Why value AnGR in economic terms?[1]

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1. This work is based on the studies of Anderson et al. (1999) and Drucker et al. (2001).

Introduction

The large number of animal genetic resources (AnGR) at risk in African countries, together with the limited financial resources available for conservation, mean that economic valuation can play an important role in ensuring an appropriate focus for conservation efforts (UNEP 1995).

Specifically, Artuso (1998, pp. 3–4) argues that establishing economic values for AnGR can contribute to policy and management decisions because they can:

- guide resource allocation between biodiversity conservation and other socially valuable endeavours, as well as within the field of biodiversity conservation, thereby allowing society to efficiently allocate its scarce economic resources.
- assist in the design of economic incentives and institutional arrangements.
- help identify potential gainers and losers from current market driven trends.

This case study provides the conceptual economic background for such valuation, while the next case study [CS No. 1.18 on the same subject] examines a variety of potentially applicable valuation methodologies.

Conceptual economic background to AnGR valuation

The large number of AnGR at risk in African countries, together with the limited financial resources available for conservation and sustainable development of AnGR, mean that there is a need to decide which breeds should be conserved and how this should be done.

Economics can therefore play a key role in orienting such decisions as *economics is about choice and the efficient allocation of scarce resources that have alternative uses.* Rationally speaking, choices should be made in such a way as to maximise the ‘utility’ (also referred to as ‘welfare’ or ‘satisfaction’) obtained.

Economic theory has shown that functioning markets can be powerful allies in the efficient allocation of resources by, through the price mechanism, reflecting the relative scarcity of a given resource and thus providing the correct incentives for its use/conservation.

However, Pearce and Moran (1994, p. xi) argue that the activity of biodiversity [and genetic resources] conservation generates economic values that may well not be captured in the market place. The result of this ‘failure’ is a distortion, a tilted playing field with the odds stacked against genetic resources conservation and in favour of the economic activities that erode such resources. The discipline of economics views this erosion largely within the following framework:

Economic forces drive much of the extinction of the world's biological resources and biological diversity; yet biodiversity (including AnGR) has economic value. If the world's economies are rationally organised, this suggests that biodiversity must have less economic value than the economic activities giving rise to its loss; yet we know that many biological resources do have significant economic value. We also know that many of the erosive/destructive activities themselves have very low economic value; therefore something is wrong with the way the actual economic decisions are made—for some reason they fail to 'capture' the economic values that can be identified; these 'economic failures' lie at the heart of any explanation for the loss of biological diversity. If we can address them, there is a chance of reducing biodiversity loss.

Think about what this 'economic' approach implies in terms of activities that must be undertaken in order to be able to overcome the problem. What activities do you think this might include?

It is clear from the above framework that the value of biodiversity and its capture play a key role in explaining biodiversity loss. It therefore becomes critical for us to consider the issues of:

- identifying the types of values attributable to biodiversity;
- quantifying these values (i.e. valuation); and
- implementing mechanisms and policies that permit the 'capture' of these values.

Notice how the above framework begins by considering that **economic forces drive much of the extinction of the world's biodiversity**. Economic rationality suggests that the decision to, say, replace a native breed of cattle with an imported high yielding modern breed will be determined by the relative profitability or rates of return of the two options.

Yet if biodiversity has economic value (as is discussed below) and many of the erosive/destructive activities themselves have very low economic value why, then, does biodiversity loss take place?

Note that the relevant rates of return are those that accrue to the farmer rather than to society or the world as a whole. This loss thus appears to be economically rational because returns from erosive/destructive alternatives may simply be higher than that from activities compatible with genetic resources conservation because the latter may consist of non-market benefits that accrue to people other than the farmer.

The main economic reason for the erosion of biodiversity is, therefore, that there is an *underlying disparity* between the private (financial) and social (economic) costs and benefits of biodiversity use and conservation. This leads to the existence of 'externalities' (see Box 1) and is why the framework considers that there is a **failure to 'capture' the economic values** that can be identified.

Box 1. Externalities.

Externalities (which can be either negative or positive) are the external costs (benefits) of market exchange that exist when an activity by one agent causes an uncompensated loss (gain) of welfare to another agent (Pearce and Turner 1990).

Externalities are important because they influence the efficient allocation of resources. Conventional free-market economics assumes economic agents to be profit maximisers, maximising private 'utility' without concern for external (social) costs and benefits; since it is the full social costs that are important in determining an efficient resource allocation, and private costs that determine prices, an efficient allocation of resources can only take place where social and private costs are the same.

