Economics of AnGR Conservation and Sustainable Use, and Implications for Policy Options in a Changing World

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Executive summary:
This paper draws on a range of previous studies in order to provide an overview of the economics and policy of AnGR conservation and sustainable use. A discussion of underlying economic concepts, including the components of total economic value, together with an analysis of potential future change that may influence policy and regulatory requirements, is used to identify potential policy options. Further exploration of such options is likely to be useful in order to assist decision-makers in making informed decisions regarding the design of future regulatory and policy environments.

I. Economic Perspectives of AnGR Erosion:

AnGR erosion can be seen in terms of the replacement of the existing slate of domestic animals with a selection from a small range of specialised "improved" breeds which provide more direct benefits to humans. Pearce and Moran (1994) argue that the recognition of the broader *total economic value*[1] of natural assets can be instrumental in altering decisions about their use, particularly in investment decisions which present a clear choice between erosion/destruction or conservation.

We note that current economic decisions are largely based on only the first category, direct use values, although the other categories may be of equal or greater importance and in the context of genetic resources are indeed likely to be positive. By focusing exclusively on direct use values (which are frequently associated with the provision of private goods, such as meat or milk), biodiversity and genetic resource conservation are likely to be consistently undervalued, thus resulting in a bias towards overexploitation through activities that are incompatible with their conservation. In the case of AnGR, a bias towards investment in favour of specialised breeds results in the under-investment of a more diverse set of breeds (and the associated provision of public goods – e.g. the maintenance of evolutionary processes and accompanying traditional knowledge). Such bias and the existence of public good aspects of AnGR conservation service provision provide a(n economic) conceptual justification for intervention and support..

Economic valuation of AnGR and the development of associated decision-support tools is thus important from a policy perspective because they can play a key role in translating social

[1] • Direct Use Values (DUV) refer to the benefits resulting from actual uses, such as for food, fertilizer and hides, as well as ritual uses, etc. DUVs tend to be associated with private good provision.
• Indirect Use Values (IUV) are the benefits deriving from ecosystem functions, such as the maintenance of evolutionary processes, co-evolution with disease challenges, gene flow and traditional knowledge. IUVs tend to be associated with public good provision and may therefore be difficult for livestock-keepers to capture leading to a sub-optimal provision of associated goods and services.
• Option Values (OV) are derived from the value given to safeguarding an asset for the option of using it at a future date. It is a kind of insurance value against the occurrence of, for example, a new animal disease or drought/climate change. OVs tend to be associated with public good provision.
• Bequest Values (BV) measure the benefit accruing to any individual from the knowledge that others might benefit from a resource in the future; and
• Existence Values (XV) are derived simply from the satisfaction of knowing that a particular asset exists (eg. blue whales, capybaras or N´Dama cattle).

(including public good) values into efficient incentives and institutional arrangements for farmers/genetic resource managers and breeders. Consequently, the field of economics of agrobiodiversity conservation and sustainable use has developed rapidly during recent years. A state of the art review (Smale and Drucker, 2007; Drucker et al., 2005[2]) of the literature covered over 170 publications (both livestock and plants). See also the SoW-AnGR (FAO, 2007, p.429-442) for an additional review of the AnGR economics literature. These reviews found that advances in economic valuation have indeed eased methodological/analytical constraints. Contributing directly to the CBD COP 8 Decision VIII/25, a wide range of decision-support tools and analytical approaches have also been successfully tested on a number of crops/species and breeds, in a number of production systems and locations, both *in situ* and *ex situ*. This body of research has consequently provided a useful, but as yet largely unapplied, framework of knowledge on the ways in which improved valuation of the components of agrobiodiversity can contribute to optimal investment allocations and policy decisions. In particular, the following types of policy-relevant questions can be addressed through the use of such methods and tools.

- Which breeds should be conservation *priorities* (given that we cannot save everything)?
- How important are particular breeds to *livelihoods* and how can such values be harnessed to support poverty alleviation efforts?
- *Which traits and functions* (both marketed and non-marketed) are the most important and degree they can be traded off against each other?
- What are the *costs of AnGR conservation* programmes and how can we minimise these? What are the related benefits?

