sell farm-saved seed/propagating material, subject to national law'. From a legal point of view, these 'rights' are not formulated in a legally binding sense, which raises issues about their enforcement in practice.

Implementing a version of farmers' rights for livestock keepers (e.g. as formulated in such documentation as the 'Karen Declaration', which includes support for indigenous knowledge remaining in the public domain and that AnGR needs to be excluded from IPR claims) would first require similar international recognition of their crucial role and contribution to AnGR.

Different strategies have been suggested for securing livestock keepers' rights, and these include codifying the customary laws that relate to the management of AnGR. A first step in this direction would be to review and analyse relevant customary law in order to identify which principles need to be included. Given that grazing rights are crucial to maintaining pastoral societies and are thus closely linked to conservation both at a breed level and at an allelic level, livestock keepers' rights could include production and grazing rights, as well as the protection of traditional knowledge. Mechanisms to strengthen livestock keepers' understanding of AnGR issues, their negotiating capacity and access to legal support would also necessarily be a crucial element of a strategy for developing livestock keepers' rights.

Obstacles to the implementation of livestock keepers' rights include the fact that they could conflict with other intellectual property rights. For example, if a patent on a particular gene existed, the consent of the patent holder could be required when animals that express that gene were used for further breeding. Addressing this potential conflict is not however an insurmountable problem. For example, India has developed a Farmers' Rights law which carefully balances these rights for crop seeds. Similarly, where livestock keepers' rights could potentially conflict with other intellectual property rights, there would be a need to have rules governing how these interests should be taken into account within the highly specified and enforceable body of patent law. One approach would be that livestock keepers' rights could *inter alia* be relevant for inclusion both when assessment of the patent criteria is carried out, as well as during enforcement. However, since livestock keeper practises are typically not published in a manner qualifying as prior art according to the patent system, this might expose them to patenting even if not new in a *de facto* sense. Two alternative approaches might also be considered:

1. either single countries could implement exemptions to intellectual property rights for livestock keepers; or
2. standard exemptions could be developed at a regional or multilateral level.

It is also possible to imagine some form of a *sui generis* protection system for livestock keepers' rights. This concept would have to be developed further on a theoretical level, but could include a model for benefit sharing or could combine individual and community rights over AnGR. A crucial issue in the development of such a concept would be whether a *sui generis* system should include a positive right to exclude others or whether

it should be geared towards being a negative right aiming at preventing misappropriation of what is in use by livestock keepers.

Section D. Conclusions: How to Balance the Rights of Stakeholders in the Livestock and Animal Breeding Sector

'Classical ownership' of AnGR includes physical ownership and communal 'law of the land' affecting livestock keeping and breeding. The existing use of contract law in a more or less explicit manner is functioning rather well in the area of animal breeding. There is, however, an increasing tension with developments in the realms of biodiversity law and intellectual property rights protection. Demarcation of these different rights systems and maintaining equity among different stakeholders is crucial to avoiding conflict and increased transaction costs. In this context, it is important to consider the rights of livestock keepers vis-à-vis national level sovereign rights, as well as obligations between patent holders and breeders/livestock keepers. Balance is not easily achieved as breeders have a need to protect their new investments as well the current practices which are functioning and thus need not to be altered.

There are several potential options that could be explored in order to better balance the rights of different stakeholders in the livestock sector under a range of future scenarios. For example specific exemptions in patent law as applied to the animal sector could be implemented. This is already a well-known strategy from in the crop sector. Key issues related to the patent system also could be considered and these include: up-dating the prior art search practice, reviewing patent criteria for assessing potential innovations relating to AnGR, and/or implementing exemptions for livestock keepers and breeders.

Sui generis protection options for AnGR could also be explored, including through protection of breeds via the establishment of breed associations, defining livestock keepers' rights and assessing other strategies to secure investments. Note also that since livestock keepers' rights are in an early phase of development as a legal concept, further development is likely to require the identification of the needs of livestock keepers and how these needs can be addressed through the use of international policy or legal instruments.

The overall conclusion of this paper is that property rights need to be adequately adapted to the field of AnGR to be conducive to the exchange, conservation and sustainable use of AnGR. A second main observation is that for these purposes the balancing of property rights may not also be easily achieved. This is because breeders have a need to protect their new investments, while current practices are functional and thus do not need to be altered. Exploration of the options discussed in this paper may however assist in this task.

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