Consider, as an example, a farmer whose land clearance for pasture for an exotic breed of cattle results in increased soil erosion and, hence, siltation of a nearby river. This change in river quality is to the detriment of society at large as fisheries, municipal water supply and recreational uses of the water are diminished.

The farmer's decision to clear his land for pasture is based on the (financial) rate of return (s)he can obtain from cattle ranching. Costs include land clearance and purchase/management of the cattle. Benefits accrue from the sale of the cattle. The costs to society of the associated river pollution are not taken into account by the farmer as they do not represent a cost of production to the farmer. Hence, the existence of an 'externality', as such costs are 'external' to the farmer's production decisions.

As noted above, the existence of this externality results in a misallocation of resources. Since the farmer does not have to pay for the damage (s)he causes to the river, private and social costs diverge. (S)he is able to sell the meat more cheaply and hence people eat more of it than they would otherwise choose to. It is therefore apparent that, as a result of this externality, the resource allocation tends to become skewed in favour of meat production and consumption, despite the fact that other activities (e.g. downstream fisheries) could make more efficient use of the resources involved.

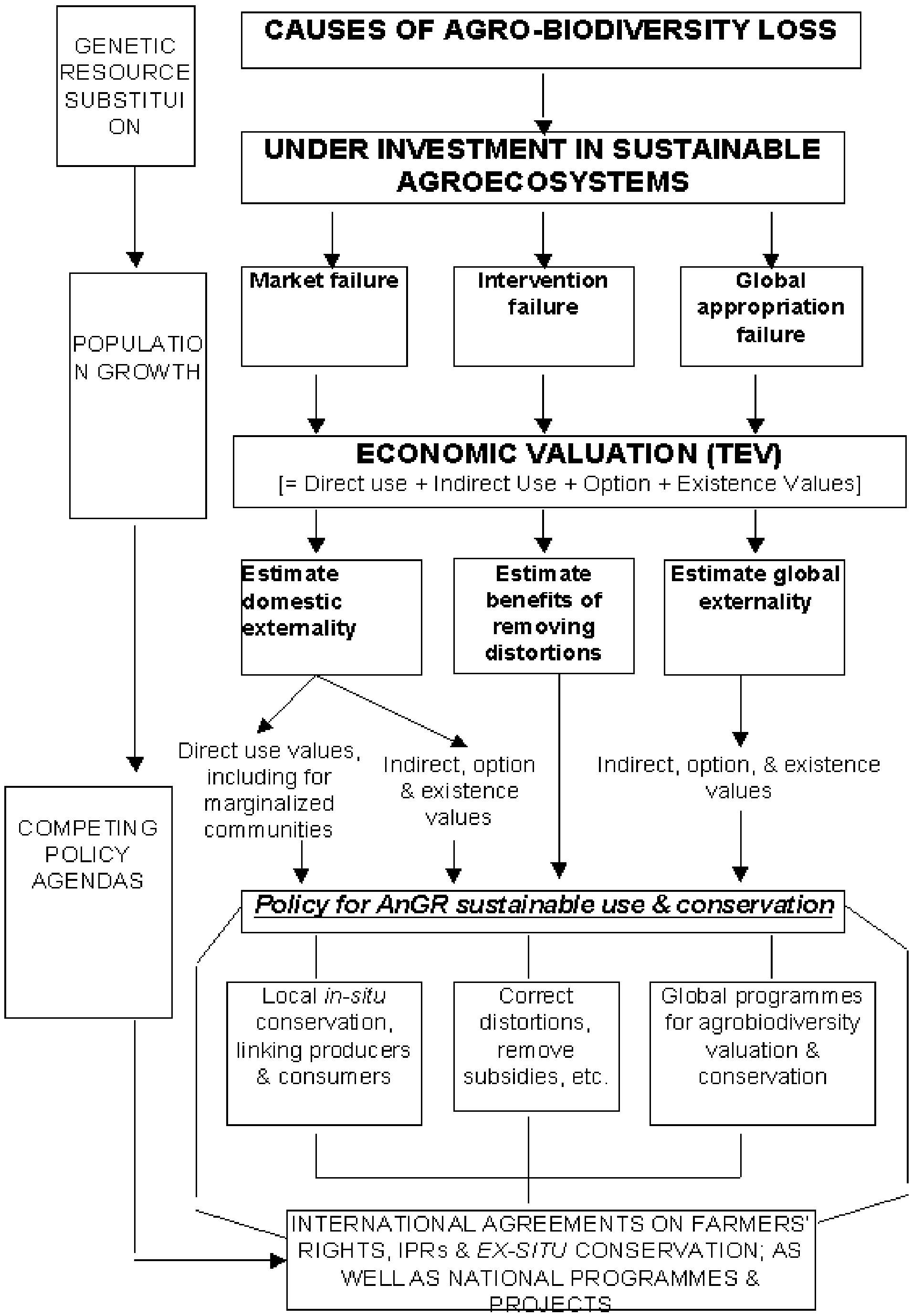
In order to bring these different social and private costs together, it is necessary to internalise the externality. This can be done through a variety of mechanisms, including the use of taxes and subsidies designed to ensure that the full costs of production are reflected in the prices charged. In the above example, even if the farmer causes pollution, (s)he can continue producing as long as full compensation to society is made for the damage. A second-best, and frequently more practical, approach is to put restrictions on certain antisocial activities (e.g. water pollution) and make other beneficial activities compulsory (e.g. riverbank reforestation).