II. AnGR Conservation and Use in a Changing World

Development of a policy or regulatory framework for AnGR should anticipate future developments. Emerging challenges or (potential) future scenarios were developed and used in Hiemstra *et al*. (2006) to illustrate plausible future developments. These future scenarios drew on dynamic changes related to globalization and regionalization; biotechnology development; climate change and environmental degradation; and diseases and disasters. The future scenarios were built on major driving forces, which are not only visible today, but which could have an increasing impact on exchange, use and conservation of AnGR in the future. Such changes are likely to lead to changes in the gene pool and consequently AnGR country interdependence.

Two major scenarios were suggested: i) that the portfolio of livestock species and breeds needed/demanded by society will change as a result of both increased demand and the environmental impacts of climate change (*"livestock portfolio change")*; and ii) that the livestock gene pool will be smaller than it is today because of continuation of current trends, losses induced by the speed of climate change outpacing evolutionary adaptations, and the impact of globalisation *("gene pool reduction"*).

These two scenarios suggest that large-scale movement of livestock breeds may be increasingly necessary, further increasing AnGR country interdependence. Of course, countries have long been highly interdependent with respect to animal genetic resources (AnGR). Most food and agricultural production systems worldwide depend on livestock originally domesticated elsewhere, and breeds developed in other countries and regions. Nevertheless, relatively little baseline quantitative data on AnGR exchange is available and the factors that will affect future gene flows and country interdependence also remain poorly understood.

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[2] Available at: http://www.bioversityinternational.org/fileadmin/bioversity/publications/pdfs/1060.pdf
For an annotated bibliography and searchable database of the applied AnGR and PGR economics literature (last updated 2008) see: http://www.ifpri.org/book-637/node/5347

Historically there have been several phases of gene flows and livestock breeding (Gibson and Pullin, 2005; FAO, 2007). Most recently, reproductive technologies have revolutionized the animal breeding sector and facilitated further and more rapid exchange of genetic material among countries and regions of the world. Such gene flow can both enhance and reduce diversity (FAO, 2007). The type of impact depends on a number of factors, including environmental suitability in the receiving country and organisational structures on both the receiving and the providing side (Mathias and Mundy, 2005). Importantly, the amount of material transferred is not indicative of its impact.

Although two recent studies (Valle Zárate et al., 2006; Mathias and Mundy, 2005) quantified and assessed trends in the transfer of AnGR, the global flow of AnGR remains poorly understood and can only be grossly characterised. There have been extensive North to North and South to South movements of livestock germplasm; although the latter is poorly documented. North to South flows have also been important. By contrast, South to North movements have been rare in the past century relative to movements in other directions; and in most cases the economic benefits to both North and South have been relatively small. Movements of germplasm, crossbreeding, and within-breed selection in the developing world are all likely to accelerate in the future (Gibson and Pullin 2005).

Potential implications of change may be considered to include (Gibson and Drucker, 2003):

- Increasing concerns regarding the CBD-recognised sovereign control of national AnGR.
- Such concerns may threaten international flows of livestock germplasm and access to AnGR, in a context where such flows and access issues have become more important.
- Increased livestock germplasm flows within and between countries will create new opportunities for crossbreeding and introduction of exotics.
- A need to ensure that any such flows are beneficial and do not threaten remaining livestock diversity.

III. Policy Options for a Changing World

A number of potential policy instruments and regulatory options, relevant for such a context, are now presented. It should be appreciated that the regulation of AnGR exchange may require quite different instruments than those developed for plant genetic resources (PGR), as there are important biological, historical, socio-economic and institutional differences. (Hiemstra et al., 2006; SGRP, 2006).

The two scenarios identified above ("livestock portfolio change" and "gene pool reduction") suggest that large-scale movement of livestock breeds may be increasingly necessary. A range of policy instruments could be applied to address some of these issues (Hiemstra et al., 2006, 2007; Drucker et al., 2007). A number of these instruments have been discussed at international meetings. These include the following and are described in further detail below:

1. Developing procedures for access and benefit sharing
2. Regulation of export and import of AnGR
3. Support for both conservation (in vivo and in vitro) and improvement of indigenous AnGR.
4. Precautionary cryoconservation
5. Special provisions for indigenous AnGR in animal disease control acts
6. Improved understanding of the economics of genetic resource conservation and sustainable use and the development of decision-support tools that allow conservation priorities to be set – we cannot save everything, so what is it that we should conserve?