Why do private and social interests diverge? The major factors involve three types of failures, as can be seen in Figure 1.

market failure—distortions due to the 'missing markets' in the external benefits generated by biodiversity conservation. Freely functioning markets are based on narrow self-interest. Individuals thus have no incentive to account for the external costs their actions impose on the rest of society. This failure arises from the uncontrolled functioning of the market place. The above example of the cattle farmer is an example of a local externality. Where the scale of such forest conversion to pasture is sufficiently large the resulting environmental impact can have wider implications.

intervention failure—distortions due to government actions in intervening in the workings of the market place. Governments may even do so to remove the major elements of an externality. However, a great many interventions, even where those appear to serve some social purpose, are contrary to the interests of biodiversity/AnGR conservation. Financial incentives for deforestation and many national livestock breeding programmes are an example. With regard to the latter, such programmes are increasingly promoting the universal use of very few 'improved' breeds. However, such programmes have important implications for genetic resource conservation and food security, as they result in a dramatic reduction in population numbers for many of the indigenous breeds and, in addition, these very few 'improved' genetic lines are unlikely to achieve high levels of production, productivity and sustainability given the broad range of production environments and farmer needs.

global appropriation failure—many biodiversity conservation activities yield **global benefits** (e.g. planetary life-support functions or existence values, see below). For example, the loss of sufficient tropical forest cover so as to affect global climate (e.g. through the release of carbon dioxide and the greenhouse effect) and biodiversity is an example of a global externality. However, if a country receives no financial incentive to pay for the costs of maintaining these **global external benefits**, it will have no incentive to preserve such resources. **Global appropriation failure,** thus, arises from the absence of markets/mechanisms to capture these values.



Note that global missing markets can co-exist with local market failure and intervention failure. The loss of biodiversity and animal genetic resources is a case in point.

1 IPRs (intellectual property rights) is a framework of laws that provides monopoly rights for the products of human activity, agriculture and technology, including patents, copyrights, Plant Breeders' rights, trademarks etc.

Figure 1. Schematic summary of factors affecting global agro-biodiversity loss.

As Wells (1992) notes, conservation, in many countries, is characterised by a spatial mismatch between costs and benefits. **Economic benefits** from conserved areas tend to be **limited on a local scale, increase somewhat on a national scale** and, as is slowly becoming clear, can be **substantial on a global scale**.

On the other hand, **costs**, in terms of foregone development opportunities, tend to be **locally significant and nationally and globally moderate.**

According to Swanson (1997), this spatial mismatch is exaggerated further by the fact that biodiversity is not equally distributed among nation states, suggesting that global external values are likely to be significant. In addition, much of global biodiversity resides in precisely those states which have the least capacity to support it. For example, 70% of the approximately 4000 breeds of livestock remaining are found in developing countries (FAO 1999, p. 28).

AnGR erosion can thus be seen in terms of the replacement (not only by substitution but also through crossbreeding and the elimination of livestock because of production system changes) of the existing slate of domestic animals with a selection from a small range of specialised 'improved' breeds. This bias towards investment in such specialised breeds results in under-investment in a more diverse set of breeds in a world where human investments are now necessary for the survival of the latter (Brown et al. 1993). At the same time, this replacement process has traditionally been regulated on a globally decentralised basis. Historically, each state or individual has been able to make their own replacement decisions without regard of the consequences for others. This creates an important regulatory problem because the cost, in terms of the value of lost services, of each successive replacement is not the same. As native animal breeds become increasingly threatened, the cost of each successive replacement (in terms of lost diverse resource services lost to all societies on Earth) escalates rapidly. The absence of any mechanism to bring these costs into the decision-making framework of the converting state or individual is a big part of the biodiversity problem (Swanson 1997).