1. Developing procedures for access and benefit sharing,

1a. *Benefits - what are they and how can they be shared?*

A popular misconception assumes that 'benefits' are purely monetary. In those cases where the use of (plant) genetic resources is commercial, any royalties that may arise can do so between ten and twenty years - and sometimes many more - after the original access to the genetic resources. Since the probability of an individual accession contributing to a commercially successful new variety is extremely low, only a tiny proportion of individual accessions give rise to such benefits. However, many other valuable benefits - both monetary and non-monetary (e.g. information technology transfer, hardware, software and know-how; training; joint research and collaboration; institutional capacity building; local income generation and employment and benefits in-kind) can arise from the time of access and beyond, whether or not any commercial product results.

In particular, it is apparent from this characterisation of benefits that current AnGR research already involves considerable non-monetary benefit sharing with national institutions and livestock keepers, in terms of information exchange, technology transfer, training, joint research and development, and institutional capacity building. Consequently, in developing a legal and regulatory framework for AnGR, consideration should therefore be given to how such a framework can be designed so as to protect and/or enhance existing forms of benefit sharing.

There is also a need to focus on the improvement of public and community use of biodiversity (e.g. improved community-based management of AnGR), including through the enhancement of existing benefit sharing at local level.

A detailed evaluation of the net costs and benefits of global flows of livestock germplasm, and prediction of potential future benefits would be a valuable input to international debates on how to address legal and regulatory issues related to livestock germplasm.

1b. The efficient assignment of property rights: Swanson and Göschl (2000) argue that in a vertical industry, the location of a property rights assignment is a crucial factor determining the incentives for efficient levels of investment at various levels of that industry.

In the context of (plant) genetic resources, the current assignment of property rights has been at the retail end of the pharmaceutical and plant breeding industries (see slide 24 in accompanying presentation). The assignment of Plant Breeders Rights (PBRs) has consequently led to an increase in: the number of research and development (R&D) programmes; the total number of plant breeders and aggregate amount of R&D expenditure; as well as private R&D (see Swanson and Göschl, 2000. p.84). At the same time, however, there is no evidence that investments increased in the essential input activities that would maintain a flow of genetic resources into the future (e.g. habitat and biodiversity conservation). Hence, PBRs have tended to create incentives to invest at the end of the industry (i.e. the plant breeding sector) but not in the earlier parts of the industry (i.e. the genetic resource providers sector). This has had an impact on both efficiency and equity within the industry. "Farmers' Rights" have been proposed as a form of counterbalance to PBRs, leading to the protection of traditional knowledge and equitable participation in benefit sharing.

Consequently, any property right assignments that affect the relationship between livestock-keeper communities, livestock breeders and biotechnology R&D must therefore be considered carefully in the light of this experience.

1c. The ITPGR process: The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR) took over a decade of negotiation and faced difficulties in getting countries to agree on a common approach.

- Will achieving such an agreement be any easier for AnGR?
- Are there alternative legal and regulatory frameworks that would be more appropriate for AnGR and easier to establish?
- Who will benefit from the establishment of legal and regulatory frameworks, and will such a framework promote greater net benefits than a free market in movement and exploitation of livestock germplasm?

Furthermore, given that AnGR gene flow has been substantially different from PGR, a number of relevant issues arise. These include:

- With improving technologies, is this scenario likely to repeat itself for AnGR?
- Will the economics of AnGR always remain substantially different from that of PGR?
- Given the current geneflows (not well understood), what are the incentives for developing countries to involve themselves in the development of an international legal and regulatory framework?
- Are there also important national regulatory issues to be addressed as well?

1d. Prior Informed Consent (PIC) and standardized material transfer agreements (MTA) may help to ensure continued flows of livestock germplasm and AnGR access in an increasingly AnGR-interdependent world. These procedures may also require an acknowledgement of the critical role that local communities play in AnGR conservation (potentially including "Karen Declaration" type of livestock-keepers rights).

2. Regulation of export and import of AnGR, including protocols for the guidance of donors and NGOs importing exotic breeds could include, *inter alia*: i) the use of "*genetic impact assessments*" (GIA), prior to importation, and subsequent implementation of mitigation mechanisms where appropriate in order to help ensure that future germplasm flows are beneficial and do not threaten remaining livestock diversity; ii) similarly, the use of standardised production environment descriptors – PEDS - (FAO/WAAP, 2008) to facilitate comparisons and evaluation of breed performance, obtain data proxies for adaptedness, inform interventions related to AnGR management, and help delineate recommendation domains for such interventions; and iii) establishment of national Biosafety Acts within which the introduction of genetically-modified AnGR could be regulated. Such GMOs may become increasingly common as biotechnology develops and climate change motivates new breeding efforts; as well

3. Support for both conservation (in vivo and in vitro) and improvement of indigenous AnGR would provide a more level playing field with other breeds (given the existence of many types of subsidy, often tending to benefit specialized production systems) and would help create mechanisms to capture public good values of indigenous breed conservation (e.g. of maintaining evolutionary processes, germplasm flow, co-evolution with diseases and traditional knowledge). Such conservation and management support will be of increasing importance given the need to both slow the rate of AnGR loss from a shrinking gene pool and to facilitate conservation through sustainable use via access to well-characterised genetic materials.

4. The loss of animals through droughts, floods and/or disease epidemics related to climate change may increase (Hoffman et al. 2008). Localized breeds are at risk of being lost in localized disasters. **Precautionary cryoconservation** of genetic material or other measures may be required to ensure that such genetic material can be conserved.

5. Special provisions for indigenous AnGR in animal disease control acts may be needed. Climate change will increase the disease challenge and may result in wider-scale mass culling of animals than has already occurred independently of climate change (e.g., the UK response to the 2001 foot and mouth disease outbreak), potentially resulting in AnGR loss. Conservation programmes are needed that ensure that animals of the same genetic background would be available where restocking becomes necessary,.

6. Development of economic methods, decision-support tools and policy intervention strategies in order to prioritise which breeds should be the subject of interventions so as to maximize the diversity conserved in a cost-effective manner. Such methods and tools would help to address the questions of what to conserve, how much to conserve and how to identify least-cost conservation service providers (farmers or communities). In this context it may be useful to consider uptake of Weitzman-type prioritization tools and payment for environmental services schemes for genetic resource conservation *per se* (Narloch et al., submitted). The latter would assist in creating a market for the establishment of safe minimum populations of priority breeds (Drucker, 2006).

IV. Concluding Remarks

Despite the importance of economic valuation and decision-support tools, the economics field would appear to have had relatively little influence on "real-life" agrobiodiversity conservation policy design and implementation. An analysis of the country reports in the FAO's (2007) State of the World's Animal Genetic Resources (SoW-AnGR) supports this view and reveals, at best, a patchy recognition of the importance of valuation and the potential future role of economics in the design of cost-effective conservation programmes. Potential reasons for this include a lack of awareness regarding the existence of appropriate methods and decision-support tools, data availability issues and a lack of capacity to both collect the necessary data through participatory mechanisms as well as to carry out the subsequent analysis. Translating the existing recognition of the importance of economics within the Global Plan of Action on AnGR into a mainstream activity will require significant awareness-raising and capacity building (Drucker, 2010).

More generally with regard to the policy options discussed above, a great deal more debate and information (e.g. relatively little baseline quantitative data on AnGR exchange is available) needs to be acquired before appropriate legal and regulatory frameworks for AnGR can be identified.

A number of areas that require further research were also identified above. These include an improved understanding of the importance of continued access and trade in livestock germplasm for research and development purposes, the nature and importance of existing benefits and how best to protect/enhance them; potential impact of property rights assignments in terms of efficiency, equity and GR conservation *per se;* and consideration of alternative regulatory frameworks and policy options (an international treaty is only one of a range of framework options, ABS is only one of many policy options).

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