We will consider policy issues in more detail below. Before we do so, however, it is worth asking how we know that such failures are important? They might, after all, be trivial when compared to the urgent need to introduce modern breeds for the benefit of economic development. AnGR resource valuation is, therefore, a key issue in such investment decisions.

Values attributable to biodiversity and genetic resources

In the previous section, we discussed how the relative distribution of the costs and benefits of biodiversity conservation plays a key role in the process of genetic resources erosion. But what are these values that should be taken into account in determining the relative economic costs and benefits of genetic resources conservation?

Pearce and Moran (1994) argue that the recognition of the broader *total economic value* 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.

Total economic value (TEV) can be expressed as follows:

$$TEV = DUV + IUV + OV + BV + XV$$

Use values are the values arising from the actual use of a given breed and can be divided between Direct Use Values (DUV), indirect use values (IUV) and option values (OV). non-use values can be divided between Bequest Values (BV) and Existence Values (XV).

Consider the types of value that could be applied to animal genetic resource valuation within the framework of total economic value. What are these values? Relate them to examples relevant to livestock.

Direct use values (DUV) refer to the benefits resulting from actual uses, such as for food, fertiliser and hides, as well as ritual uses, etc.

Indirect use values (IUV) are the benefits deriving from ecosystem functions, such as the maintenance of genetic stock and other important interactions between these breeds and the ecosystem. For example, some animals play a key role in the dispersion of certain plant species.

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.

Similarly, non-use values can be divided between:

Bequest values (BV) are non-use values that 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 non-use values derived simply from the satisfaction of knowing that a particular asset exists (e.g. blue whales, capybaras or N'Dama cattle).

Note that some asset values may overlap between these categories and double counting must be avoided e.g. direct use of hides and indirect maintenance of genetic stock may be mutually exclusive. In addition, attempts to isolate option, bequest and existence values can be problematic. Underlying principles and procedures for such valuation are still debated. However, if the objective is to demonstrate economic value, however it is motivated, then this is not an insurmountable problem.

Also 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, 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.

It is also necessary to consider if the above concept of total economic value is really total? This is not the case for two reasons. First, only economic values have been captured by this concept. This does not include intrinsic values (see Box 2). Second, there are some underlying functions of ecological systems, which are prior to such ecological functions as evolutionary laboratories of biodiversity. These are 'primary values'. They are essentially the system characteristics upon which all ecological functions are contingent. There is in some sense a 'glue' which holds everything together and this glue has economic value. Hence, the sum of the individual parts is less than that of the whole.

In general, we conclude that the concept of TEV represents a lower-bound estimate of the value of biodiversity/genetic resource diversity.

Box 2: Intrinsic values and criticisms of economic valuation.

It should be appreciated that economic valuation is an anthropocentric approach i.e. resources are economically valuable because they are useful to people. 'Intrinsic values', are values that are nominally unrelated to human use (such as the 'right' of an animal to exist). While being relevant to conservation decisions, they are not generally measurable and as such do not help to define actions in the context where choices have to be made against the backdrop of scarce conservation funds.

The fact that economic approaches ignore intrinsic values has led to critics of economic valuation to argue that:

conservation is a moral issue, to be determined by a discussion of the 'rights' of other species, indigenous peoples, etc. Hence, the status of biodiversity is an end in itself (rather than a means to an end) and by putting economic conditions on the conservation decision these rights are contravened.

However, Pearce and Moran (1994) argue that:

- the economic view can also be regarded as a moral view given that it takes an effectively utilitarian approach to conservation.
- given that the current situation is one of crisis, a utilitarian approach is likely to be superior from the point of view of saving biodiversity in real world contexts.
- given current human population growth, further loss of biodiversity is inevitable and it is essential to establish priorities (which is inconsistent with arguing that everything has an equal right to exist).
- given that 'economic' causes are important, then whatever your moral standpoint a practical agenda for conservation should begin with economic factors.
- given that people often are utilitarian, it is the only approach which really explains why biodiversity is being lost and hence the process of policy correction.

Source: Pearce and Moran (1994)

The importance of establishing economic values for AnGR

As we saw above, factors such as the existence of externalities, the divergence between private and social costs, and a focus on direct use values only, contribute to the fact that AnGR are unlikely to have an exchange value that reflects their economic scarcity.

Having identified why private and social values diverge, and the nature of those values (i.e. use and non-use values), it is important to ask how establishing economic values for AnGR can contribute to policy and management decisions.

Artuso (1998) notes that establishing such values is important because they can:

- guide resource allocation between biodiversity conservation and other socially valuable endeavours.
- guide resource allocation between various types of genetic resource conservation, research and development.
- assist in the design of economic incentives and institutional arrangements.

Consider how valuation can guide resource allocation. It will allow society to **efficiently allocate** its scarce economic resources, **among competing sectors** (including that of biodiversity conservation), so that overall social welfare is maximised. Given that the benefits of genetic resources conservation and utilisation are currently undervalued, taking their 'true' value into account in investment decisions would lead to a relative shift in the allocation of resources towards genetic diversity conservation because the marginal benefits to investment in this sector would now be more attractive. Given that this relative shift takes place at the expense of sectors and activities that tend to erode AnGR, an economy shift towards a sustainable development path can be said to have taken place.

Valuation will also allow resources to be **efficiently allocated** within **the field** of genetic resource conservation. Think about this. What types of question would we then be able to answer? Artuso (1998) identifies a whole range of issues (drawing on the plant genetic resource literature) that we could then address. These include:

- Should resources be preserved *in-situ* or *ex-situ*?
- What is the value of maintaining existing collections?
- Is it worth adding genetic resources available in natural conditions to collections?
- What is the value of more complete genetic evaluation of these collections?
- Should additional resources be allocated to the evaluation of existing stocks or to the collection of new germplasm?
- Is it worth developing transgenic collections?

Before we go on in the next case study to see to what degree valuation can provide answers to these questions in practice, it is worth noting how the reasons given for valuation appeal to different sets of stakeholders.

Brush and Meng (1998) note that the burden of being more specific about the value of genetic resources comes from different directions:

- Resource conservationists and government planners who need to identify such values in order to justify budgets for biodiversity conservation in general, as well as between types of genetic resource conservation.
- Farmer's rights activists who want measures of the value in order to calculate compensation to farmers of less developed countries.

A further source of pressure for establishing such values and which gives legitimacy to much of the above is the 1992 Convention on Biodiversity (CBD), which stresses the importance of 'the fair and equitable distribution of the benefits arising out of the utilisation of genetic resources' (Article 1).

Policy implications and the design of incentives and institutional arrangements

Although the economic valuation of AnGR is important, it is not, however, an end in itself. Even where it is possible to identify the total economic value of AnGR, mechanisms to capture those benefits are necessary (Artuso 1998). The current divergence of private and social costs means that the relative costs and benefits of AnGR conservation tend to accrue unevenly at local, national and international levels (Wells 1992; Swanson 1997). Artuso (1998) discusses several potential mechanisms (such as genetic call options,[2] licensing agreements, prospecting/royalty rights and farmers' rights) for translating these social values into efficient incentives for farmers/genetic resource managers and breeders. Where *ex-situ* conservation is to take place then the focus shifts to motivating efficient collection, storage, maintenance and evaluation of genetic resources. These mechanisms may even help speed the development of improved valuation models (Artuso 1998).

2. Genetic call options are a payment for maintaining genetic resources *in-situ* and which give the payee the right to obtain samples over a specified period of time. This mechanism would be used where the international benefits of *in-situ* genetic resource conservation exceed local/national opportunity cost.

The particular nature of the erosion of AnGR diversity allows us to identify some areas for further research, and will also orient valuation activities. There should be a focus on the development/adaptation of valuation methodologies that are appropriate for *in-situ* conservation and can be implemented under developing country situations of limited secondary data availability.

Three primary strategies are therefore envisioned (Brush and Meng 1998, p. 28):

- **research on AnGR, ecology and social science** in order to determine the number and distribution of farms needed to maintain animal evolutionary systems in specific locations.
- **community development activities related to increasing the value of local breeds.** Although increasing such values can play an important role in promoting *in-situ* use and conservation, it is worth noting that Franks (1999) warns that conservation goals are unlikely to be met by depending on revenues earned from marketing commercially valuable traits of rare breeds. Biotechnology (which may create/discover substitutes to the traits of rare breeds) and current livestock subsidies for commercial herds mean that higher importance on non-market based payments may need to be made. In this context economists have an important role to play in terms of: i) estimating willingness to pay (WTP) for the conservation of AnGR; ii) estimating the commercial value of genetic traits once they have been incorporated into commercial herds; and iii) assisting in the design of payment mechanisms which ensure a fair distribution of any subsidy payments.
- **decentralised or participatory breeding to increase the use of local AnGR in breeding programmes**. The Intermediate Technology Development Group (ITDG) (1996) agrees with the FAO regarding the importance of the ***in-situ* conservation** of indigenous breeds, as this has proved more successful in sustaining and enhancing the gene pool than do *ex-situ* methods. However, it notes that such an approach should also be combined with the realisation of '**genetic impact statements'**. Many native breeds have the potential for increased production. This potential needs to be fully evaluated before breed substitution occurs. Properly planned *in-situ* conservation could also serve as a model for sustainable livestock development with a minimum of external input. It is therefore proposed that like the Environmental Impact Assessment (EIA) of development projects a 'genetic impact statement' that calculates the effects on the number of animals of local breeds in the project's vicinity accompany the approval of any livestock programme. Valuation should play a role in the assessment of the economic significance of this genetic impact. *In-situ* conservation programmes should also pay more attention to **gender issues**, as women often play a key role in farm animal management; as well as increasing the 'visibility' of local breeds, by including those important in backyard and other non-commercial production systems in **national statistics.**

Conclusions

The seriousness of AnGR diversity erosion represents a major threat to agro-biodiversity, agricultural sustainability and the livelihoods of many resource-poor farming families. AnGR have economic values (use and non-use values), which are not captured in the market place. The resulting disparity between the private and social costs tends to favour activities that promote the erosion of such resources. Economic valuation of AnGR is thus important from a policy perspective because it can play a key role in translating such social values into efficient incentives and institutional arrangements for farmers/genetic resource managers and breeders. In order to do so, it is also necessary to identify the winners and losers in policy programmes.

References

Anderson S., Drucker A. and Guendel S. 1999. *Conservation of animal genetic resources*. External Programme, Wye College, University of London, Wye, UK. 280 pp.

Artuso A. 1998. Creating linkages between valuation, conservation and sustainable development of genetic resources. In: Evenson R.E., Gollin D. and Santaniello V. (eds), *Proceedings of the symposium on the economics of valuation and conservation of genetic resources for agriculture, held at the Centre for International Studies on Economic Growth, Tor Vergata University, Rome, Italy, 13–15 May 1996.* FAO (Food and Agriculture Organization of the United Nations), Rome, Italy, CEIS-Tor Vergata and CABI publishing, Wallingford, UK. pp. 197–206.

Brown K., Pearce D., Perrings C. and Swanson T. 1993. *Economics and the conservation of global diversity.* Working Paper 2. Global Environmental Facility, Washington, DC, USA. 61 pp.

Brush S. and Meng E. 1998. Farmers' valuation and conservation of crop genetic resources. In: Evenson R.E., Gollin D. and Santaniello V. (eds), *Proceedings of the symposium on the economics of valuation and conservation of genetic resources for agriculture, held at the Centre for International Studies on Economic Growth, Tor Vergata University, Rome, Italy, 13–15 May 1996.* FAO (Food and Agriculture Organization of the United Nations), Rome, Italy, CEIS-Tor Vergata and CABI publishing, Wallingford, UK. 35–41.

CBD/UNEP (Convention on Biological Diversity/United Nations Environmental Programme). 1992. *Handbook on the Convention on Biological Diversity*. UNEP, Nairobi, Kenya.

Drucker A., Gomez V. and Anderson S. 2001. The economic valuation of farm animal genetic resources: A survey of available methods. *Ecological Economics* 31:1–18.

FAO (Food and Agriculture Organization of the United Nations). 1999. *The global strategy for the management of farm animal genetic resources*. FAO, Rome, Italy. 43 pp.

Franks J. 1999. The conservation of domestic animal genetic resources. *Ecological Economic Bulletin*. 4(1):16–19.

ITDG (Intermediate Technology Development Group). 1996. *Livestock keepers safeguarding domestic animal diversity through their animal husbandry.* Dynamic Diversity Series. ITDG, Rugby, UK.

Pearce D. and Moran D. 1994. *The economic value of biodiversity*. Earthscan, London, UK.

Pearce D. and Turner R. 1990. *Economics of natural resources and the environment.* Harvester Wheatsheaf, London, UK.

Swanson T. 1997. *Global action for biodiversity*. Earthscan, London, UK.

UNEP (United Nations Environment Programme). 1995. *Global biodiversity assessment*. Cambridge University Press, Cambridge, UK.

Wells M. 1992. Fiduciary funds to preserve biodiversity: Green funds. *Ecologia*: